ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

Action Agency: National Marine Fisheries Service, Northeast Fisheries Science Center, and National Marine Fisheries Service, Office of Protected Resources

Activity: Reinitiation of Endangered Species Act Section 7 Consultation on Fisheries and Ecosystem Research to be Conducted and Funded by the Northeast Fisheries Science Center and a Letter of Authorization under the Marine Mammal Protection Act for the Incidental Take of Marine Mammals Pursuant to those Research Activities from 2021-2026
ECO ID: GARFO-2023-00351

Consulting Agency: National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office, Protected Resources Division

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Approved by: ______________________ *for:*
Jennifer Anderson
Assistant Regional Administrator for Protected Resources

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1.0 INTRODUCTION

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) issued pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended, on the effects of fisheries and ecosystem research conducted and funded by the Northeast Fisheries Science Center (NEFSC), inclusive of handling and sampling activities on ESA-listed species by the NEFSC's observer programs, through 2026. This Opinion is based on the description and analysis of the effects from NEFSC conducted or funded fisheries and ecosystem research activities as described in their December 7, 2020, biological assessment (BA), which informed our prior October 8, 2021, Opinion (ECO ID: GARFO-2021-01039). It is also based on the summary of effects of newly included NEFSC observer program actions on ESA-listed species and critical habitat that were provided in a supplemental BA dated March 14, 2023. The 2020 BA and its 2023 supplement, along with other sources of information listed in the Literature Cited section, helped form the basis of this Opinion. A complete administrative record of this consultation will be kept at our NMFS Greater Atlantic Regional Fisheries Office. We have reinitiated formal consultation on the NEFSC's actions that were addressed in our 2021 Opinion as those actions have been modified in a manner that causes an effect to ESA-listed species or critical habitat that was not considered in the prior Opinion (reinitiation trigger #3).

We, the Greater Atlantic Regional Fisheries Office, Protected Resources Division (GARFO PRD), most recently completed formal consultation and issued an Opinion pursuant to section 7 of the ESA on the NEFSC's fisheries and ecosystem research and their associated Marine Mammal Protection Act (MMPA) letter of authorization (LOA) on October 8, 2021. In both that and prior Opinions on the NEFSC's fisheries and ecosystem research, we concluded that NEFSC research activities may adversely affect, but were not likely to jeopardize the continued existence of ESA-listed species. We also concluded in previous Opinions that none of the NEFSC conducted or funded research activities was likely to destroy or adversely modify designated critical habitat for ESA-listed species. Through the issuance of this new Opinion, we will analyze the effects of all fisheries and ecosystem research activities to be conducted or funded by the NEFSC over the remainder of the five-year period from October 2021 to October 2026 and withdraw the previous 2021 Opinion.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 ESA regulations that were revised or added to 50 CFR 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 two 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 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.

2.0 CONSULTATION HISTORY

With the exception of the observer program handling and sampling activities to be discussed further below, most fisheries and ecosystem research activities to be conducted or funded by the NEFSC have previously undergone formal consultation, as they were determined to be likely to adversely affect ESA-listed species or their critical habitats. The product of a formal consultation is an Opinion that determines if the proposed action is likely to jeopardize the continued existence of ESA-listed species or result in the destruction or adverse modification of designated critical habitat.

2.1 Prior Formal Consultations on Actions Conducted or Funded by the NEFSC

Since 2007, we have formally consulted on the effects of fisheries and ecosystem research conducted or funded by the NEFSC on multiple occasions. These included Opinions on the NEFSC fisheries research vessel surveys (NMFS 2007a, 2012a, 2012b), fisheries sampling surveys in the Penobscot River estuary (NMFS 2008a, 2012c), the NMFS-funded spring and fall NorthEast Area Monitoring and Assessment Program (NEAMAP) surveys conducted by the Virginia Institute of Marine Science (VIMS) (NMFS 2009a, 2010a, 2012d, 2013a), and gear research studies conducted by the NEFSC Protected Species Branch (NMFS 2013a), in addition to our most recent 2016 and 2021 programmatic Opinions encompassing all NEFSC fisheries and ecosystem research activities conducted from 2016-2021 and 2021-2026 (NMFS 2016a, 2021a). For a brief summary of those prior Opinions, please refer to the 2016 and 2021 NEFSC programmatic Opinions or the references listed above. This programmatic Opinion will replace the 2021 programmatic Opinion and will continue to provide ESA section 7 coverage for NEFSC-conducted or funded fisheries and ecosystem research projects that may result in the incidental take of ESA-listed species over the remainder of the five-year period from October 2021 to October 2026.

2.2 Other Associated Consultations (non-ESA)

An essential fish habitat (EFH) consultation has been conducted by the NMFS GARFO Habitat Conservation Division on the NEFSC's fisheries and ecosystem research activities, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600, and is included as part of the final PEA for this action. The EFH consultation concluded that impacts to EFH will be no more than minimal and temporary, and relied heavily on a calculation of the small amount of area swept by survey tows (trawls and dredges) that the NEFSC did for a previous EA. No new information has been provided that changes the analysis conducted during that EFH consultation and no additional EFH analysis will be provided in this Opinion.

The NMFS Office of National Marine Sanctuaries (ONMS) has also completed a consultation and associated environmental review of fisheries and ecosystem research conducted and funded by the NEFSC, which may occur in portions of the Stellwagen Bank, Monitor, and Grays Reef National Marine Sanctuaries. On April 1, 2016, the ONMS issued a research permit to the NEFSC (SBNMS-2015-003), which was effective from April 1, 2016, until January 31, 2021. The research permit allowed the NEFSC to conduct bottom-tending research trawls in sanctuary waters, with the exception of identified "Areas to Avoid" and five long-term monitoring sites, for the purpose of assessing the status and trends of fishery resources. The NEFSC sent their draft SPEA to ONMS for comment and no additional consultation under Section 304(d) of the National Marine Sanctuaries Act (NMSA) was required. A letter to the NEFSC on September 18, 2020, acknowledged that consultation under section 304(d) of the NMSA had been completed.

3.0 DESCRIPTION OF THE PROPOSED ACTIONS

The NEFSC is the research arm of the NMFS in the Greater Atlantic Region, which spans U.S. ocean and coastal waters from Maine through Virginia. The NEFSC plans, develops, and manages a multidisciplinary program of basic and applied research to:

- better understand living marine resources of the Northeast Continental Shelf Large Marine Ecosystem (NE LME) from the Gulf of Maine to Cape Hatteras, North Carolina, and the habitat quality essential for their existence and continued productivity;
- provide fishery independent survey data for management of sharks in the NE LME as well as the Southeast Continental Shelf Large Marine Ecosystem (SE LME) to encompass the range of the surveyed species; and
- describe and provide to management, industry, and the public, options for the conservation and use of living marine resources, and for the restoration and maintenance of marine environmental quality.

Since 1963, the NEFSC has conducted research surveys from the Gulf of Maine south to Cape Hatteras. Additionally, shark longline surveys have recently been conducted between Florida and Rhode Island in coastal and estuarine waters to encompass the range of the surveyed species and opportunistic juvenile pelagic shark surveys have been conducted as far north and east as the Western Scotian Shelf off Newfoundland, Canada. Opportunistic plankton and hydrographic sampling is also conducted by the NEFSC in Southeast U.S. waters during ship transits. Finally, the NEFSC uses rod and reel trolling gear to capture, tag, and release Atlantic salmon in both U.S. and international (southwest Greenland) waters. These surveys, described in more detail below and in the December 2020 BA, are conducted to monitor important indicators of the overall health and status of fisheries resources in the western North Atlantic Ocean such as recruitment, abundance and survival of harvestable sizes, geographic distribution of species, ecosystem changes, biological rates of stocks, and environmental data to support other research.

The proposed actions include both short- and long-term research activities conducted by the NEFSC or its research partners that involve:

- the deployment of fishing gear and scientific instruments into the water in order to sample and monitor living marine resources and their environmental conditions,
- handling and sampling of ESA-listed species by the NEFSC's observer programs,
- active acoustic devices for navigation and remote sensing,
- the transiting of research vessels through the marine waters of the Atlantic Ocean, and
- observational surveys made from the deck of those vessels (e.g., marine mammal and seabird transects).

It should be noted that the proposed actions assessed here only include activities that may affect ESA-listed species of marine mammals, sea turtles, fish, and their critical habitats. In addition, the research activities covered in this Opinion only include those resulting in or done in response to *incidental* interactions with listed species, not *intentional* interactions. Any research activities conducted or funded by the NEFSC that directly study, sample, or capture ESA-listed species (e.g., Atlantic Marine Assessment Program for Protected Species [AMAPPS] surveys, gear research projects that are designed to capture sea turtles and Atlantic sturgeon) are not included in this Opinion. Directed take of ESA-listed species as a result of those types of activities must instead be assessed in and covered under an ESA section 10 permit. The primary focus of this Opinion is on fisheries-related research, but several other types of surveys and monitoring activities are also included because they deploy fishing gear and other instruments similar to those used in fisheries research, and therefore involve the same potential risks of incidental interactions with ESA-listed species.

3.1 Fisheries and Ecosystem Research Conducted and Funded by the NEFSC

As discussed above, the NEFSC collects a wide array of information necessary to evaluate the status of fishery resources and the marine environment. NEFSC scientists conduct fishery-independent research onboard NOAA owned and operated vessels or on chartered vessels in the NE and SE LMEs, an area of the Atlantic Ocean stretching from the U.S.-Canada border to Florida. In recent years, the NEFSC has used the fishery survey vessels *Henry B. Bigelow*, *Delaware II*, and *Pisces*; the fishery research vessels *Hugh R. Sharp*, *Gloria Michelle*, and *E.S.S. Pursuit*; the NOAA Ships *Gordon Gunter*, *Thomas Jefferson*, and *Okeanos Explorer*; and multiple charter vessels.

As proposed, the NEFSC would conduct or fund a wide range of fishery-independent and industry-associated research and survey programs as they have in the recent past, in addition to a few new surveys and cooperative research projects, all of which are summarized by gear type in Table 2-1 of the 2020 final BA (NEFSC 2020a). The cooperative research projects are designed to address emerging needs of the fishing industry for information about particular species or modifications to fishing gear to address conservation concerns. They are typically funded through competitive grant processes that entertain new research proposals every year. The exact scientific focus and research procedures for future proposals beyond those identified in the 2020 final BA are difficult to anticipate. However, we assume that similar types of projects and survey methods may be conducted or funded in the future as part of the proposed actions. The NEFSC has estimated the types of fishing gear and level of effort required to accommodate future requests for short-term cooperative research projects. This level of fishing effort will be considered, along with the long-term projects that have been ongoing for years, as the collective level of research activities under the proposed actions. Future proposals for funding and other support for cooperative research will be compared to the scope of research analyzed in this Opinion to assess whether the proposed projects are consistent with the analysis presented here.

In addition to the long-term research activities conducted aboard research and contract vessels, the proposed actions include a set of fisheries and ecosystem research activities which fall predominately under the category of short-term cooperative research, which in the Greater Atlantic Region is made up of several focus areas including Surveys, Conservation Engineering, Trawl Comparison Research, Tagging, and Research Set-Aside as described below.

- ***Survey Projects*** – The NEFSC partners with the fishing industry and other researchers to survey flatfish, monkfish, squids, scup, and black sea bass. Flatfish are assessed by bottom trawl methods in the Gulf of Maine (GOM), Georges Bank (GB), Southern New England (SNE), and Mid-Atlantic Bight (MAB). Up to 550 tows per year could be conducted. Monkfish and squid are assessed by pelagic trawl in the GOM, GB, SNE, and MAB. Effort for this survey is about 30 tows per year. Scup and black sea bass are collected using pots and traps in the SNE, Rhode Island Bight, Nantucket waters, and the MAB from shore to shelf. Over 2,600 pots could be set per year.

- ***Conservation Engineering Projects*** – Potential Conservation Engineering Projects include the use of bottom trawls to determine gear efficiency and net conservation strategy, study redfish and other small net fisheries, and squid selectivity. Dredges are used to study the effectivity of finfish and turtle extruders, and to test the hydrodynamics of turtle deflection during dredging. The bottom trawl studies would occur in the GOM, GB, SNE, and MAB, with an effort of about 500 tows per year for all bottom trawl studies. Dredge studies would occur in the GB, SNE, and MAB, with an estimated total of over 1,700 dredge tows per year for all dredge projects.

- ***Trawl Comparison Research Projects*** – These studies consist of twin trawl and paired vessel trawling operations to test cookie sweep and rockhopper efficiency. Two Bigelow 4-seam 3-bridle nets are used with different sweeps (one cookie and one rock hopper) to allow comparisons. The annual level of effort for this study is 100 twin tows for 20 minutes at a speed of 3 knots and 257 paired vessel tows for 20 minutes at a speed of 3 knots. One hundred days at sea (DAS) would be required to complete the project.

- ***Tagging Projects*** - Species slated for potential tagging projects include winter flounder, spiny dogfish, and monkfish. Winer flounder would be collected by bottom trawls and otter trawls in GOM coastal waters. About 650 trawls per year would be conducted to collect winter flounder for tagging. Spiny dogfish in GOM and GB waters adjacent to Cape Cod would be collected by hook and line and gillnets. Monkfish would be collected by gillnet in the GOM, SNE, and MAB in 18-20 DAS.

- ***Research Set-Aside Programs*** – Research set-aside (RSA) programs were developed by the New England and Mid-Atlantic Fishery Management Councils (NEFMC, MAFMC) as part of the fishery management plan (FMP) process, and are administered by NMFS. RSA programs encourage cooperative research among fisheries participants, marine scientists, and fishery managers. The goals of the RSA programs are to further the understanding of our nation's fisheries, enhance information used in fisheries management decision-making, and foster collaborations among marine fisheries interests. RSA programs are implemented in accordance with individual FMPs. Some FMPs set aside a portion of the annual fishery-wide quota or total allowable catch (TAC) to be harvested for the purpose of funding research. FMPs such as those for sea scallops and Atlantic herring in New England, and summer flounder, scup, black sea bass, tilefish, spiny dogfish, *Illex* squid, *Loligo* squid, butterfish, Atlantic mackerel, and bluefish in the Mid-Atlantic reserve up to 2-3% of the TAC, depending on the fishery, for research funding. The Monkfish FMP sets aside a portion of the DAS allocated for fishing to establish an annual pool of research DAS. A vessel that participates in an approved research project may apply for research DAS instead of using valuable fishing time to participate in cooperative monkfish research. Currently, RSA programs have been implemented for the Atlantic Sea Scallop, Mid-Atlantic multi-species, Monkfish, and Atlantic Herring FMPs. The effects from research conducted under the RSA programs are covered under this Opinion, while any effects from compensation fishing that are awarded to commercial fishermen for participating in the RSA programs are covered under the consultations on the specific fisheries or FMPs involved (e.g., Scallop FMP).

The specific projects funded through these programs vary on an annual basis as needs arise for information to support particular fisheries or address emerging conservation concerns. Given our past experience with and knowledge of the usual applicants and partners (and where/when they fish), we expect that future Cooperative Research projects would propose fishing methods, ecosystem research equipment, and associated fishing effort similar to projects conducted or funded by the NEFSC from previous years and, therefore, not introduce a significant increase in effort levels for the overall proposed actions considered in this Opinion. As a result, the funding and carrying out of those Cooperative Research projects, if at a similar level and in similar areas, would be expected to fall within the level of effort and impacts considered in this Opinion. This includes all NEFSC-funded RSA projects. If a Cooperative Research project is proposed which modifies the proposed actions in a manner that causes effects to ESA-listed species or critical habitat not considered in this Opinion, consultation will be reinitiated.

Table 2-1 in the 2020 final BA provides a detailed accounting of the collective scope of the many long-term studies and shorter-term cooperative research projects that are anticipated to be conducted or funded in the next five years. The table includes the specific gear types to be used and average range for fishing effort or days-at-sea (DAS) to be expended. Future research planned for the period of October 2021 to October 2026 includes most of the studies described in the 2016 Opinion, as briefly described above and more thoroughly summarized in Table 2-1 of the 2020 final BA, as well as the four additional/modified studies described in detail below.

- ***Ropeless Lobster Trap Research*** – Studies on acoustic/mechanical releases and other techniques for ropeless lobster gear and buoy lines are proposed to occur over 50-100 DAS. The lines and buoys remain in the water, potentially creating a hazard for marine life. Ropeless fishing eliminates vertical lines and buoys, retrieving bottom gear only when the vessel is on site through methods from grappling to the use of acoustic release technology whereby a sound signal is sent from the boat to the pot. The pots are tethered to a bag, trap, or other configuration of stored rope and buoys on the seafloor, which are released from the bag by the acoustic signal. The pots are retrieved once the buoys reach the surface. When the pots are not actively being fished, they lie on the seafloor without ropes or buoys, reducing entanglement risk.

- ***Rod and Reel Tagging of Atlantic Salmon*** - Over the course of this study, 200-500 tags will be applied to sub-adult Atlantic salmon off the southwest coast of Greenland by NEFSC researchers in cooperation with researchers from the Department of Fisheries and Oceans Canada (DFO) and the Atlantic Salmon Federation. Fish are collected using recreational rod and reel trolling gear, which drags lures through the water. The method is usually associated with recreational fishing as the catch is much lower than gillnets. Activities are planned in international waters where trolling would occur within the Igaliku Fjord in southwest Greenland. This research is a follow-up study to work originally conducted from 2010-2012 that was not specifically analyzed in the June 2016 final PEA. This new research project started in 2018, will continue during the 2021-2026 time period, and targets Atlantic salmon from non-listed populations that migrate to Greenland as sub-adults and spend two years in marine waters foraging off the Greenland coast before returning to natal streams primarily in Canada and Europe.

- ***Continuous Plankton Recorder (CPR) Transect Surveys in the GOM*** – This is a towed array study proposed over the course of 24 DAS. The CPR is towed from the stern of a ship and can capture plankton samples over large ocean areas. It works by filtering plankton from the water on continuously moving bands of filter silk. The internal mechanism of the CPR is a self-contained cassette that is loaded with the filtering silk. After towing, the silk is removed from the mechanism in the laboratory and divided into samples representing 10 nautical miles of towing. The plankton on these samples are then analyzed according to standard procedures.

- ***Deepwater Biodiversity Studies*** – For these ongoing studies, the gear has changed to a Deep-Sea acoustic/optic/oceanographic/eDNA system and trawl camera system. Acoustic and optic systems are integrated into a dead-weight platform towed approximately 20 feet behind the vessel. The platform includes wideband echosounders, stereo and holographic cameras, environmental and light sensors, and eDNA instruments towed at the depths of the meso and bathypelagic communities enabling high-band-width data telemetry and real-time control. The gear previously used was a 4-seam, 3-bridle net bottom trawl.

International research, such as the rod and reel tagging of sub-adult Atlantic salmon described above, may also be conducted by NEFSC. While work in territorial waters of another country does not require authorization under the ESA or MMPA, NMFS must follow the applicable laws of the lead country (for example, studies led by the Canada DFO). Additionally, Executive Order (EO) 12114 *Environmental Effects Abroad of Major Federal Actions* (January 1979) requires that federal agencies taking major federal actions outside of the geographical boundaries of the U.S. and its territories and possessions shall exchange information concerning the environment on a continuing basis. To provide a comprehensive evaluation of the NEFSC's proposed research activities, this Opinion covers proposed surveys planned for the North Atlantic Ocean for the period from October 2021 to October 2026.

3.2 Fisheries Observer Program Handling and Sampling Activities

In addition to the above research activities, the NEFSC Fisheries Monitoring and Operations Branch currently manages three separate observer programs: the Northeast Fisheries Observer Program (NEFOP), Industry Funded Scallop (IFS) program, and the At-Sea Monitoring (ASM) program, which includes Electronic Monitoring (EM) in lieu of human observer coverage. Observers collect catch, gear, fishing effort, and biological data over a range of commercial fisheries. These data are widely used throughout the region for a variety of scientific and management analyses. These data are especially key for estimating the annual bycatch of all federally managed species in the region, including protected species. The observer program actions do not include the initial capture of ESA-listed species by commercial fishing activities, which would occur whether or not the observer program existed, but rather the handling and sampling activities that an observer conducts once the animal has been transferred to them.

The observer programs monitor fisheries under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), MMPA, and ESA. Under the MSA, all federally permitted vessels are required to carry an observer when selected. Each year under the Standardized Bycatch Reporting Methodology (SBRM) Omnibus Amendment, the previous year's discards are estimated utilizing the NEFOP and IFS observer program data. The results are used to allocate sea days to each fleet to achieve a given level of precision of the discard estimates for 14 federally-managed fish/invertebrate species groups and one sea turtle species group for the upcoming year. The derived sea day schedule for the NEFOP program is how SBRM coverage is directed. The IFS program also must meet the precision-based SBRM sampling requirements, however, coverage is based on a set target coverage rate. The ASM coverage is also determined using a set target coverage rate and does not include biological sampling. Under the MMPA, vessels operating in state and federal water fisheries may be required to carry a NEFOP observer if they have a high likelihood of interacting with marine mammals and, under the ESA, vessels operating in state and federal waters may be required to carry an observer to learn more about sea turtle bycatch. To assess impacts of the fisheries on ESA-listed species, the observers handle and sample the animals. These activities are described in more detail below.

Using Northeast observer program protocols and logs, NEFSC-certified observers document all interactions of ESA-listed species during commercial fishing operations within the Northwest Atlantic Ocean and collect a suite of fisheries data. These data are collected under the MSA, MMPA, and ESA, and provide information on the fisheries in order to implement sound fisheries management decisions. To accomplish this, observers are required to handle, identify, photograph, measure, collect genetic samples, and scan and tag ESA-listed species. For sea turtles, observers also will bring in dead or injured animals to be transferred to NMFS approved Sea Turtle Stranding and Salvage Network (STSSN) personnel. These handling and sampling procedures differ by species and are described in more detail below.

Sea turtles
Observers complete the following activities for sea turtles. The detailed sampling procedures can be found in Appendix A.

- Identify, photograph, and video the turtle. The photographs and videos are used to confirm identification and extent of injuries. These data are provided to the NMFS post-interaction mortality working group to assess the likelihood that an individual released alive later dies.
- Collect length and weight data. These data are used by fisheries managers to determine the size class of sea turtles affected by the fisheries. As different size classes have different reproductive values, this information is important to assess population level effects. In addition, the information is used to assess the health of the animal and in determining mitigation approaches.

- Scan for Passive Integrated Transponder (PIT) tags. PIT tags are used in a wide variety of research studies to identify an individual animal. As these tags are beneath the skin, observers use a PIT tag reader, which does not come into contact with the animal, to read the tag. If PIT or flipper tags are found, the observer will record the information. ASM observers are not issued a PIT tag scanner and would only document external tags.
- Tag. Flipper tags are attached externally to the flipper and include a unique number and other information to identify the turtle. Observers record information for any tags already present. Existing tags encountered and newly tagged turtle data are reported to the Cooperative Marine Turtle Tagging Program (CMTTP) at the Archie Carr Center for Sea Turtle Research (ACCSTR). Tag data is used to track movements and behavior of captured turtles over time. NEFOP and IFS observers are trained to tag turtles with inconel tags using aseptic techniques.
- Biopsy. Genetic samples are collected to identify individual sea turtles to a Distinct Population Segment (DPS) or other population. This information is used to determine if the fisheries are having a disproportionate effect on a particular DPS or population, informing more effective management. ASM observers do not collect this data.
- Transfer to rehabilitation. Observers coordinate with the STSSN to transfer animals that are compromised. These include animals that are stranded, obviously weak, lethargic, positively buoyant, emaciated, or that have severe injuries or other debilitating abnormalities. This allows fisheries managers to better assess impacts that may not be visible to the observer (e.g., decompression sickness) which provides for a more robust understanding of fishery impacts and will be used to inform management.
- Resuscitation. The regulations at 50 CFR 223.206 require that sea turtles taken incidentally during fishing activities be handled with due care and specify procedures for resuscitating turtles that are unresponsive or exhibit severe weakness or lethargy following in-water capture. Resuscitation must be attempted unless the turtle is determined to be deceased based on rigor mortis or decomposition. Observers are trained in these procedures and will advise fishermen, if needed. On occasion, fishermen are unable to perform the resuscitation procedures. In these cases, the observer may take possession of the animal to resuscitate it.
- Release. The regulations 50 CFR 223.206 require that sea turtles are released in a manner that reduces the chances of recapture or injury. Observers are trained in and have resources for fishermen on proper release protocols to provide advice if necessary. Observers must carefully observe newly released turtles and record observations on the turtle's ability to swim and dive in a normal manner.
- Salvage. Freshly deceased turtles are maintained when possible or transferred to the STSSN in order to conduct a necropsy to determine cause of death. Parts of the salvaged turtles may also be used to further research or support training activities.

Atlantic and Shortnose Sturgeon
Observers complete the following activities for both Atlantic and shortnose sturgeon. The detailed sampling procedures can be found in Appendix B.

- Identify, photograph, and video the sturgeon. The photographs and videos are used to confirm identifications and extent of injuries.

- Collect length and weight data. These data are used by fisheries managers to determine whether the sturgeon are immature or mature animals. This information is important in assessing population level effects. In addition, the size helps to inform development of bycatch mitigation.
- Scan for PIT tags. PIT tags are used in a wide variety of research studies to identify an individual animal. As these tags are beneath the skin, observers use a PIT tag reader, which does not come into contact with the animal, to read the tag. If PIT or external tags are found, the observer will record the information. If there are other external tags present on the animal, observers will record the tag number. ASM observers are not issued a PIT tag scanner and would only document external tags.
- Fin clip collection. Genetic samples are collected to identify individual sturgeon to a DPS or other population. This information is used to determine if the fisheries are having a disproportionate effect on a particular DPS or population, informing more effective management. ASM observers do not collect this data.

Atlantic Salmon
Observers complete the following activities for Atlantic salmon. The detailed sampling procedures can be found in Appendix C.

- Identify, photograph, and video the salmon. The photographs and videos are used to confirm identifications and extent of injuries.
- Collect length and weight data. These data are used by fisheries managers to determine the size class of salmon affected by the fisheries. As different size classes have different reproductive values, this information is important to assess population level effects. In addition, the information is used in determining mitigation approaches.
- Scan for PIT tags. PIT tags are used in a wide variety of research studies to identify an individual animal. As these tags are beneath the skin, observers use a PIT tag reader, which does not come into contact with the animal, to read the tag. If PIT or flipper tags are found, the observer will record the information. If there are other external tags present on the animal, observers will record the tag number. ASM observers are not issued a PIT tag scanner and would only document external tags.
- Fin clip collection. Genetic samples are collected to identify individual sturgeon to a DPS or other population. This information is used to determine if the fisheries are having a disproportionate effect on a particular DPS or population, informing more effective management. ASM observers do not collect this data.
- Scale collection. This information is used to assist population dynamics research and can be used to determine age, rearing origin, and growth rates. ASM observers do not collect this data.
- Salvage. Freshly deceased Atlantic salmon are maintained when possible and frozen in order to conduct a necropsy to determine cause of death.

3.3 Regulations and a Letter of Authorization to Permit Marine Mammal Takes

Under this action, the NEFSC has been granted an authorization under the MMPA for the incidental take of marine mammals during these research activities. The OPR considered the proposed fisheries and ecosystem research activities and corresponding mitigation measures for marine mammals and has promulgated regulations and issued an LOA as appropriate to the NEFSC. Through the NMFS Permits and Conservation Division, the OPR issued regulations and a LOA to the NEFSC, pursuant to section 101(a)(5)(A) of the MMPA of 1972, as amended (16 U.S.C. 1361 *et seq.*), for the taking of both ESA- and MMPA-listed marine mammals incidental to fisheries and ecosystem research in the Atlantic Ocean over the course of five years. The LOA is effective for a period of five years from the October 21, 2021, date of issuance.

The Permits and Conservation Division published a final rule in the *Federal Register* on October 21, 2021, related to the authorization of take incidental to the NEFSC's fisheries and ecosystem research activities over a five-year period (86 FR 58434). These regulations prescribe the permissible methods of taking; a suite of mitigation measures intended to reduce the risk of potentially adverse interactions with marine mammals and their habitats during the specified research activities; and require reporting that will result in increased knowledge of the species and the level of taking.

Mitigation measures and monitoring requirements for the NEFSC's fisheries and ecosystem research activities are described in detail in the final rule and include:

- Required monitoring of the sampling areas to detect the presence of marine mammals before deployment of pelagic trawl nets, pelagic or demersal longline gear, dredge gear, fyke nets, and beach seines;
- Required implementation of standard tow durations of not more than 30 minutes to reduce the likelihood of incidental take of marine mammals[1];
- Required implementation of the mitigation strategy known as the "move-on rule," which incorporates best professional judgment, when necessary during pelagic trawl and pelagic longline operations;
- Required compliance with applicable vessel speed restrictions;
- Required compliance with applicable and relevant take reduction plans for marine mammals;
- Required training for scientists and vessel crew in marine mammal detection and identification, rule compliance, and marine mammal handling; and
- Required removal of gear from water if marine mammals are at-risk or interact with gear.

The NEFSC did not request, and the NMFS Permits and Conservation Division did not authorize mortality, serious injury, or MMPA Level A harassment (that which has the potential to injure a marine mammal) for any ESA-listed marine mammal species within the action area incidental to NEFSC fisheries and ecosystem research. However, the NEFSC requested and NMFS authorized MMPA Level B harassment (behavioral) incidental to the use of active acoustic sources for ESA-listed large whales. A wide range of active acoustic sources are used in the NEFSC's fisheries and ecosystem research for remotely sensing bathymetric, oceanographic, and biological features of the environment. Most of these sources involve relatively high frequency, directional, and brief repeated signals tuned to provide sufficient focus and resolution on specific objects. Three sound sources used by the NEFSC are likely to produce underwater noise levels that may result in behavioral harassment to ESA-listed large whales: the Simrad EK60, SX-90,

[1] Exceptions to the 30-minute tow duration requirements are the Atlantic Herring Acoustic Pelagic Trawl Survey and the Deepwater Biodiversity Survey, where total time in the water (deployment, fishing, and haul-back) is 40 to 60 minutes and 180 minutes, respectively.

and ME70 sounders. Important characteristics of these three acoustic sources are provided below in Table 1, followed by more detailed descriptions. The other predominant sound sources used by the NEFSC are described in more detail in the August 2021 final SPEA and LOA final rule, but those will not be addressed here as they do not operate at sound levels known to adversely affect ESA-listed whales, sea turtles, or fish.

Table 1. Characteristics for the three NEFSC active acoustic sources assessed in this Opinion.

Active Acoustic System (product name and #)	Operating frequencies (kilohertz - kHz)	Maximum source level (dB re 1 µPa at 1 m)	Nominal beam width (degrees)
Simrad EK60 Narrow Beam Scientific Echo Sounder	18, 38, 70, 120, 200, 330	224	11@18kHz; 7@38kHz
Simrad SX-90 Single Frequency Omnidirectional Sonar	20-30	219	7
Simrad ME70 Multi-Beam Echo Sounder	70-120	205	140

Multi-frequency Narrow Beam Scientific Echo Sounder (Simrad EK60 – 18, 38, 70, 120, 200, and 330 kHz)

Similar to multibeam echosounders, multi-frequency split-beam sensors are deployed from NOAA survey vessels to acoustically map the distributions and estimate the abundances and biomasses of many types of fish; characterize their biotic and abiotic environments; investigate ecological linkages; and gather information about their schooling behavior, migration patterns, and avoidance reactions to the survey vessel. The use of multiple frequencies allows coverage of a broad range of marine acoustic survey activity, ranging from studies of small plankton to large fish schools in a variety of environments from shallow coastal waters to deep ocean basins. Simultaneous use of several discrete echosounder frequencies facilitates accurate estimates of the size of individual fish, and can also be used for species identification based on differences in frequency-dependent acoustic backscattering between species. The NEFSC uses devices that transmit and receive at four frequencies ranging from 38 to 200 kHz.

Single Frequency Omnidirectional Sonar (Simrad SX-90 – 20-30 kHz)

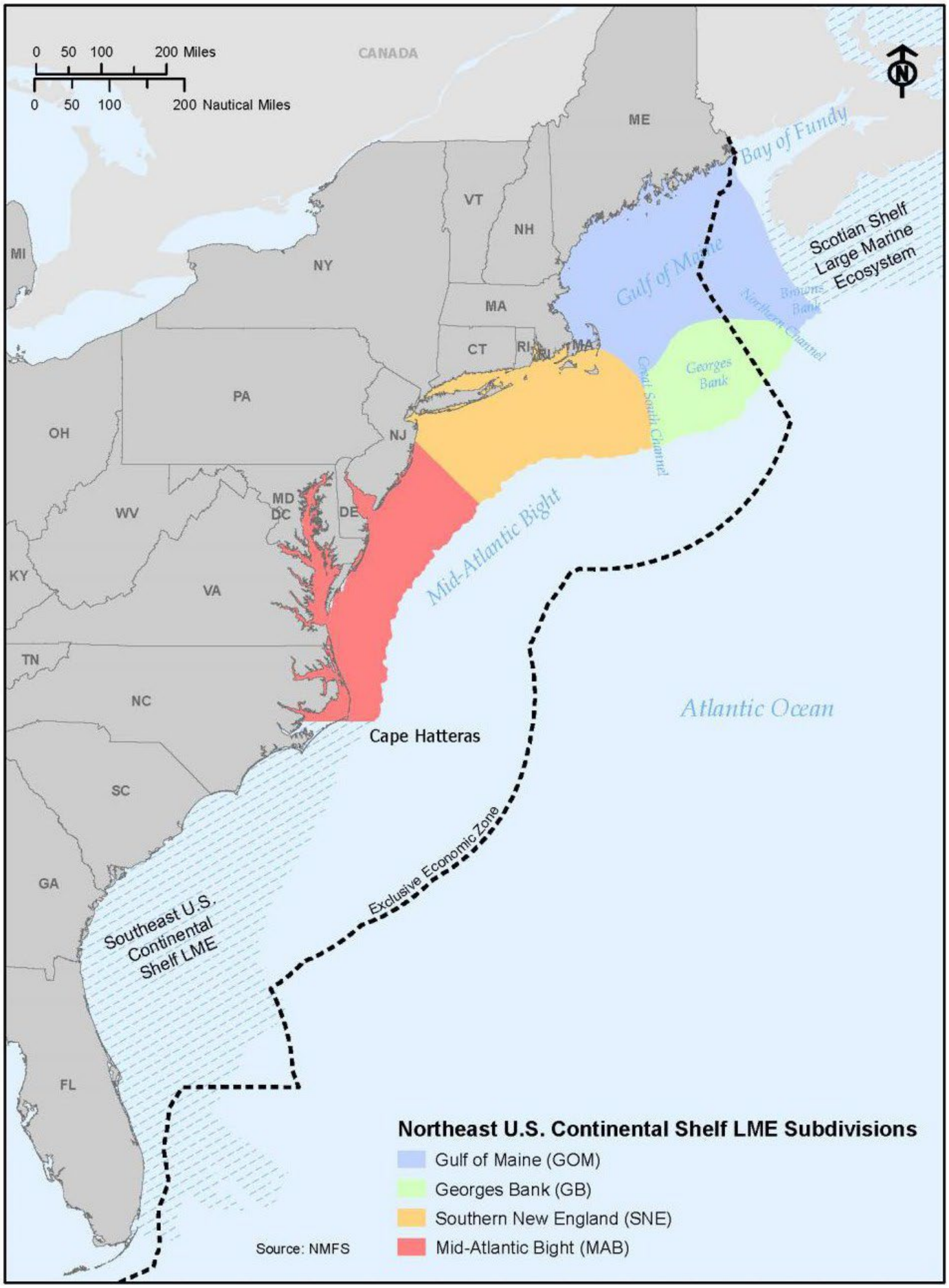
Low frequency, high-resolution, long-range fishery sonars including the SX-90 operate with user selectable frequencies between 20 and 30 kHz providing longer range and prevent interference from other vessels. These sources provide an omnidirectional imaging around the source with three different vertical beamwidths, single or dual vertical view and 180° tiltable vertical views are available. At 30 kHz operating frequency, the vertical beamwidth is less than seven degrees. This beam can be electronically tilted from +10 to -80 degrees, which results in differential transmitting beam patterns. The cylindrical multi-element transducer allows the omnidirectional sonar beam to be electronically tilted down to -60 degrees, allowing automatic tracking of schools of fish within the whole water volume around the vessel. The signal processing and beamforming is performed in a fast digital signal processing system using the full dynamic range of the signals.

Multi-beam echosounder (Simrad ME70 – 70-120 kHz)
Multibeam echosounders and sonars work by transmitting acoustic pulses into the water then measuring the time required for the pulses to reflect and return to the receiver and the angle of the reflected signal. The depth and position of the reflecting surface can be determined from this information, if the speed of sound in water can be accurately calculated for the entire signal path. The use of multiple acoustic 'beams' allows coverage of a greater area compared to single beam sonar. The sensor arrays for multibeam echosounders and sonars are usually mounted on the keel of the vessel and have the ability to look horizontally in the water column as well as straight down. Multibeam echosounders and sonars are used for mapping seafloor bathymetry, estimating fish biomass, characterizing fish schools, and studying fish behavior. The multibeam echosounders used by NEFSC are mounted to the hull of the research vessels and emit frequencies in the 70-120 kHz range.

3.4 Action Area

The action area for section 7 consultations is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402.02). This includes the action's footprint as well as the area beyond it that may experience direct or indirect effects that would not occur but for the action. We anticipate that the effects on ESA-listed species as a result of the proposed actions include the effects of interactions with fishing gear that will be used for these studies (i.e., trawls, gillnets, dredges, hook and line, and pot/trap gear), which includes collisions with and captures in the gear, as well as the effects on other marine organisms (i.e., prey) on or very near to the sea floor that may result from direct capture in the gear. Effects to ESA-listed species, their prey, and habitats may also result from the handling and sampling techniques of the observer programs, active acoustic sources being used, and from potential collisions or harassment from the survey and fishing vessels themselves. Therefore, for the purpose of this consultation, the action area is defined by the area in which various survey and fishing vessels will be conducting fisheries and ecosystem research and monitoring activities and the areas through which they will be transiting. Broadly defined, this includes all U.S. Exclusive Economic Zone (EEZ) waters in the Northwest Atlantic Ocean (including nearshore bays, estuaries, and river mouths) from the U.S./Canada border to Key West, Florida; although the vast majority of NEFSC fisheries and ecosystem research activities will occur offshore and only range as far south as Cape Hatteras (Figure 1). The action area also includes Canadian waters on the Western Scotian Shelf, where bottom and pelagic trawling and multi-beam acoustic studies are conducted, as well as southwest Greenland waters in the Igaliku Fjord, where rod and reel trolling studies for Atlantic salmon are conducted.

Figure 1. NEFSC research areas in the western North Atlantic Ocean. This figure does not include waters of the Igaliku Fjord in southwest Greenland where rod and reel studies of Atlantic salmon occur. Those waters are also included as part of the action area as well as any areas where NEFSC research vessels and those carrying fishery observers transit.



Source: (NEFSC 2016, 2020a)

4.0 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

Several ESA-listed species and designated critical habitats occur in the action area of the proposed actions. Table 2 summarizes the species and critical habitats that occur in the action area and may be affected by the proposed actions (i.e., there have been observed or documented interactions in NEFSC fisheries and ecosystem research or similar activities or there is the potential for interactions). Section 4.1 details which species and critical habitats are *not likely to be adversely affected* by the proposed actions because we have determined that the effects are insignificant, discountable, or completely beneficial. Section 4.2 summarizes the biology and ecology of those species in the action area that are *likely to be adversely affected* by the proposed actions. Section 4.3 discusses a few species and critical habitats that are addressed in the original December 2020 BA, but for which we have determined that no effects are anticipated, even though they may overlap with the proposed actions.

Table 2. ESA-listed species and designated critical habitats that may be affected by the proposed actions.

Species	**Status**	**Likely be adversely affected by the proposed actions?**
Marine Mammals: Cetaceans		
North Atlantic right whale (*Eubalaena glacialis*)	Endangered	No
Fin whale (*Balaenoptera physalus*)	Endangered	No
Sei whale (*Balaenoptera borealis*)	Endangered	No
Sperm whale (*Physeter macrocephalus)*	Endangered	No
Blue whale (*Balaenoptera musculus*)	Endangered	No
Marine Reptiles: Sea Turtles		
Loggerhead sea turtle (*Caretta caretta*), Northwest Atlantic DPS	Threatened	Yes
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered	Yes
Green sea turtle (*Chelonia mydas*), North Atlantic DPS	Threatened	Yes
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	Yes
Hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered	No
Fish		
Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered	Yes
Atlantic sturgeon *(Acipenser oxyrinchus)*		
Gulf of Maine DPS	Threatened	Yes
New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs	Endangered	Yes
Atlantic salmon (*Salmo salar*), Gulf of Maine DPS	Endangered	Yes
Giant manta ray (*Manta birostris)*	Threatened	No
Oceanic whitetip shark (*Carcharhinus longimanus*)	Threatened	No
Critical Habitat		
North Atlantic right whale	Designated	No
Northwest Atlantic DPS of loggerhead sea turtle	Designated	No
Gulf of Maine DPS of Atlantic salmon	Designated	No

4.1 Species and Critical Habitats Not Likely to be Adversely Affected by the Proposed Actions

As indicated in Table 2, we have determined that the action considered in this Opinion is not likely to adversely affect a number of species that are listed as threatened or endangered under the ESA. Additionally, we have determined that the proposed actions are not likely to adversely affect any designated critical habitat found in the action area (Table 2). Destruction or adverse modification of critical habitat is a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species (50 CFR 402.2). Below, we present our rationale for our *not likely to adversely affect* determinations.

Large whales

Federally endangered North Atlantic right, fin, sei, blue, and sperm whales are known to occur in areas where the proposed actions will occur. However, none of these species are likely to be adversely affected by the use of gears, observer handling and sampling techniques, active acoustic sources, or vessels used in the NEFSC's fisheries and ecosystem research and monitoring given the following. While these species may occur in the action area, they have the speed and maneuverability to get out of the way of oncoming mobile gear, including trawl, dredge, and hook and line gear, and vessels. The slow speed of the vessels and mobile gears they are towing (1.4 to 4.0 knots) and the short tow times to be implemented (15-60 minutes for most surveys, with the majority being 30 minutes or less) further reduce the potential for entanglement, collision, or any other interaction. Observations of many fishing trips and surveys using mobile gear have shown that entanglement or capture of large whales in these gear types is extremely rare and unlikely. The use of other gear types known to be more detrimental to large whales (e.g., gillnets and pot/trap gear) will be minimal and monitored regularly over short set times (3-96 hours, with most being less than 24 hours). Also, a number of pot/trap gear studies will involve ropeless gear and technology, which should eliminate the entanglement risk from vertical lines and buoys in the water column for these monitoring activities. As a result, we have determined that it is extremely unlikely that any large whale would interact with the gear types used during the proposed actions, making impacts to these species discountable[2]. As fisheries observers are not expected to handle or sample any species of ESA-listed whale, the effects from those activities are also discountable.

In regards to the NEFSC's use of active acoustic sources, the operating frequencies of the Simrad E60, SX-90, and ME70 echosounders (18-330 kHz) overlap with the functional hearing ranges of baleen whales (7 Hz to 35 kHz) and sperm whales (150 Hz to 160 kHz). While Level B harassment of ESA-listed whales is anticipated and will be authorized by the OPR through its MMPA LOA, such take does not automatically equate to ESA take (NMFS Policy Directive 02-110-19; December 21, 2016). The active acoustic sources considered here have moderate to high output frequencies, generally short ping durations, and are typically focused (highly directional with narrow beam width) to serve their intended purpose of mapping specific objects, depths, or

[2] When the terms "discountable" or "discountable effects" appear in this document, they refer to potential effects that are found to support a "not likely to adversely affect" conclusion because they are extremely unlikely to occur. The use of these terms should not be interpreted as having any meaning inconsistent with our regulatory definition of "effects of the action."

environmental features. In addition, some of these sources can be operated in different output modes (*e.g.,* energy can be distributed among multiple output beams) that may lessen the likelihood of perception by and potential impacts on marine mammals.

NMFS considers exposure to impulsive noise greater than 160 dB re 1uPa rms to result in MMPA Level B harassment. As defined under the MMPA, Level B harassment refers to acts that have the potential to disturb (but not injure) a marine mammal or marine mammal stock in the wild by disrupting behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. Among Level B exposures, the Permits and Conservation Division does not distinguish between those individuals that are expected to experience temporary threshold shifts (TTS) and those that would only exhibit a behavioral response. The 160 dB re 1uPa rms threshold is based on observations of behavioral responses of baleen whales (e.g., right, fin, sei, and blue whales; Malme et al. 1984; Richardson et al. 1986; Richardson 1995), but is used for all marine mammal species including sperm whales.

NMFS defines "harm" in the definition of "take" as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR §222.102). No ESA-listed whales will be injured or killed due to exposure to active acoustic sources. Further, while exposure to this noise may disrupt behaviors of individual whales, it will not significantly impair any essential behavioral patterns. This is due to the short term, localized nature of the effects and because we expect these behaviors to resume once the whales are no longer exposed to the noise. The energetic consequences of the evasive behavior and delay in resting or foraging are not expected affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in breeding or calving. TTS will resolve within a week of exposure and are not expected to affect the health of any whale or its ability to migrate, forage, breed, or calve.

There is some minimal potential for temporary effects to hearing capabilities within specific frequency ranges for select marine mammals, but most effects would likely be limited to temporary behavioral disturbance. If individuals are in close proximity to active acoustic sources they may temporarily increase swimming speeds (presumably swimming away from the source) and surfacing time or decrease foraging effort (if such activity were occurring). These reactions are considered to be of low severity due to the short duration of the reaction. Individuals may move away from the source if disturbed, but because the source is itself moving and because of the directional nature of the sources considered here, it is unlikely any temporary displacement from areas of significance would occur and any disturbance would be of short duration. In addition, because the NEFSC survey effort is widely dispersed in space and time, repeated exposures of the same individuals would be very unlikely. Thus, the response of ESA-listed whales to noise from active acoustic sources does not meet the definition of "harm" and we have determined that the effects from those sources are so small that they cannot be meaningfully measured, detected, or evaluated, and are therefore insignificant.

The proposed actions would expose all ESA-listed whale species under NMFS jurisdiction to the risk of collision with research and fishing vessels. Injuries and mortalities from vessel strikes are a threat to North Atlantic right, fin, sei, blue, and sperm whales. Reports from 2009 to 2018 indicate that right whales experienced four vessel strike mortalities and five serious injuries, two of which were prorated serious injuries, in the U.S. or in an unknown country of origin. The annual average of vessel strikes between 2012 and 2016 in U.S. waters was 1.4 and 0.8 for fin and sei whale respectively (Hayes et al. 2019). The 2014 stock assessment report (SAR) for sperm whales indicates one vessel strike resulting in mortality in 2012 (Waring et al. 2015). From 2013-2020, no strandings of sperm whales were classified as human interactions (Hayes et al. 2020). While vessel collisions with marine mammals have been documented, there are few records of interactions between research or fishing vessels and large whales, and the interactions that have occurred involved species that are not ESA-listed. From 2010-2019, there was only one interaction reported between a large whale and a fishing vessel. In 2015, a self-report from a fishing vessel indicated the vessel interacted with a live humpback whale. There have been no observed or reported interactions of right, fin, sei, blue, or sperm whales with research or fishing vessels. This analysis focuses on whether interactions with research or fishing vessels considered in this Opinion are likely to impact ESA-listed large whales.

Research and fishing vessels actively fishing either operate at relatively slow speeds, drift, or remain idle, when setting, soaking and hauling gear. Thus, any listed species in the path of a research or fishing vessel would be more likely to have time to move away before being struck. Research and fishing vessels transiting to and from port or between research/fishing areas can travel at greater speeds, particularly smaller vessels, and thus do have more potential to strike a vulnerable species than during active research/fishing. However, larger vessels are required to comply with seasonal management areas that have speed restrictions to help protect large whales.

Several large scale management efforts to mitigate vessel strikes have proven to be successful (Laist et al. 2014), including the ship speed restriction rule implemented in 2008 (50 CFR 225.105), shifts in traffic separation schemes in the Bay of Fundy and Boston, and the designation of the Roseway Basin and Great South Channel as Areas to be Avoided. In the U.S., the Seasonal and Dynamic Management Areas will continue to reduce vessel traffic around aggregations of right whales and lower the risk of any vessel striking a right whale. Since the implementation of the speed restriction, there has been a decline in large whale mortalities resulting from vessel strikes.

Given the rarity of vessel strikes when considering (1) the large amount of vessel traffic in the action area, (2) that all research and fishing vessels (state, federal, and unregulated) represent only a portion of marine vessel activity, (3) that research and fishing vessels considered in this Opinion represent an even smaller portion of marine activity; and (4) that there are regulations in place to reduce the risk of vessel strike to whales, it seems extremely unlikely and discountable that a research or fishing vessel would strike a whale, even during transiting. Based on this information, we have determined that all listed large whales in the action area are not likely to be adversely affected by vessels operating under the proposed actions.

We have also determined that the proposed actions will not have any adverse effects on the availability of prey for right, fin, sei, sperm, and blue whales. Right and sei whales feed on copepods. As indicated above, the proposed gears will not affect the availability of copepods for foraging sei whales because copepods are very small organisms that will pass through the fishing gear rather than being captured in it. Fin and blue whales feed on krill as well as small schooling fish (e.g., sand lance, herring, mackerel), while sperm whales feed primarily on giant squid (Aguilar 2002; Sears 2002; Whitehead 2002). The total prey removal by all NEFSC fisheries research surveys and projects, regardless of season and location in the Atlantic coast region, totals a few hundreds of tons of fish per year, which is a negligible percentage of the estimated fish consumed by large whales. The NEFSC research catch of invertebrate prey is also small; the average annual NEFSC research catch of long-finned squid was less than 12 tons (NEFSC 2016).

In addition to the small total biomass taken, some of the size classes of fish targeted in research surveys are smaller than that generally targeted by large whales. Research catches are also distributed over a wide area because of the random sampling design covering large sample areas. Fish removals by research are therefore highly localized and unlikely to affect the spatial concentrations and availability of prey for any large whale species. In the southern portion of the Atlantic coast region, NEFSC-affiliated fisheries research is primarily related to catch, tag, and release studies of sharks, with minimal numbers of finfish collected for lab analysis. This level of effort would have no impact on prey sources for large whales in southern portion of the Atlantic coast region. Therefore, the impacts on prey for large whales are insignificant and the proposed actions will not affect the availability of prey for these species.

In addition, the proposed actions will not occur in low latitude waters where the overwhelming majority of calving and nursing occurs for these five large whale species (Aguilar 2002; Horwood 2002; Kenney 2002; Sears 2002; Whitehead 2002). Therefore, the proposed actions will not affect the oceanographic conditions that are conducive for large whale calving and nursing.

Hawksbill sea turtles
The hawksbill sea turtle is uncommon in the waters of the continental U.S. Hawksbills prefer tropical, coral reef habitats, such as those found in the Caribbean and Central America. The waters surrounding Mona and Monito Islands (Puerto Rico) are designated as critical habitat for the species, and Buck Island (St. Croix, U.S. Virgin Islands) also contains especially important foraging and nesting habitat for hawksbills. Within the continental U.S., nesting is restricted to the southeast coast of Florida and the Florida Keys, but nesting in these areas is rare. Hawksbills have been recorded from all U.S. states adjacent to the Gulf of Mexico and along the east coast of the U.S. as far north as Massachusetts, although sightings north of Florida are rare. Aside from Florida, Texas is the only other U.S. state where hawksbills are sighted with any regularity. Since hawksbill sea turtles are not expected to be present in the vast majority of areas where NEFSC fisheries and ecosystem research will occur, impacts to this species because of the proposed actions are extremely unlikely. The lack of captures of hawksbill sea turtles in any NEFSC conducted or funded project to date supports this determination. The only recorded capture of a hawksbill sea turtle during a NMFS fisheries research project occurred outside of the action area in a bag seine during a Southeast Fisheries Science Center (SEFSC) shellfish survey off Texas in 2009. Because there are no proposed changes to the proposed actions since the previous Opinion that would increase the likelihood of interactions between hawksbills, we do not anticipate any future interactions. Because of this, effects to hawksbill sea turtles from NEFSC fisheries and ecosystem research are highly unlikely and therefore discountable. As

fisheries observers are not expected to handle or sample hawksbill sea turtles, the effects from those activities are also discountable.

Giant manta rays

Information on population sizes and distribution of giant manta rays in the Atlantic is lacking. While giant manta rays in the Atlantic have been confirmed as far north as offshore around the Hudson Canyon region near Long Island, New York (Normandeau Associates and APEM Ltd 2017; as cited in 84 FR 66652), the species is considered rare north of Cape Hatteras, North Carolina. 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 and Klimovich (2017), based on the available data, giant manta rays do not appear to be a significant component of the bycatch. Based on NEFOP data for the period 2010-2019, 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 period and none have been captured in any NEFSC conducted or funded surveys or research. Considering that the volume and extent of research trawl, gillnet, and longline effort in the action area is much lower than for the many commercial fisheries, giant manta rays are extremely unlikely to be captured during NEFSC fisheries and ecosystem research. For this reason, the proposed actions may affect but are not likely to adversely affect giant manta rays as all effects are discountable. As fisheries observers are not expected to handle or sample giant manta rays, the effects from those activities are also discountable.

Oceanic white-tip sharks

In the western Atlantic, oceanic white-tip sharks occur from Maine to Argentina, including the Caribbean and Gulf of Mexico. It is a highly migratory species that is usually found offshore in the open ocean, on the outer continental shelf, or around oceanic islands (Bonfil et al. 2008; Young et al. 2017). The species can be found in waters temperatures between 15°C and 28°C, but it exhibits a strong preference for the surface mixed layer in water with temperatures above 20°C (Bonfil et al. 2008) and is considered a surface-dwelling shark. Little is known about movements or possible migration paths (Young et al. 2017). Currently, the most significant threat to oceanic white-tip sharks is mortality in commercial fisheries, largely driven by demand of the international shark fin trade and bycatch-related mortality, as well as illegal, unreported, and unregulated fishing. Oceanic white-tip sharks are generally not targeted, but are frequently caught as bycatch in many global fisheries, including pelagic longline fisheries targeting tuna and swordfish, purse seine, gillnet, and artisanal fisheries (Young et al. 2017).

Although bottom trawl and gillnet gear have the potential to interact with oceanic white-tip sharks, these sharks are typically found farther offshore in the open ocean, on the continental shelf, or around oceanic islands in deep water greater than 184 meters. They have a strong preference for the surface mixed layers in waters warmer than 20°C (Young et al. 2017). Given the offshore distribution of oceanic white-tip sharks, little overlap between NEFSC research activities and oceanic whitetip sharks is expected. As a surface-dwelling species, oceanic white-tip sharks are unlikely to interact with gears that are fished deeper in the water column such as bottom trawls, sink gillnets, pots/traps, and dredges. In addition, there have not been any observed interactions between NEFSC research activities and oceanic whitetip sharks. Given their offshore distribution and the diffuse vessel traffic, of which a limited number are fisheries and ecosystem research vessels, it is also extremely unlikely that there will be interactions between oceanic white-tip sharks and vessels. Given this information and the pelagic surface-dwelling nature of the species, it is extremely unlikely and, therefore, discountable that NEFSC research activities would interact with oceanic white-tip sharks. As fisheries observers are not expected to handle or sample oceanic white-tip sharks, the effects from those activities are also discountable.

North Atlantic right whale critical habitat
We have determined that the actions being considered in the Opinion are not likely to adversely modify or destroy designated critical habitat for North Atlantic right whales. This determination is based on the actions' effects on the conservation value of the habitat that has been designated. Specifically, we considered whether the actions were likely to affect the physical or biological features that afford the designated area value for the conservation of North Atlantic right whales. On January 27, 2016, NMFS published a final rule (81 FR 4838) to replace the critical habitat for right whales in the North Atlantic originally designated in 1994 with two new areas. The final rule became effective on February 26, 2016. The areas newly designated as critical habitat contain approximately 29,763 square nautical miles of marine habitat in the Gulf of Maine and Georges Bank region (Unit 1, Northeastern U.S. Foraging Area) and off the Southeast U.S. coast (Unit 2, Southeastern U.S. Calving Area).

The final rule identifies the following four physical and biological features of the Northeastern U.S. foraging habitat that are essential to the conservation of the species: (1) the physical oceanographic conditions and structures of the Gulf of Maine and Georges Bank region that combine to distribute and aggregate *Calanus finmarchicus* for right whale foraging, namely prevailing currents and circulation patterns, bathymetric features (basins, banks, and channels), oceanic fronts, density gradients, and temperature regimes; (2) low flow velocities in Jordan, Wilkinson, and Georges Basins that allow diapausing *C. finmarchicus* to aggregate passively below the convective layer so that the copepods are retained in the basins; (3) late stage *C. finmarchicus* in dense aggregations in the Gulf of Maine and Georges Bank region; and (4) diapausing *C. finmarchicus* in aggregations in the Gulf of Maine and Georges Bank region. The Northeastern U.S. foraging habitat, which is located within the action area, has been designated as critical habitat for right whales due to its importance as a spring/summer foraging ground for the species. What makes this area so critical, as indicated above, is the presence of dense concentrations of copepods. None of the gear types used in the proposed actions will affect the availability of copepods for foraging right whales because copepods are very small organisms that will pass through the fishing gear rather than being captured in it. In addition, the proposed actions will not affect the oceanographic conditions in the Gulf of Maine which serve to concentrate the copepods.

Nearshore waters off southern North Carolina, South Carolina, Georgia, and northeastern Florida have been designated as critical habitat for right whales due to their importance as winter calving and nursery grounds for the species. The environmental features that have been correlated with the distribution of right whales in these waters include preferred water depths and water temperature (Keller et al. 2012). Currently there is no evidence that the NEFSC's fisheries and ecosystem research, its associated gear types, and its observer handling and sampling protocols are likely to impact water depth, water temperature, or distance from shore.

Since the proposed actions are not likely to affect the physical and biological features that characterize both the feeding and calving habitat for North Atlantic right whales, these actions are not likely to adversely affect designated critical habitat for the species. Therefore, North Atlantic right whale critical habitat will not be considered further in this Opinion.

NWA DPS loggerhead sea turtle critical habitat

We have determined that the actions being considered in the Opinion are not likely to adversely modify or destroy designated critical habitat for the NWA DPS of loggerhead sea turtles. On July 10, 2014, the U.S. FWS and NMFS published two separate final rules in the Federal Register designating critical habitat for the NWA DPS of loggerhead sea turtles under the ESA (79 FR 39755 for nesting beaches under U.S. FWS jurisdiction; 79 FR 39856 for marine areas under NMFS jurisdiction). Effective August 11, 2014, NMFS's final rule for marine areas designated 38 occupied areas within the at-sea range of the NWA DPS. These marine areas of critical habitat contain one or a combination of nearshore reproductive habitat, overwintering habitat, breeding habitat, migratory habitat, and *Sargassum* habitat.

Fisheries research activities using fixed gear (e.g., gillnets and pots/traps) are a concern for loggerhead sea turtle critical habitat if the gear is arranged closely together within the designated migratory, overwintering, breeding, and nearshore reproductive habitats off the U.S. Atlantic coast, as those gears could result in altered habitat conditions needed for efficient passage of loggerheads through the areas (79 FR 39856). The NEFSC's fisheries and ecosystem research activities use the following gear types: trawls, gillnets, traps/pots, dredges, longlines, purse seines, weirs, rod and reel, and other hand gears (e.g., rakes, jigs, dip nets, spears). While these gears are known to be deployed within certain areas of the critical habitat for NWA DPS loggerheads, the occasional placement and wide-ranging operation of these gear types within the fisheries research surveys discussed here (per research protocols currently in place) is not expected to prevent the passage of loggerheads through the critical habitat areas or inhibit their usage of those areas. In regards to effects on benthic habitat in the designated critical habitat, there is no evidence that bottom trawls or any other types of gears used by the NEFSC's fisheries and ecosystem research surveys adversely affect sandy, muddy, or hard bottom habitats where NWA DPS loggerheads routinely forage and rest (NREFHSC 2002). In addition to the actions of setting and hauling gear, research and fishing vessel movements are not expected to significantly alter the physical or biological features of the critical habitat areas to levels that would affect life history patterns of individual turtles or the health of prey species found in these habitats. Previous formal consultations on the NEFSC's fisheries and ecosystem research surveys support the conclusion that effects to sea turtle habitats from fishing activities are insignificant and/or discountable (see NMFS 2007a, 2009a, 2010a, 2012a, 2012b, 2012d, 2013a, 2016a). Based on this information, we have determined that there will be no adverse effects to designated critical habitat for NWA DPS loggerheads from the NEFSC's fisheries and ecosystem research activities or its observer program handling and sampling protocols.

GOM DPS Atlantic salmon critical habitat

We have determined that the action being considered in this Opinion is not likely to adversely modify or destroy critical habitat that was designated for the Gulf of Maine DPS of Atlantic salmon on June 19, 2009 (74 FR 29300), and revised on August 10, 2009, to exclude trust and fee holdings of the Penobscot Indian Nation and a table was corrected (74 FR 39003; August 10, 2009). There is no Atlantic salmon critical habitat in the marine environment where the majority of the NEFSC's fisheries and ecosystem research activities will occur. For inshore and estuarine areas where the NEFSC will operate, a discussion of effects on critical habitat is included below.

The critical habitat designation for the Gulf of Maine DPS of Atlantic salmon consists of 45 specific areas that include approximately 19,571 kilometers of perennial river, stream, and estuary habitat and 799 square kilometers of lake habitat within the geographic area occupied by the Gulf of Maine DPS at the time of listing, and in which are found those physical and biological features essential to the conservation of the species. The entire occupied range of the Gulf of Maine DPS in which critical habitat is designated is within the State of Maine. Some of the estuarine research activities proposed by the NEFSC occur within designated critical habitat for listed Atlantic salmon.

The action area, albeit an extremely small portion of it in Maine, contains known migratory corridors for both juvenile and adult Atlantic salmon. A migratory corridor free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds or prevent emigration of smolts to the marine environment is identified in the critical habitat designation as essential for the conservation of Atlantic salmon. The Primary Constituent Elements (PCE) for designated critical habitat of listed Atlantic salmon in the action area are: 1) freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations; 2) freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation; and 3) freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.

We have analyzed the potential impacts of the NEFSC's fisheries and ecosystem research on designated critical and PCEs in the action area. We have determined that the effects to these PCEs will be insignificant for the following reasons: the research activities will not result in a migration barrier as the surveys will only affect small portions of specific rivers and estuaries at any given time, and because no salmon will be prevented from passing through the action area. The research activities will not alter the habitat in any way that would increase the risk of predation, as all research in Maine rivers and estuaries will primarily involve low impact surface and mid-water trawls, hook and line gear, pot/trap gear, and possibly beach seines and fyke nets. There will be no water quality impacts from the proposed actions and therefore the research activities are not expected to affect water quality during salmon migrations in the action area. The research activities will not significantly affect the forage of juvenile or adult Atlantic salmon, as their prey are not normally the target of the fisheries and ecosystem research activities being undertaken (and if they are, they will be collected in small numbers with most being returned to the water soon after capture). Finally, as the proposed actions will not affect the natural structure of the nearshore habitat, since the gears and vessels to be used will only be there temporarily, there will be no reduction in the capacity of substrate, food resources, and natural cover to meet the conservation needs of Atlantic salmon. Based upon this reasoning, we have determined that any effects to designated critical habitat in the action area from the NEFSC's fisheries and ecosystem research activities or its observer program handling and sampling protocols will be insignificant.

4.2 Species Likely to be Adversely Affected by the Proposed Actions

This section examines the status of each species that are likely to be adversely affected (Table 2) by the proposed actions. Under the ESA, species include any subspecies of any species and any distinct population segment of any species of vertebrate fish or wildlife that interbreeds when mature. This section considers the species as listed under the ESA, which may be globally or as a DPS. The status includes the current level of risk that the ESA-listed species face, based on factors considered in documents such as recovery plans, status reviews, and listing decisions. This section helps detail the species' current "reproduction, numbers, or distribution," which is considered in the jeopardy determination as described in 50 CFR §402.02. More detailed information on the status and trends of these ESA-listed species, and their biology and ecology, is in the listing regulations and critical habitat designations published in the *Federal Register*, status reviews, recovery plans, and on NMFS' website: (https://www.fisheries.noaa.gov/species-directory/threatened-endangered), among others.

4.2.1 Status of Sea Turtles

Leatherback and Kemp's ridley sea turtles are currently listed under the ESA at the species level, while loggerhead and green sea turtles are listed at the DPS level. Therefore, we are including information on the range-wide status of leatherback and Kemp's ridley sea turtles to provide the overall status of those species. Information on the status of loggerhead and green sea turtles is for the specific DPS affected by the proposed actions (NWA DPS for loggerheads, North Atlantic DPS for greens). Additional background information on the status of these species can be found in a number of published documents, including sea turtle status reviews and biological reports (NMFS and U.S. FWS 1995, 2020; Hirth 1997; TEWG 1998, 2000, 2007, 2009; Conant et al. 2009; Seminoff et al. 2015) and recovery plans and five-year reviews for the loggerhead sea turtle (NMFS and U.S. FWS 2008, 2023; Bolten et al. 2019), Kemp's ridley sea turtle (NMFS et al. 2011; NMFS and U.S. FWS 2015), green sea turtle (NMFS and U.S. FWS 1991), and leatherback sea turtle (NMFS and U.S. FWS 1992, 1998, 2013).

4.2.1.1 Status of Loggerhead Sea Turtles – Northwest Atlantic DPS

Loggerhead sea turtles are circumglobal and are found in the temperate and tropical regions of the Atlantic, Indian, and Pacific Oceans. The loggerhead is distinguished from other sea turtles by its reddish-brown carapace, large head, and powerful jaws. The species was first listed as threatened under the ESA in 1978 (43 FR 32800, July 28, 1978). On September 22, 2011, the NMFS and U.S. FWS designated nine DPSs of loggerhead sea turtles, with the NWA DPS listed as threatened (76 FR 58868). The NWA DPS of loggerheads is found along eastern North America, Central America, and northern South America (Figure 2).

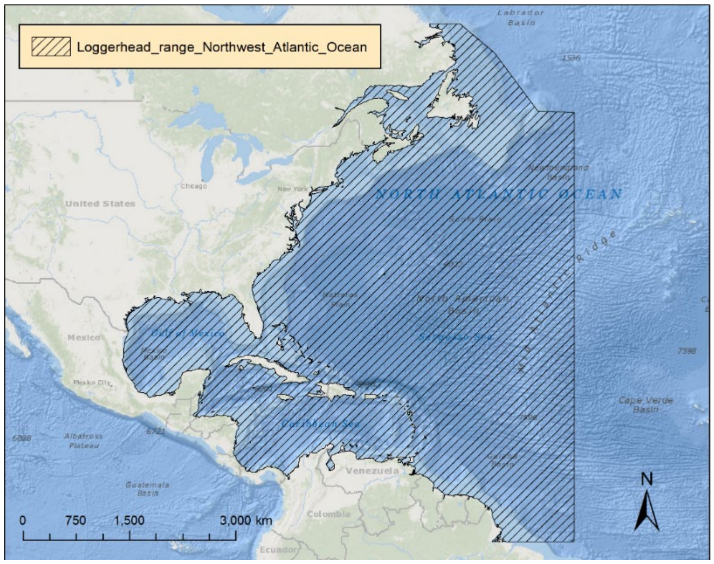


Figure 2. Range of the NWA DPS of loggerhead sea turtles.

We used information available in the 2009 status review (Conant et al. 2009), the final listing rule (76 FR 58868, September 22, 2011), the most recent five-year review (NMFS and U.S. FWS 2023), the relevant literature, and recent nesting data from the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWRI) to summarize the life history, population dynamics and status of the species, as follows.

Life History

Nesting occurs on beaches where warm, humid sand temperatures incubate the eggs. Northwest Atlantic females lay a range of one to seven clutches per year. Clutch sizes range from 95 to 130 eggs per nest (NMFS and U.S. FWS 2023). Females do not nest every year. The average remigration interval is three years. Emergence success rate varies by location, ranging from 40 to 75% (NMFS and U.S. FWS 2023). As with other sea turtles, temperature determines the sex of the turtle during the middle of the incubation period. Loggerheads spend the post-hatchling stage in pelagic waters. The juvenile stage is spent first in the oceanic zone and later in coastal waters. Some juveniles may periodically move between the oceanic zone and coastal waters (Witzell 2002; Bolten 2003; Morreale and Standora 2005; Mansfield 2006; Conant et al. 2009). Coastal waters provide important foraging, inter-nesting, and migratory habitats for adult loggerheads. In both the oceanic zone and coastal waters, loggerheads are primarily carnivorous, although they do consume some plant matter as well (Conant et al. 2009). Loggerheads have been documented to feed on crustaceans, mollusks, jellyfish and salps, and algae (Bjorndal 1997; Seney and Musick 2007; Donaton et al. 2019).

Avens et al. (2015) used three approaches to estimate age at maturation. Mean age predictions associated with minimum and mean maturation straight carapace lengths were 22.5-25 and 36-38 years for females and 26-28 and 37-42 years for males. Male and female sea turtles have similar post-maturation longevity, ranging from 4-46 (mean 19) years (Avens et al. 2015).

Loggerhead hatchlings from the western Atlantic disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. MtDNA evidence demonstrates that juvenile loggerheads from southern Florida nesting beaches comprise the vast majority (71%-88%) of individuals found in foraging grounds throughout the western and eastern Atlantic: Nicaragua, Panama, Azores and Madeira, Canary Islands and Andalusia, Gulf of Mexico, and Brazil (Masuda 2010). LaCasella et al. (2013) found that loggerheads, primarily juveniles, caught within the Northeast Distant (NED) waters of the North Atlantic mostly originated from nesting populations in the southeast U.S. and, in particular, Florida. They found that nearly all loggerheads caught in the NED came from the Northwest Atlantic DPS (mean = 99.2%), primarily from the large eastern Florida rookeries. There was little evidence of contributions from the South Atlantic, Northeast Atlantic, or Mediterranean DPSs (LaCasella et al. 2013).

A more recent analysis assessed sea turtles captured in fisheries in the Northwest Atlantic and included samples from 850 turtles (including 24 caught during fisheries research) caught from 2000-2013 in coastal and oceanic habitats (Stewart et al. 2019). The turtles were primarily captured in pelagic longline and bottom otter trawls. Other gears included bottom longline, hook and line, gillnet, dredge, and dip net. Turtles were identified from 19 distinct management units; the western Atlantic nesting populations were the main contributors with little representation from the Northeast Atlantic, Mediterranean, or South Atlantic DPSs (Stewart et al. 2019). There was a significant split in the distribution of small (≤63 cm straight carapace length [SCL]) and large (>63 cm SCL) loggerheads north and south of Cape Hatteras, North Carolina. North of Cape Hatteras, large turtles came mainly from southeast Florida (44%±15%) and the northern U.S. management units (33%±16%); small turtles came from central east Florida (64%±14%). South of Cape Hatteras, large turtles came mainly from central east Florida (52%±20%) and southeast Florida (41%±20%); small turtles came from southeast Florida (56%±25%). The authors concluded that bycatch in the western North Atlantic would affect the Northwest Atlantic DPS almost exclusively (Stewart et al. 2019).

Population Dynamics

A number of stock assessments and similar reviews (TEWG 1998, 2000, 2009; SEFSC 2001, 2009; Heppell et al. 2005; Conant et al. 2009; Richards et al. 2011) have examined the stock status of loggerheads in the Atlantic Ocean, but none have been able to develop a reliable estimate of absolute population size. As with other species, counts of nests and nesting females are commonly used as an index of abundance and population trends, even though there are doubts about the ability to estimate the overall population size.

Based on genetic analysis of nesting subpopulations, the NWA DPS is divided into five recovery units: Northern, Peninsular Florida, Dry Tortugas, Northern Gulf of Mexico, and Greater Caribbean (NMFS and U.S. FWS 2008). A more recent analysis using expanded mtDNA sequences revealed that rookeries from the Gulf and Atlantic coasts of Florida are genetically distinct (Shamblin et al. 2014). The recent genetic analyses suggest that the NWA DPS should be considered as ten management units: (1) South Carolina and Georgia, (2) central eastern Florida, (3) southeastern Florida, (4) Cay Sal, Bahamas, (5) Dry Tortugas, Florida, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin et al. 2012).

The Northwest Atlantic Ocean's loggerhead nesting aggregation is considered the largest in the world (Casale and Tucker 2017). Based on data from 2016-2020, the NWA DPS hosts more than

110,000 nests annually (NMFS and U.S. FWS 2023). In the most recent IUCN assessment, Ceriani and Meylan (2017) reported a five-year average (2009-2013) of more than 83,717 nests per year in the southeast U.S. and Mexico (excluding Cancun (Quintana Roo, Mexico). These estimates included sites without long-term (≥10 years) datasets. Trends at the different index nesting beaches ranged from negative to positive. In a trend analysis of the 86 index sites, the overall trend for the NWA DPS was positive (+2%) (Ceriani and Meylan 2017). Uncertainties in this analysis include, among others, using nesting females as proxies for overall population abundance and trends, demographic parameters, monitoring methodologies, and evaluation methods involving simple comparisons of early and later five-year average annual nest counts. However, the authors concluded that the subpopulation is well monitored and the data evaluated represents 63.4 % of the total estimated annual nests of the subpopulation and, therefore, are representative of the overall trend (Ceriani and Meylan 2017).

An overall estimate of nesting females for the DPS is not available because of reproductive parameter uncertainty (e.g., variations in remigration intervals and clutch frequencies, data deficiencies). Some estimations have been made however. Using data from 2004-2008, the adult female population size of the DPS was estimated at 20,000 to 40,000 females (SEFSC 2009). Ceriani et al. (2019) used the average annual number of loggerhead nests between 2014 and 2018 to estimate the total number of adults females nesting in Florida at 51,319 (95% CI=16,639–99,739). Their estimate is higher than the Richards et al. (2011) point estimate of 38,334 (range = 30,096-51,211) females nesting in the NWA DPS between 2001 and 2010 because Ceriani et al. (2019) accounted for uncertainties in remigration interval and clutch frequency. Thus, the difference does not reflect an increase in nesting. Shamblin et al. (2021) used genetic analyses to estimate female abundance for the Northern Recovery Unit and found 8,074 total nesting females from 2010 to 2015 (Shamblin et al. 2021).

The Peninsula Florida Recovery Unit and the Northern Recovery Unit represent approximately 87% and 10%, respectively of all nesting effort in the NWA DPS (NMFS and U.S. FWS 2008; Ceriani and Meylan 2017). As described above, FWRI collects standardized nesting data for sea turtles through the Index Nesting Beach Survey (INBS). The index nest counts for loggerheads represent approximately 52% of known nesting in Florida. There have been three distinct intervals observed: increasing (1989-1998), decreasing (1998-2007), and increasing (2007-2022) (Figure 3). At core index beaches in Florida, nesting totaled a minimum of 28,876 nests in 2007 and a maximum of 65,807 nests in 2016 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). In 2022, more than 62,000 nests were documented (Figure 3). The nest counts in Figure 3 represent peninsular Florida and do not include an additional set of beaches in the Florida Panhandle and southwest coast that were added to the program in 1997 and more recent years. Nest counts at these Florida Panhandle index beaches have a general upward trend since 2010 (Figure 4).

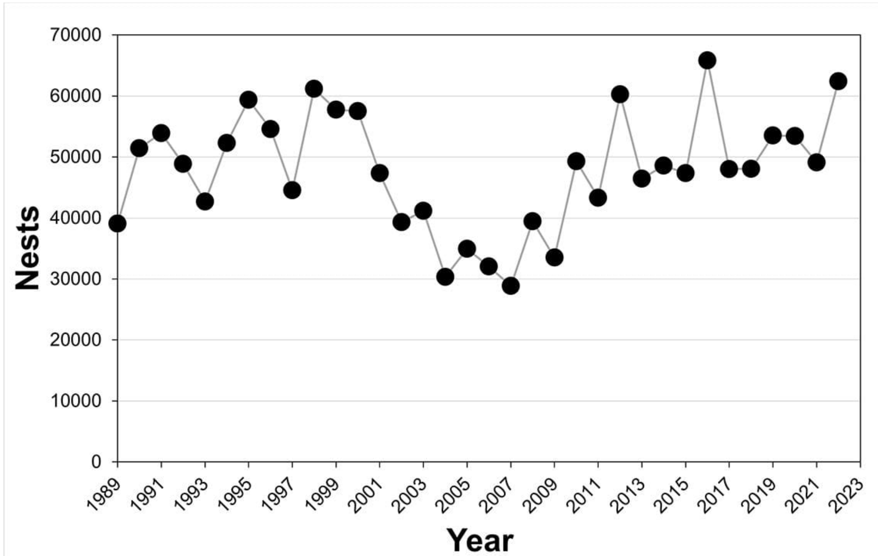


Figure 3. Annual nest counts for loggerhead sea turtles on Florida core index beaches in peninsular Florida, 1989-2022. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

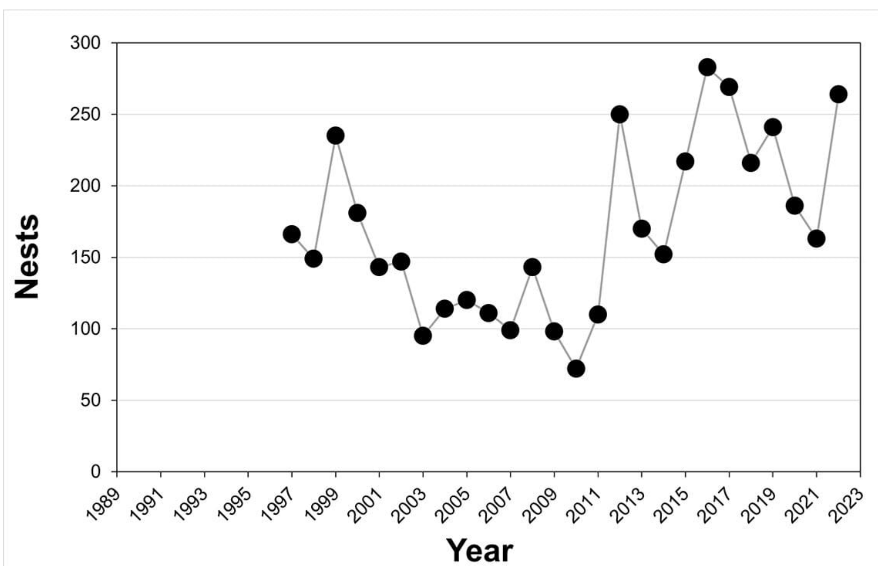


Figure 4. Annual nest counts on index beaches in the Florida Panhandle, 1997-2022. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

The annual nest counts on Florida's index beaches fluctuate widely, and we do not fully understand what drives these fluctuations. In assessing the population, Ceriani and Meylan (2017) and Bolten et al. (2019) looked at trends by recovery unit. Trends by recovery unit were variable.

The Peninsular Florida Recovery Unit (PFRU) extends from the Georgia-Florida border south and then north (excluding the islands west of Key West, Florida) through Pinellas County on the west coast of Florida. Annual nest counts from 1989 to 2022 ranged from a low of 28,876 in 2007 to a high of 65,807 in 2016 (Bolten et al. 2019; FFWCC 2023). An increase in the number of loggerhead nests in the PFRU has been observed since 2007 and long-term nesting data from 1989-2022 reveal a complex pattern with three distinct phases: increasing (1989-1998), decreasing (1998-2007), and increasing (2007-2022) (FFWCC 2023). At those index nesting beaches monitored for 30 years, the average annual growth rate is not significantly different from zero indicating a lack of trend in the data (Bolten et al. 2019). The recovery team cautions that using short term trends in nesting abundance can be misleading and trends should be considered in the context of one generation (50 years for loggerheads) (Bolten et al. 2019).

The Northern Recovery Unit (NRU), ranging from the Florida-Georgia border through southern Virginia, is the second largest nesting aggregation in the DPS. Annual nest totals for this recovery unit from 1983 to 2019 have ranged from a low of 520 in 2004 to a high of 5,555 in 2019 (Bolten et al. 2019). From 2008 to 2019, counts have ranged from 1,289 nests in 2014 to 5,555 nests in 2019 (Bolten et al. 2019). Nest counts at loggerhead nesting beaches in North Carolina, South Carolina, and Georgia declined at 1.9% annually from 1983 to 2005 (NMFS and U.S. FWS 2008). Recently, the trend has been increasing. Ceriani and Meylan (2017) reported a 35% increase for this recovery unit from 2009 through 2013. A longer-term trend analysis based on data from 1983 to 2019 indicates that the annual rate of increase is 1.3% and statistically significant (Bolten et al. 2019).

The Dry Tortugas Recovery Unit (DTRU) includes all islands west of Key West, Florida. A census on Key West from 1995 to 2004 (excluding 2002) estimated a mean of 246 nests per year, or about 60 nesting females (NMFS and U.S. FWS 2008). No trend analysis is available because there was not an adequate time series to evaluate the Dry Tortugas recovery unit (Ceriani and Meylan 2017; Bolten et al. 2019; Ceriani et al. 2019), which accounts for less than 1% of the NWA DPS (Ceriani and Meylan 2017).

The Northern Gulf of Mexico Recovery Unit (NGMRU) is defined as loggerheads originating from beaches in Franklin County on the northwest Gulf coast of Florida through Texas. From 1995 to 2007, there were an average of 906 nests per year on approximately 300 kilometers of beach in Alabama and Florida, which equates to about 221 females nesting per year (NMFS and U.S. FWS 2008). Annual nest totals for this recovery unit from 1997-2018 have ranged from a low of 72 in 2010 to a high of 283 in 2016 (Bolten et al. 2019). Evaluation of long-term nesting trends for the Northern Gulf of Mexico Recovery Unit is difficult because of changed and expanded beach coverage. However, there are now over 20 years of Florida INBS data. A number of trend analyses have been conducted. From 1995 to 2005, the recovery unit exhibited a significant declining trend (NMFS and U.S. FWS 2008; Conant et al. 2009). Nest numbers have increased in recent years (Bolten et al. 2019; https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). In the 2009-2013 trend analysis by Ceriani and Meylan (2017), a 1% decrease for this recovery unit was reported, likely due to diminished nesting on beaches in Alabama, Mississippi, Louisiana, and Texas. A longer-term analysis from 1997-2018 found that there has been a non-significant increase of 1.7% (Bolten et al. 2019).

The Greater Caribbean Recovery Unit (GCRU) 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 an annual range of 3,142 to 5,367 nests during the time period of 2016-2020 (NMFS and U.S. FWS 2023). Other significant nesting sites are found throughout the Caribbean, including Cuba, with approximately 250 to 300 nests annually (Ehrhart et al. 2003), and over 100 nests annually in Cay Sal in the Bahamas (NMFS and U.S. FWS 2008). In the trend analysis by Ceriani and Meylan (2017), a 53% increase for this Recovery Unit was reported from 2009 through 2013. However, the five-year review (NMFS and U.S. FWS 2023) noted that trend estimates for the GCRU are not available due to insufficient data.

Status
Fisheries bycatch is the highest threat to the NWA DPS of loggerhead sea turtles (Conant et al. 2009). Other threats include boat strikes, marine debris, coastal development, habitat loss, contaminants, disease, and climate change. Nesting trends for each of the loggerhead sea turtle recovery units in the NWA DPS are variable. Overall, short-term trends have shown increases, however, over the long-term the DPS is considered stable.

Critical Habitat
Critical habitat for the NWA DPS of loggerhead sea turtles was described earlier in section 4.1 and we have determined that the proposed actions are not likely to adversely affect it.

Recovery Goals
The recovery goal for the NWA DPS of loggerheads is to ensure that each recovery unit meets its recovery criteria alleviating threats to the species so that protection under the ESA are not needed. The recovery criteria relate to the number of nests and nesting females, trends in abundance on the foraging grounds, and trends in neritic strandings relative to in-water abundance. The 2008 Final Recovery Plan for the Northwest Atlantic Population of Loggerheads includes the complete delisting criteria (NMFS and U.S. FWS 2008).

Delisting criteria include:

1. Each recovery unit has recovered to a viable level and has increased for at least one generation. By recovery unit, over a 50-year period, the annual rate of increase is greater than or equal to 2% resulting in at least 14,000 nests annually for the Northern Recovery Unit; greater than or equal to 1% resulting in 106,100 nests annually for the Peninsular Florida Recovery Unit; greater than or equal to 3% resulting in at least 1,100 nests for the Dry Tortugas Recovery unit; and greater than or equal to 3% resulting in at least 4,000 nests annually for the Northern Gulf of Mexico Recovery Unit. For the Greater Caribbean Recovery Unit, the demographic criteria specifies that the total annual number of nests at a minimum of three nesting assemblages, averaging greater than 100 nests annually, has increased over 50 years.
2. The increases in the number of nests for each recovery unit must be a result of corresponding increases in the number of nesting females.
3. A network of in-water sites across the foraging range is established and measure abundance. A composite estimate of relative abundance from these sites is increasing for at least one generation.

4. Stranding trends are not increasing at a rate greater than the in-water relative abundance trends for similar age classes for at least one generation.
5. Listing factor recover criteria include criteria related to maintenance and protection of nesting habitat; development and implementation of a strategy to protect marine habitats important to loggerheads; implementation of nest protection strategies; elimination of legal harvest; reduction of nest predation; implementing legislation to ensure long-term protection of loggerheads and their habitats; implementation of strategies to reduce fisheries bycatch, marine debris ingestion and entanglement, and vessel strikes.

The recovery objectives to meet these goals include:

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.
13. Minimize vessel strike mortality.

4.2.1.2 Status of Kemp's Ridley Sea Turtles

The range of Kemp's ridley sea turtles extends from the Gulf of Mexico to the U.S. Atlantic coast (Figure 5). They have occasionally been found in the Mediterranean Sea, which may be due to migration expansion or increased hatchling production (Tomás and Raga 2008). They are the smallest of all sea turtle species, with a nearly circular top shell and a pale yellowish bottom shell. The species was first listed under the Endangered Species Conservation Act (35 FR 18319, December 2, 1970) in 1970. The species has been listed as endangered under the ESA since 1973.

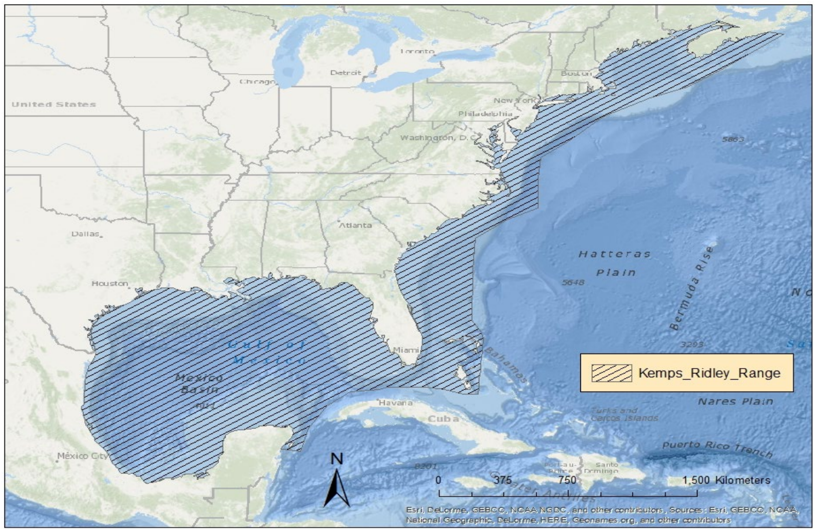


Figure 5. Range of the endangered Kemp's ridley sea turtle.

We used information available in the revised recovery plan (NMFS et al. 2011), the Five-Year Review (NMFS and U.S. FWS 2015), and published literature to summarize the life history, population dynamics and status of the species, as follows.

Life History

Kemp's ridley nesting is essentially limited to the western Gulf of Mexico. Approximately 97% of the global population's nesting activity occurs on a 146-kilometer stretch of beach that includes Rancho Nuevo in Mexico (Wibbels and Bevan 2019). In the U.S., nesting occurs primarily in Texas and occasionally in Florida, Alabama, Georgia, South Carolina, and North Carolina (NMFS and U.S. FWS 2015). Nesting occurs from April to July in large arribadas (synchronized large-scale nesting). The average remigration interval is two years, although intervals of one and three years are not uncommon (TEWG 1998, 2000; NMFS et al. 2011). Females lay an average of 2.5 clutches per season (NMFS et al. 2011). The annual average clutch size is 95 to 112 eggs per nest (NMFS and U.S. FWS 2015). The nesting location may be particularly important because hatchlings can more easily migrate to foraging grounds in deeper oceanic waters, where they remain for approximately two years before returning to nearshore coastal habitats (Snover et al. 2007; Epperly et al. 2013; NMFS and U.S. FWS 2015). Modeling indicates that oceanic-stage Kemp's ridley sea turtles are likely distributed throughout the Gulf of Mexico into the Northwest Atlantic (Putman et al. 2013). Kemp's ridleys nearing the age when recruitment to nearshore waters occurs are more likely to be distributed in the northern Gulf of Mexico, eastern Gulf of Mexico, and the western Atlantic (Putman et al. 2013).

Several studies, including those of captive turtles, recaptured turtles of known age, mark-recapture data, and skeletochronology, have estimated the average age at sexual maturity for Kemp's ridleys between 5 to 12 years (captive only) (Bjorndal et al. 2014), 10 to 16 years (Chaloupka and Zug 1997; Schmid and Witzell 1997; Zug et al. 1997; Schmid and Woodhead 2000), 9.9 to 16.7 years (Snover et al. 2007), 10 and 18 years (Shaver and Wibbels 2007), 6.8 to 21.8 years (mean 12.9 years) (Avens et al. 2017).

During spring and summer, juvenile Kemp's ridleys generally occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida and along the U.S. Atlantic coast from southern Florida to the Mid-Atlantic and New England. In addition, the NEFSC caught a juvenile Kemp's ridley during a June 2015 tagging project in deep water south of Georges Bank (NEFSC, unpublished data). In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter. As adults, many Kemp's ridleys remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS et al. 2011). Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 feet (37 meters) deep (Shaver et al. 2005; Seney and Landry 2008; Shaver and Rubio 2008), although they can also be found in deeper offshore waters. As larger juveniles and adults, Kemp's ridleys forage on swimming crabs, fish, mollusks, and tunicates (NMFS et al. 2011).

Population Dynamics

Of all 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. From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased at 15% annually (Heppell et al. 2005). However, due to recent declines in nest counts, decreased survival of immature and adult sea turtles, and updated population modeling, this rate is not expected to continue and the overall trend is unclear (NMFS and U.S. FWS 2015; Caillouet et al. 2018). In 2019, there were 11,090 nests, a 37.61% decrease from 2018 and a 54.89% decrease from 2017, which had the highest number (24,587) of nests (Figure 6; unpublished data). The reason for this recent decline is uncertain. However, while not included in Figure 6, nests in 2020 increased to 20,205 (Burchfield et al. 2021). The 2020 nest totals are the most recent currently available.

Using the standard IUCN protocol for sea turtle assessments, the number of mature individuals was recently estimated at 22,341 (Wibbels and Bevan 2019). The calculation took into account the average annual nests from 2016-2018 (21,156), a clutch frequency of 2.5 per year, a remigration interval of two years, and a sex ratio of 3.17 females:1 male. Based on the data in their analysis, the assessment concluded the current population trend is unknown (Wibbels and Bevan 2019).

Genetic variability in Kemp's ridley turtles is considered to be high, as measured by nuclear DNA analyses (i.e., microsatellites) (NMFS et al. 2011). If this holds true than rapid increases in population over one or two generations would likely prevent any negative consequences in the genetic variability of the species (NMFS et al. 2011). Additional analysis of the mtDNA taken from samples of Kemp's ridley sea turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006).

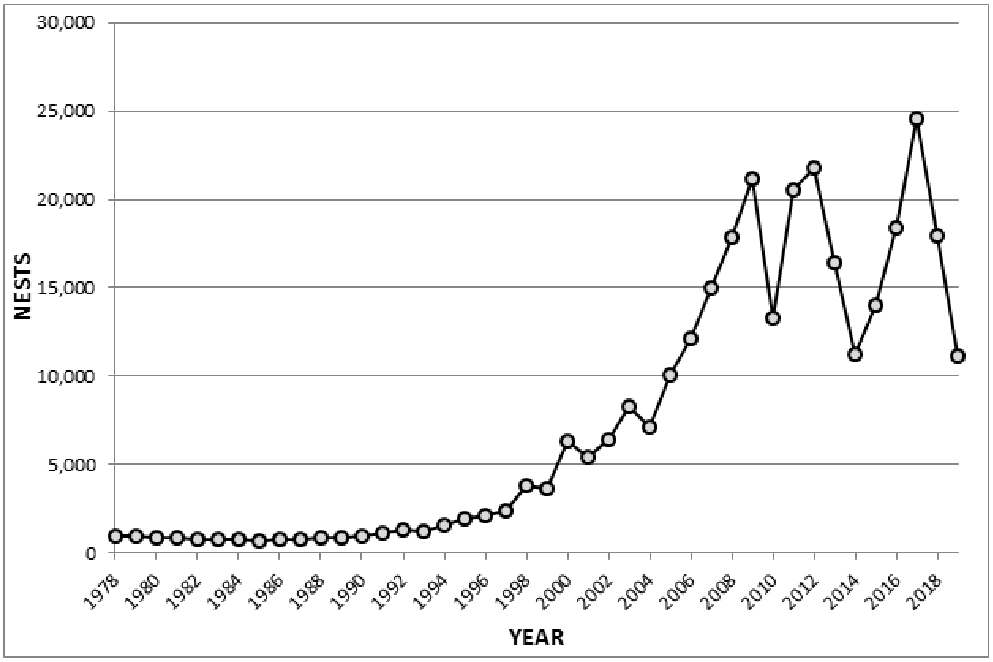


Figure 6. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2019).

Status

The Kemp's ridley was listed as endangered in response to a severe population decline, primarily the result of egg collection. In 1973, legal ordinances in Mexico prohibited the harvest of sea turtles from May to August, and in 1990, the harvest of all sea turtles was prohibited by presidential decree. In 2002, Rancho Nuevo was declared a Sanctuary. Nesting beaches in Texas have been re-established. Fishery interactions are the main threat to the species. Other threats include habitat destruction, oil spills, dredging, disease, cold stunning, and climate change. The current population trend is uncertain. While the population has increased, recent nesting numbers have been variable. In addition, 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.

Critical Habitat

Critical habitat has not been designated for Kemp's ridley sea turtles.

Recovery Goals

As with other recovery plans, the goal of the Kemp's ridley recovery plan is to conserve and protect the species so that the listing is no longer necessary. The recovery criteria relate to the number of nesting females, hatchling recruitment, habitat protection, social and/or economic initiatives compatible with conservation, reduction of predation, turtle excluder device (TED) or other protective measures in trawl gear, and improved information available to ensure recovery. The recovery plan includes the complete downlisting/delisting criteria (NMFS et al. 2011). These criteria, which are related to demographic and listing factor criteria, are summarized here.

Downlisting criteria include:

1. A population of at least 10,000 nesting females in a season distributed at primary nesting beaches.
2. Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches in Mexico.
3. Listing factor criteria related to long-term protection of habitat at two of the primary nesting beaches; initiation of social and/or economic community initiatives; reduction of nest predation; maintenance and enforcement of TED regulations; and identification and review of data on foraging areas, interesting habitats, mating areas, and adult migration routes to provide information to ensure recovery.

Delisting criteria include:

1. Average population of at least 40,000 nesting females per season over a six-year period distributed among nesting beaches.
2. Average annual recruitment of hatchlings over a 6-year period sufficient to maintain a population of at least 40,000 nesting females per nesting season.
3. Listing factor criteria related to maintaining long-term habitat protection at nesting beaches of Tamaulipas and Texas; maintaining and expanding community socioeconomic programs; reducing nest predation through protective measures; implementing specific, comprehensive legislation/regulations to ensure post-delisting protection, as appropriate; establishing a network on in-water sites to monitor population and implementing surveys; initiating monitoring programs in commercial and recreational fisheries have been initiated and implementing measures to minimize mortality in fisheries; ensuring all other significant anthropogenic mortalities have been sufficiently addressed to ensure recruitment to maintain population level criterion; and continuing STSSN research and data collection to monitor the effectiveness of protection and restoration activities.

Major actions needed to meet the recovery goals include:

1. Protect and manage terrestrial and marine habitats and Kemp's ridley populations.
2. Maintain the STSSN.
3. Manage captive stocks.
4. Develop local, state, national government and community partnerships.
5. Educate the public.
6. Maintain and expand legal protections, promote awareness of these, and increase enforcement.
7. Implement international agreements.

4.2.1.3 Status of Green Sea Turtles – North Atlantic DPS

The green sea turtle has a circumglobal distribution, occurring throughout tropical, subtropical and, to a lesser extent, temperate waters. They commonly inhabit nearshore and inshore waters. It is the largest of the hard-shelled sea turtles, growing to a weight of approximately 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (one meter). The species was listed under the ESA on July 28, 1978 (43 FR 32800) as endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed 11 DPSs of green sea turtles as threatened or endangered under the ESA (81 FR 20057). The North Atlantic DPS of green sea turtle is found in the North Atlantic Ocean and Gulf of Mexico (Figure 7) and is listed as threatened. Green sea turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5°N, 77°W) in the south, throughout the Caribbean, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48°N, 77°W) in the north. The range of the DPS then extends due east along latitudes 48°N and 19°N to the western coasts of Europe and Africa.

We used information available in the 2015 Status Review (Seminoff et al. 2015), relevant literature, and recent nesting data from the Florida FWRI to summarize the life history, population dynamics and status of the species, as follows.

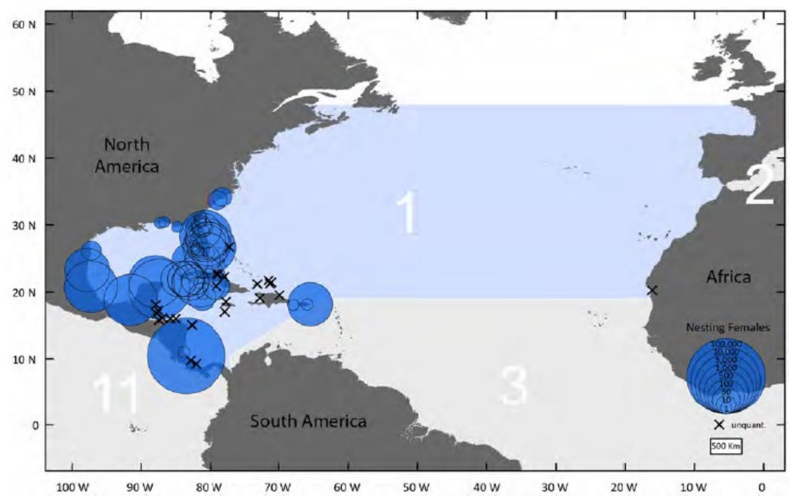


Figure 7. Geographic range of the North Atlantic DPS of green sea turtles (1), with location and abundance of nesting females (Seminoff et al. 2015).

Life history

Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, Quintana Roo), the U.S. (Florida), and Cuba (Figure 7) support nesting concentrations of particular interest in the North Atlantic DPS (Seminoff et al. 2015). The largest nesting site in the North Atlantic DPS is in Tortuguero, Costa Rica, which hosts 79% of nesting females for the DPS (Seminoff et al. 2015). In the southeastern U.S., females generally nest between May and September (Witherington et al. 2006; Seminoff et al. 2015). Green sea turtles lay an average of three nests per season with an average of one hundred eggs per nest (Hirth 1997; Seminoff et al. 2015). The remigration interval (period between nesting seasons) is two to five years (Hirth 1997; Seminoff et al. 2015). Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during the summer months.

Green sea turtles are long-lived animals. Size and age at sexual maturity have been estimated using several methods, including mark-recapture, skeletochronology, and marked, known-aged individuals. Skeletochronology analyzes growth marks in bones to obtain growth rates and age at sexual maturity estimates. Estimates vary widely among studies and populations, and methods continue to be developed and refined (Avens and Snover 2013). Early mark-recapture studies in

Florida estimated the age at sexual maturity at 18-30 years (Mendonça 1981; Frazer and Ehrhart 1985; Goshe et al. 2010). More recent estimates of age at sexual maturity are as high as 35-50 years (Goshe et al. 2010; Avens and Snover 2013), with lower ranges reported from known age turtles (15-19 years) from the Cayman Islands (Bell et al. 2005) and Caribbean Mexico (12-20 years) (Zurita et al. 2012). A study of green sea turtles that use waters of the southeastern U.S. as developmental habitat found the age at sexual maturity likely ranges from 30-44 years (Goshe et al. 2010). Green sea turtles in the Northwestern Atlantic mature at 85-100+ centimeters SCL (Avens and Snover 2013).

Adult green sea turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adults feed primarily on seagrasses and algae, although they also eat other invertebrate prey (Seminoff et al. 2015).

Population dynamics
The North Atlantic DPS has a globally unique haplotype, which was a factor in defining the discreteness of the 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). More recent genetic analysis indicates that designating a new western Gulf of Mexico management unit might be appropriate (Shamblin et al. 2016).

Compared to other DPSs, the North Atlantic DPS exhibits the highest nester abundance, with approximately 167,424 females at 73 nesting sites (using data through 2012), and available data at that time indicated an increasing trend in nesting (Seminoff et al. 2015). Counts of nests and nesting females are commonly used as an index of abundance and population trends, even though there are doubts about the ability to estimate the overall population size.

There are no reliable estimates of population growth rate for the DPS as a whole, but estimates have been developed at a localized level. The status review for green sea turtles assessed population trends for seven nesting sites with more than ten years of data collection in the North Atlantic DPS. The results were variable with some sites showing no trend and others increasing. All major nesting populations (using data through 2011-2012) demonstrated increases in abundance (Seminoff et al. 2015). However, more recent nesting numbers at Tortuguero, the largest nesting assemblage for the North Atlantic DPS, have shown declining trends. Restrepo et al. (in press) modelled the long-term trend in annual clutch numbers from 1971 to 2021 and found that Tortuguero's clutch abundance trend increased steadily through 2000, then slowed gradually until 2008, after which the trend shifted downwards.

More recent data is also available for the southeastern U.S. The FWRI monitors sea turtle nesting through the Statewide Nesting Beach Survey (SNBS) and INBS. Since 1979, the SNBS had surveyed approximately 215 beaches to collect information on the distribution, seasonality, and abundance of sea turtle nesting in Florida. Since 1989, the INBS has been conducted on a subset of SNBS beaches to monitor trends through consistent effort and specialized training of surveyors. The INBS data uses a standardized data-collection protocol to allow for comparisons between years and are presented for green, loggerhead, and leatherback sea turtles. The index counts represent 27 core index beaches. The index nest counts represent approximately 74% of known green turtle nesting in Florida (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/).

Nest counts at Florida's core index beaches have ranged from less than 300 to almost 41,000 in 2019. Overall, the nest numbers show a mostly biennial pattern of fluctuation (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/; Figure 8). It should also be noted that green sea turtle nest counts have increased eightyfold since standardized nest counts began in 1989 – a trend that differs dramatically from that of the loggerheads that nest on the same beaches. Green sea turtles set record highs for nesting at Florida core index beaches in 2017 and 2019. In 2022, green sea turtle nest counts on the 27 core index beaches reached almost 30,000 nests recorded, which was not another record high but was only marginally higher than 2020, an unusually high "low year" considering the above-mentioned cycles (FFWCC 2023). This recent nesting data over the past decade suggests a potentially strong increasing trend in Florida nesting, although similar to loggerheads, using short term trends in nesting abundance can be misleading and trends should be considered in the context of one generation.

Overall, given high nesting in Florida but recent reports of lower nests at Tortuguero (Restrepo et al. in press), nesting in the North Atlantic DPS is considered stable. Due to fluctuating nest counts across major nesting beaches in recent years, a larger time series of data is needed to discern longer term trends.

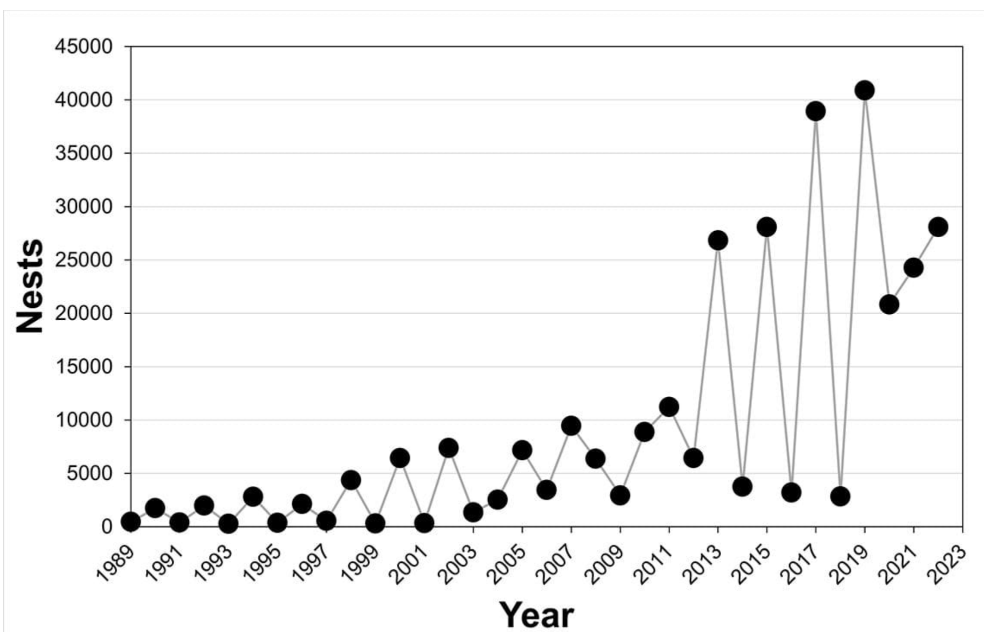


Figure 8. Number of green sea turtle nests counted on core index beaches in Florida from 1989-2022. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

Status
Historically, green sea turtles in the North Atlantic DPS were hunted for food, which was the principle cause of the population's decline. Apparent increases in nester abundance for the North Atlantic DPS in recent years are encouraging but must be viewed cautiously, as the datasets represent a fraction of a green sea turtle generation which is between 30 and 40 years (Seminoff et al. 2015). While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue, the North Atlantic DPS appears to be somewhat resilient to future perturbations.

Critical Habitat
Critical habitat in effect for the North Atlantic DPS green sea turtles surrounds Culebra Island, Puerto Rico (66 FR 20058, April 6, 2016), which is outside the action area.

Recovery Goals
The recovery plan for green sea turtles has not been recently updated. In the plan, the recovery goal for the U.S. population of green sea turtles is delist the species once the recovery criteria are met (NMFS and U.S. FWS 1991). The recovery plan includes criteria for delisting related to nesting activity, nesting habitat protection, and reduction in mortality.

Delisting can be considered if over a period of 25 years:

1. Florida nesting has increased to an average of 5,000 nests per year for at least six years.
2. At least 25% (105 kilometers) of available nesting beaches is in public ownership and encompasses greater than 50% of nesting activity.
3. Stage class mortality reduction is reflected in higher abundance counts on foraging grounds.
4. All priority one tasks have been successfully implemented (NMFS and U.S. FWS 1991).

Major actions needed to help meet the recovery goals include:

1. Providing long-term protection to important nesting beaches.
2. Ensuring at least a 60% hatch rate success on major nesting beaches.
3. Implementing effective lighting ordinances/plans on nesting beaches.
4. Determining distribution and seasonal movements of all life stages in the marine environment.
5. Minimizing commercial fishing mortality.
6. Reducing threat to the population and foraging habitat from marine pollution.

4.2.1.4 Status of Leatherback Sea Turtles

The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (Figure 9).

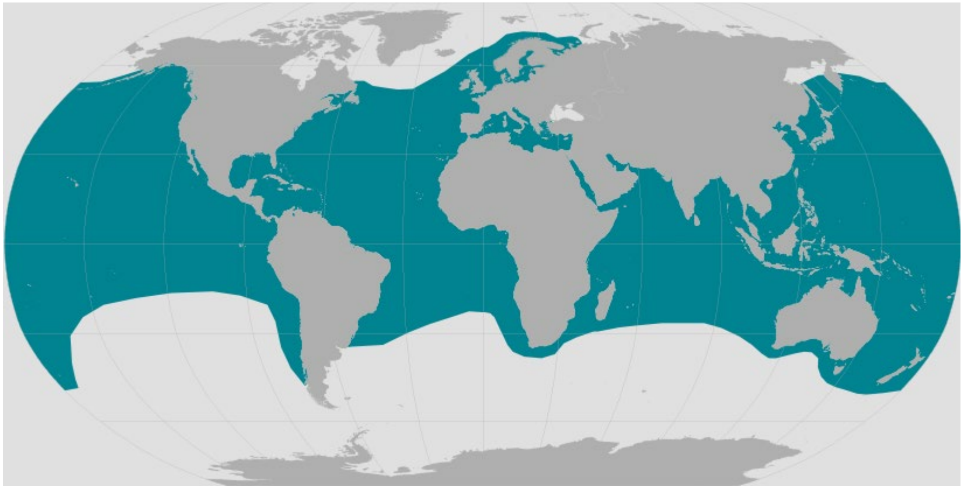


Figure 9. Range of the leatherback sea turtle (https://www.fisheries.noaa.gov/species/leatherback-turtle).

Leatherbacks are the largest living turtle, reaching lengths of six feet long, and weighing up to one ton. Leatherback sea turtles have a distinct black leathery skin covering their carapace with pinkish white skin on their plastron. The species was first listed under the Endangered Species Conservation Act (35 FR 8491, June 2, 1970) and has been listed as endangered under the ESA since 1973. In 2020, seven leatherback subpopulations that met the discreteness and significance criteria of a DPS were identified (NMFS and U.S. FWS 2020). The subpopulation found within the action area is the Northwest Atlantic DPS (Figure 10). NMFS and U.S. FWS concluded that the seven subpopulations, which met the criteria for DPSs, all met the definition of an endangered species. As such, they determined that the listing of DPSs was not warranted and leatherbacks continue to be listed at the global level (85 FR 48332, August 10, 2020). Even though listing as DPSs was not appropriate, the analysis in this Opinion looks at the range-wide and subpopulation statuses of the species and the subpopulations we describe align with the seven DPSs considered in the 2020 status review. We used information available in the most recent five-year review (NMFS and U.S. FWS 2013), the critical habitat designation (44 FR 17710, March 23, 1979), the 2020 status review (NMFS and U.S. FWS 2020), relevant literature, and recent nesting data from the FWRI to summarize the life history, population dynamics, and status of the species, as follows.

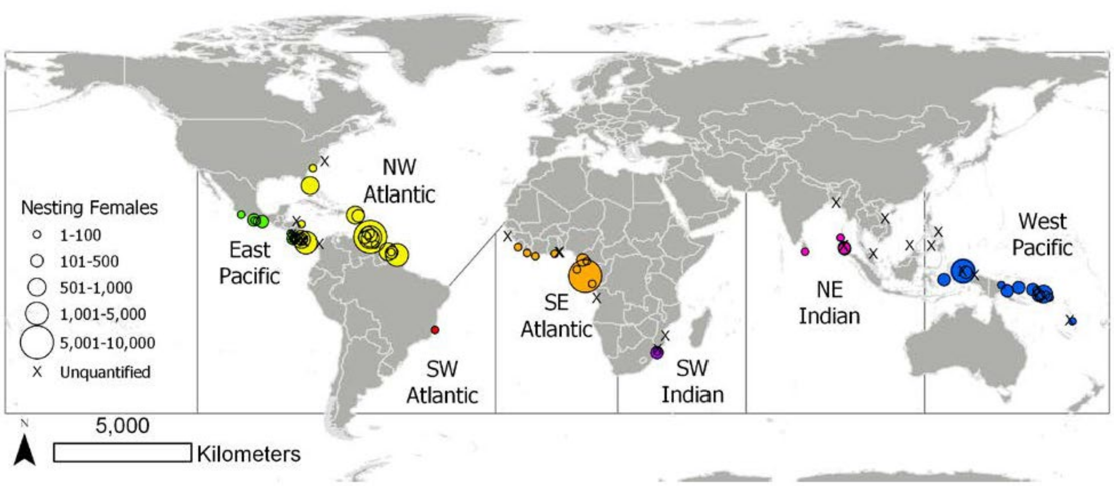


Figure 10. Leatherback sea turtle DPSs and nesting beaches (NMFS and U.S. FWS 2020).

Life History

Leatherbacks are a long-lived species. Preferred nesting grounds are in the tropics; though, nests span latitudes from 34°S in western Cape, South Africa to 38°N in Maryland (Eckert et al. 2012, 2015). Females lay an average of five to seven clutches (range: 1-14 clutches) per season, with 20 to over 100 eggs per clutch (Reina et al. 2002; Wallace et al. 2007; Eckert et al. 2012). The average clutch frequency for the Northwest Atlantic DPS is 5.5 clutches per season (NMFS and U.S. FWS 2020). In the western Atlantic, leatherbacks lay about 82 eggs per clutch (Sotherland et al. 2015). Remigration intervals are 2-4 years for most populations (range 1-11 years) (Eckert et al. 2015; NMFS and U.S. FWS 2020); the remigration interval for the Northwest Atlantic DPS is approximately three years (NMFS and U.S. FWS 2020). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergence success) is approximately 50% worldwide (Eckert et al. 2012).

Age at sexual maturity has been challenging to obtain given the species physiology and habitat use (Avens et al. 2020). Past estimates ranged from 5-29 years (Spotila et al. 1996; Avens et al. 2009). More recently, Avens et al. (2020) used refined skeletochronology to assess the age at sexual maturity for leatherback sea turtles in the Atlantic and the Pacific. In the Atlantic, the mean age at sexual maturity was 19 years (range 13-28) and the mean size at sexual maturity was 129.2 centimeters curved carapace length (CCL) (range 112.8-153.8). In the Pacific, the mean age at sexual maturity was 17 years (range 12-28) and the mean size at sexual maturity was 129.3 centimeters CCL (range 110.7-152.3) (Avens et al. 2020).

Leatherbacks have a greater tolerance for colder waters compared to all other sea turtle species due to their thermoregulatory capabilities (Paladino et al. 1990; Shoop and Kenney 1992; Wallace and Jones 2008). Evidence from tag returns, satellite telemetry, and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between temperate/boreal and tropical waters (NMFS and U.S. FWS 1992; James et al. 2005a, 2005b, 2005c; Eckert et al. 2006; Fossette et al. 2014; Dodge et al. 2015; Bond and James 2017). Tagging studies collectively show a clear separation of leatherback movements between the North and South Atlantic Oceans (NMFS and U.S. FWS 2020).

Leatherback sea turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh about 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. 2005c; Wallace et al. 2006). Studies on the foraging ecology of leatherbacks in the North Atlantic show that leatherbacks off Massachusetts primarily consumed lion's mane jellyfish, sea nettles, and ctenophores (Dodge et al. 2011). Juvenile and small sub-adult leatherbacks may spend more time in oligotrophic (relatively low plant nutrient usually accompanied by high dissolved oxygen) open ocean waters where prey is more difficult to find (Dodge et al. 2011). Sea turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals are dependent upon foraging success and duration (Hays 2000; Price et al. 2004).

Population Dynamics
The distribution is global, with nesting beaches in the Atlantic, Pacific, and Indian Oceans. Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (Shoop and Kenney 1992; NMFS and U.S. FWS 2020). 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).

Analyses of mtDNA from leatherback sea turtles indicates a low level of genetic diversity (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 U.S. FWS 2013). Using genetic data, combined with nesting, tagging, and tracking data, researchers identified seven global subpopulations: Northwest Atlantic, Southeast Atlantic, Southwest Atlantic, Northwest Indian, Southwest Indian, East Pacific, and West Pacific (Wallace et al. 2010). The 2020 status review concluded that the subpopulations identified by Wallace et al. (2010) are discrete and then evaluated whether any other populations exhibit this level of genetic discontinuity (NMFS and U.S. FWS 2020).

To evaluate the subpopulations and fine-scale structure in the Atlantic, Dutton et al. (2013) conducted a comprehensive genetic re-analysis of rookery stock structure. Samples from eight nesting sites in the Atlantic and one in the southwest Indian Ocean identified seven management units in the Atlantic and revealed fine scale genetic differentiation among neighboring populations. The mtDNA analysis failed to find significant differentiation between Florida and Costa Rica or between Trinidad and French Guiana/Suriname (Dutton et al. 2013). While Dutton et al. (2013) identified fine-scale genetic partitioning in the Atlantic Ocean, the differences did not rise to the level of marked separation or discreteness (NMFS and U.S. FWS 2020). Other genetic analyses corroborate the conclusions of Dutton et al. (2013). These studies analyzed nesting sites in French Guiana (Molfetti et al. 2013), nesting and foraging areas in Brazil (Vargas et al. 2019), and nesting beaches in the Caribbean (Carreras et al. 2013). These studies all support three discrete populations in the Atlantic (NMFS and U.S. FWS 2020). While they detected fine-scale genetic differentiation in the Northwest, Southwest, and Southeast Atlantic populations, the genetic differences were insufficient to be considered marked separation (NMFS and U.S. FWS 2020).

Population growth rates for leatherback sea turtles vary by ocean basin. An assessment of leatherback populations through 2010 found a global decline overall (Wallace et al. 2013). Using datasets with abundance data series that are 10 years or greater, they estimated that leatherback populations have declined from 90,599 nests per year to 54,262 nests per year over three generations ending in 2010 (Wallace et al. 2013).

Several more recent assessments have been conducted. The Northwest Atlantic Leatherback Working Group was formed to compile nesting abundance data, analyze regional trends, and provide conservation recommendations. The most recent, published IUCN Red List assessment for the Northwest Atlantic Ocean subpopulation estimated 20,000 mature individuals and approximately 23,000 nests per year (estimate to 2017) (Northwest Atlantic Leatherback Working Group 2019). Annual nest counts show high inter-annual variability within and across nesting sites (Northwest Atlantic Leatherback Working Group 2018). Using data from 24 nesting sites in 10 nations within the Northwest Atlantic DPS, the leatherback status review estimated that the total index of nesting female abundance for the Northwest Atlantic DPS is 20,659 females (NMFS and U.S. FWS 2020). This estimate only includes nesting data from recently and consistently monitored nesting beaches. An index (rather than a census) was developed given that the estimate is based on the number of nests on main nesting beaches with recent and consistent data, and assumes a three-year remigration interval. This index provides a minimum estimate of nesting female abundance (NMFS and U.S. FWS 2020). This index of nesting female abundance is similar to other estimates. The TEWG estimated approximately 18,700 (range 10,000 to 31,000) adult females using nesting data from 2004 and 2005 (TEWG 2007). As described above, the IUCN Red List Assessment estimated 20,000 mature individuals (male and female). The estimate in the status review is higher than the estimate for the IUCN Red List assessment, likely due to a different remigration interval, which has been increasing in recent years (NMFS and U.S. FWS 2020).

Previous assessments of leatherbacks concluded that the Northwest Atlantic population was stable or increasing (TEWG 2007; Tiwari et al. 2013a). However, based on more recent analyses, leatherback nesting in the Northwest Atlantic is showing an overall negative trend, with the most notable decrease occurring during the most recent period of 2008-2017 (Northwest Atlantic Leatherback Working Group 2018). The analyses for the IUCN Red List assessment indicate that the overall regional, abundance-weighted trends are negative (Northwest Atlantic Leatherback Working Group 2018, 2019). The dataset for trend analyses included 23 sites across 14 countries/territories. Three periods were used for the trend analysis: long-term (1990-2017), intermediate (1998-2017), and recent (2008-2017) trends. Overall, regional, abundance-weighted trends were negative across the periods and became more negative as the time-series became shorter. At the stock level, the Working Group evaluated the Northwest Atlantic – Guianas-Trinidad, Florida, Northern Caribbean, and the Western Caribbean. The Northwest Atlantic – Guianas-Trinidad stock is the largest stock and declined significantly across all periods, which was attributed to an exponential decline in abundance at Awala-Yalimapo, French Guiana as well as declines in Guyana, Suriname, Cayenne, and Matura. Declines in Awala-Yalimapo were attributed, in part, due to beach erosion and a loss of nesting habitat (Northwest Atlantic

Leatherback Working Group 2018). The Florida stock increased significantly over the long-term, but declined from 2008-2017. The Northern Caribbean and Western Caribbean stocks also declined over all three periods. The Working Group report also includes trends at the site-level, which varied depending on the site and time period, but were generally negative especially in the recent time period. The Working Group identified anthropogenic sources (fishery bycatch, vessel strikes), habitat loss, and changes in life history parameters as possible drivers of nesting abundance declines (Northwest Atlantic Leatherback Working Group 2018). Fisheries bycatch is a well-documented threat to leatherback sea turtles. The Working Group discussed entanglement in vertical line fisheries off New England and Canada as potentially important monitoring sinks. They also noted that vessels strikes result in mortality annually in feeding habitats off New England. Off nesting beaches in Trinidad and the Guianas, net fisheries take leatherbacks in high numbers (~3,000/year) (Lum 2006; Eckert 2013).

Similarly, the leatherback status review concluded that the Northwest Atlantic DPS exhibits decreasing nest trends at nesting aggregations with the greatest indices of nesting female abundance. Significant declines have been observed at nesting beaches with the greatest historical or current nesting female abundance, most notably in Trinidad and Tobago, Suriname, and French Guiana. Though some nesting aggregations (see status review document for information on specific nesting aggregations) indicated increasing trends, most of the largest ones are declining. The declining trend is considered to be representative of the DPS (NMFS and U.S. FWS 2020). The status review found that fisheries bycatch is the primary threat to the Northwest Atlantic DPS (NMFS and U.S. FWS 2020).

In the vicinity of the action area, leatherback sea turtles nest in the southeastern U.S. From 1989-2022, leatherback nests at core index beaches in Florida (representing 30% of known leatherback nesting) have varied from a minimum of 30 nests in 1990 to a maximum of 657 in 2014 (Figure 11; https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). Leatherback nesting declined from 2014 to 2017, followed by an increase since 2018. While lower than the nest numbers documented during the 2009-2014 period, 514 nests were reported in 2022 (Figure 11; FFWCC 2023). The status review found that the median trend for Florida from 2008-2017 was a decrease of 2.1% annually (NMFS and U.S. FWS 2020).

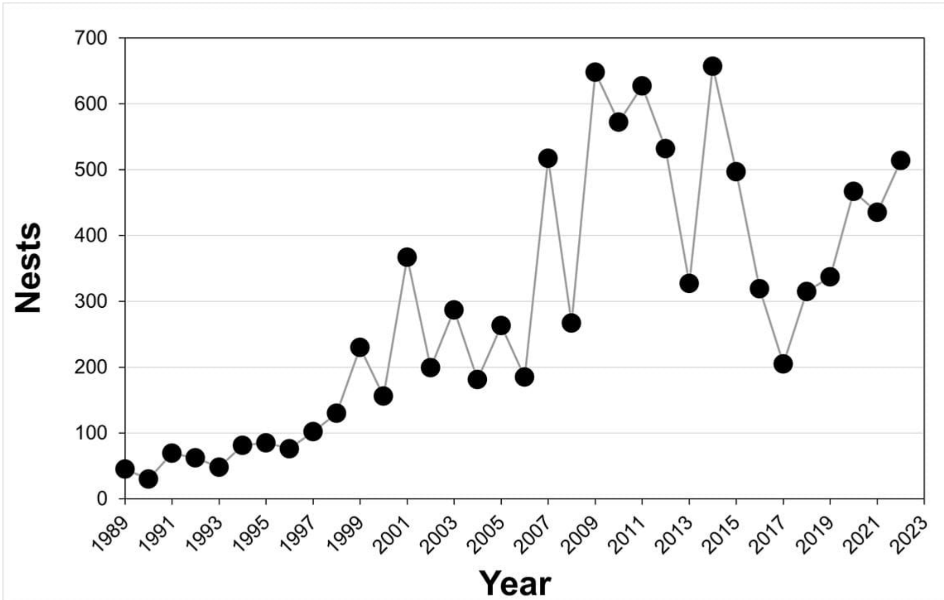


Figure 11. Number of leatherback sea turtle nests counted on core index beaches in Florida from 1989-2022. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/.

For the Southwest Atlantic DPS, the status review estimates the total index of nesting female abundance at approximately 27 females (NMFS and U.S. FWS 2020). This is similar to the IUCN Red List assessment that estimated 35 mature individuals (male and female) using nesting data since 2010 (Tiwari et al. 2013b). Nesting has increased since 2010 overall, though the 2014-2017 estimates were lower than the previous three years. The trend is increasing, though variable (NMFS and U.S. FWS 2020). The Southeast Atlantic DPS has an index of nesting female abundance of 9,198 females and demonstrates a declining nest trend at the largest nesting aggregation (NMFS and U.S. FWS 2020).

Populations in the Pacific have shown dramatic declines at many nesting sites (Santidrián Tomillo et al. 2007, 2017; Sarti Martínez et al. 2007; Tapilatu et al. 2013; Mazaris et al. 2017). For an IUCN Red List evaluation, datasets for nesting at all index beaches for the West Pacific population were compiled (Tiwari et al. 2013c). This assessment estimated the number of total mature individuals (males and females) at Jamursba-Medi and Wermon beaches to be 1,438 turtles (Tiwari et al. 2013c). Counts of leatherbacks at nesting beaches in the western Pacific indicate that the subpopulation declined at a rate of almost 6% per year from 1984 to 2011 (Tapilatu et al. 2013). More recently, the leatherback status review estimated the total index of nesting female abundance of the West Pacific DPS at 1,277 females, and the DPS exhibits low hatchling success (NMFS and U.S. FWS 2020). The total index of nesting female abundance for the East Pacific DPS is 755 nesting females. It has exhibited a decreasing trend since monitoring began with a 97.4% decline since the 1980s or 1990s, depending on nesting beach (Wallace et al. 2013). The low productivity parameters, drastic reductions in nesting female abundance, and current declines in nesting place the DPS at risk (NMFS and U.S. FWS 2020).

Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Available data from southern Mozambique show that approximately ten females nest per year from 1994 to 2004, and about 296 nests per year counted in South Africa (NMFS and U.S. FWS 2013). A five-year status review in 2013 found that, in the southwest Indian Ocean, populations in South Africa are stable (NMFS and U.S. FWS 2013). More recently, the 2020 status review estimated that the total index of nesting female abundance for the Southwest Indian DPS is 149 females and that the DPS is exhibiting a slight decreasing nest trend (NMFS and U.S. FWS 2020). While data on nesting in the Northeast Indian Ocean DPS is limited, the DPS is estimated at 109 females. This DPS has exhibited a drastic population decline with extirpation of the largest nesting aggregation in Malaysia (NMFS and U.S. FWS 2020).

Status

The leatherback sea turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. There has been a global decline overall. For all DPSs, including the Northwest Atlantic DPS, fisheries bycatch is the primary threat to the species (NMFS and U.S. FWS 2020). Leatherback sea turtle nesting in the Northwest Atlantic showed an overall negative trend through 2017, with the most notable decrease occurring during the most recent time frame of 2008 to 2017 (Northwest Atlantic Leatherback Working Group 2018). Though some nesting aggregations indicated increasing trends, most of the largest ones are declining. Therefore, the leatherback status review in 2020 concluded that the Northwest Atlantic DPS exhibits an overall decreasing trend in annual nesting activity (NMFS and U.S. FWS 2020). Threats to leatherback sea turtles include loss of nesting habitat, fisheries bycatch, vessel strikes, harvest of eggs, and marine debris, among others (Northwest Atlantic Leatherback Working Group 2018). Because of the threats, once large nesting areas in the Indian and Pacific Oceans are now functionally extinct (Tiwari et al. 2013c) and there have been range-wide reductions in population abundance. The species' resilience to additional perturbation both within the Northwest Atlantic and worldwide is low.

Critical Habitat

Critical habitat has been designated for leatherback sea turtles in the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands (44 FR 17710, March 23, 1979) and along the U.S. West Coast (77 FR 4170, January 26, 2012), both of which are outside the action area.

Recovery Goals

There are separate plans for the U.S. Caribbean, Gulf of Mexico, and Atlantic (NMFS and U.S. FWS 1992) and the U.S. Pacific (NMFS and U.S. FWS 1998) populations of leatherback sea turtles. Neither plan has been recently updated. As with other sea turtle species, the recovery plans for leatherbacks includes criteria for considering delisting. These criteria relate to increases in the populations, nesting trends, nesting beach and habitat protection, and implementation of priority actions. Criteria for delisting in the recovery plan for the U.S. Caribbean, Gulf of Mexico, and Atlantic are described here.

Delisting criteria:

1. Adult female population increases for 25 years after publication of the recovery plan, as evidenced by a statistically significant trend in nest numbers at Culebra, Puerto Rico, St. Croix, USVI, and the east coast of Florida.
2. Nesting habitat encompassing at least 75% of nesting activity in the USVI, Puerto Rico, and Florida is in public ownership.

3. All priority one tasks have been successfully implemented (see the recovery plan for a list of priority one tasks).

Major recovery actions in the U.S. Caribbean, Gulf of Mexico and Atlantic include actions to:

1. Protect and manage terrestrial and marine habitats.
2. Protect and manage the population.
3. Inform and educate the public.
4. Develop and implement international agreements.

The Pacific leatherback sea turtle is a NOAA Species in the Spotlight. The Species in the Spotlight program identifies those species most-at risk of extinction. A five-year action plan has been developed for these species to identify immediate, targeted efforts vital to stabilize the population and prevent extinction. The following items were the top five recovery actions identified to support in the Leatherback Five Year Action Plan (NMFS 2016b):

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

4.2.1.5 Other factors outside the action area affecting the status of sea turtles

The April 20, 2010, explosion of the Deepwater Horizon oil rig affected sea turtles in the Gulf of Mexico. While the spill occurred outside the action area, it does impact the same sea turtle populations occur in the action area. Therefore, we are considering it in the status of the species. This extensive oiling event contaminated important sea turtle foraging, migratory, and breeding habitats used by different life stages at the surface, in the water column, on the ocean bottom, and on beaches throughout the northern Gulf of Mexico. Sea turtles were exposed to oil when in contaminated water or habitats; by breathing oil droplets, oil vapors, and smoke; by ingesting oil-contaminated water and prey; and potentially by maternal transfer of oil compounds to embryos. Response activities and shoreline oiling also directly injured sea turtles, disrupting and deterring sea turtle nesting in the Gulf (DWH NRDA Trustees 2016).

During direct at-sea capture events, more than 900 sea turtles were sighted, 574 of which were captured and examined for oiling (Stacy 2012). Of the sea turtles captured during these operations, greater than 80% were visibly oiled (DWH NRDA Trustees 2016). Most of the rescued sea turtles were taken to rehabilitation facilities; more than 90% of the sea turtles admitted to rehabilitation centers eventually recovered and were released (Stacy 2012; Stacy and Innis 2015). Recovery efforts also included relocating nearly 275 sea turtle nests from the northern Gulf to the Florida Panhandle, with the goal of preventing hatchlings from entering the oiled waters of the northern Gulf. More than 28,000 eggs were moved to an incubation facility in Cape Canaveral, Florida, where they were incubated until emergence and release. Approximately 14,000 hatchlings were released off the Atlantic coast of Florida, 95% of which were loggerheads (https://www.fisheries.noaa.gov/national/marine-life-distress/sea-turtles-dolphins-and-whales-10-years-after-deepwater-horizon-oil).

Direct observations of the effects of oil on sea turtles obtained by at-sea captures, sightings, and strandings represent a fraction of the scope of the injury. As such, the DWH NRDA Trustees used expert opinion, surface oiling maps, and statistical approaches to apply the directly observed adverse effects of oil exposure to turtles in areas and at times that could not be surveyed. The Trustees estimated that between 4,900 and 7,600 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and hard-shelled sea turtles not identified to species), and between 55,000 and 160,000 small juvenile sea turtles (Kemp's ridleys, greens, loggerheads, hawksbills, and hard-shelled sea turtles not identified to species) were killed by the DWH oil spill. Nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridleys, and greens) were also injured by response activities (DWH NRDA Trustees 2016). Despite uncertainties and some unquantified injuries to sea turtles (e.g., injury to leatherbacks, unrealized reproduction), the Trustees conclude that this assessment adequately quantifies the nature and magnitude of injuries to sea turtles caused by the DWH oil spill and related activities. Other impacts assessed include reproductive failure and adverse health effects. Chapter 4 of the NRDA report includes details of the assessment and results (DWH NRDA Trustees 2016).

In addition, Wallace et al. (2017) later determined through a modeling approach that the highest probabilities of heavy oil exposure were limited to areas nearest the wellhead, and the probability of heavy oiling decreased with increasing distance from the wellhead. They also determined that the estimated distribution of heavily oiled neritic turtles was similar to the estimated distribution of heavily oiled oceanic turtles (Wallace et al. 2017). This modeling approach produced reasonable estimates of heavy oiling probability for both sea turtles and surface habitats that were not directly observed during the NRDA response and survey efforts. A toxicological estimation of mortality of oceanic sea turtles oiled during the spill concluded that, overall, approximately 30% of all oceanic sea turtles in the region affected by the spill that were not heavily oiled would have died from ingestion of oil (Mitchelmore et al. 2017).

Response methods used to minimize the extent and harm resulting from a spill can also affect sea turtles. These responses may include collection of oil, in situ burning, use of oil booms, and application of dispersants. Oil removal via skimming or burning can incidentally entrap and kill sea turtles. The effects of dispersants on sea turtles is poorly understood, and there is a lack of empirical studies and controlled experiments (Stacy et al. 2019). Exposure over the short-term to a dispersant and a mixture of oil/dispersant affected hydration and weight gain in loggerhead hatchlings (Harms et al. 2019). While the effects of dispersants on sea turtles is largely unknown, they remain a concern in sea turtles based on observations in other species (Stacy et al. 2019).

Based on these quantifications of sea turtle injuries and mortalities caused by the DWH oil spill, hard-shelled sea turtles from all life stages and all geographic areas were lost from the northern Gulf of Mexico ecosystem. Injuries to leatherback sea turtles could not be quantified (DWH NRDA Trustees 2016). The DWH NRDA Trustees (2016) concluded that the recovery of sea turtles in the northern Gulf of Mexico from injuries and mortalities caused by the DWH oil spill will require decades of sustained efforts to reduce the most critical threats and enhance survival of turtles at multiple life stages. The ultimate population level effects of the spill and impacts of the associated response activities are likely to remain unknown for some period into the future.

4.2.2 Status of Shortnose Sturgeon

Shortnose sturgeon occur in estuaries and rivers along the east coast of North America (Vladykov and Greeley 1963). Their northerly distribution extends to the Saint John River, New Brunswick, Canada, and their southerly distribution historically extended to the Indian River, Florida (Evermann and Bean 1898; Scott and Scott 1988) (Figure 12).

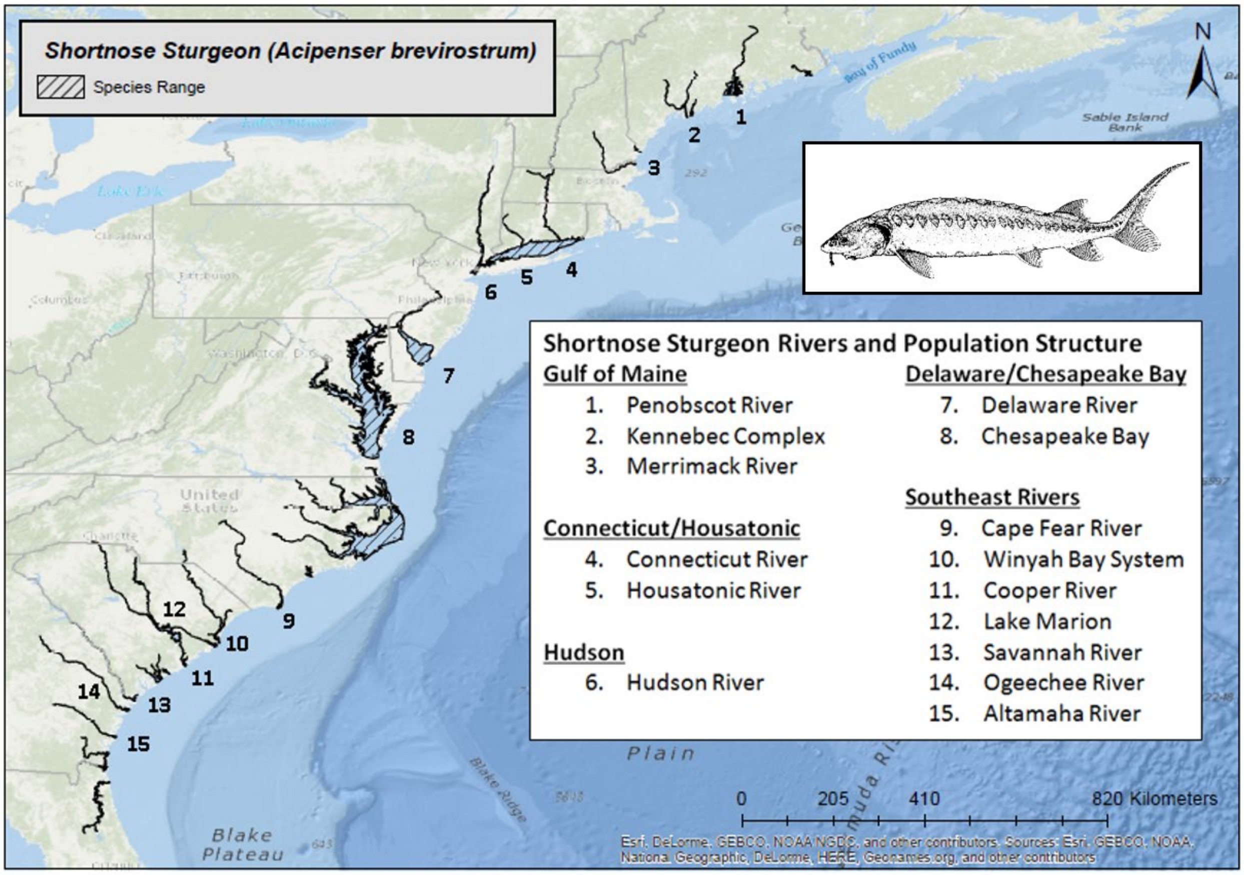


Figure 12. Geographic range of shortnose sturgeon.

The shortnose sturgeon (*Acipenser brevirostrum*) is the smallest of the three sturgeon species that occur in eastern North America. It has a benthic fusiform body and its head and snout are smaller while its mouth is larger relative to Atlantic sturgeon (Dadswell 1984). Shortnose sturgeon vary in color but are generally dark brown to olive/black on the dorsal surface, lighter along the row of lateral scutes and nearly white on the ventral surface (Gilbert 1989). The shortnose sturgeon was listed as endangered on March 11, 1967 (32 FR 4001) and remained on the endangered species list with the enactment of the ESA in 1973 (Table 3).

Table 3. Shortnose sturgeon information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Acipenser brevirostrum	Sturgeon, Shortnose	Entire Population	Endangered	2010	1967 32 FR 4001	1998	None Designated

Life history

Shortnose sturgeon are relatively slow growing, late maturing and long-lived. Growth rate, maximum age and maximum size vary with latitude; populations in southern areas grow more rapidly and mature at younger ages but attain smaller maximum sizes than those in the north (Dadswell et al. 1984). In general, females reach sexual maturity in the south as early as age 4 and in the north as late as age 18, and males display similar difference in latitudinal development, maturing between ages 2 and 11 (SSSRT 2010). Shortnose sturgeon overwinter in the lower portions of rivers and migrate upriver to spawn in the spring. Spawning periodicity is poorly understood, but males seem to spawn more frequently than females. Dadswell (1984) estimated that Saint John River males spawned at 2-year intervals; females at 3-5 year intervals. Spawning females deposit their eggs over gravel, rubble, and/or cobble often in the farthest accessible upstream reach of the river (Kynard 1997). After spawning, adult shortnose sturgeon move rapidly to downstream feeding areas where they forage on benthic insects, crustaceans, mollusks, and polychaetes (Dadswell 1984; Buckley and Kynard 1985; Kieffer and Kynard 1993; O'Herron et al. 1993).

Upon hatching, shortnose sturgeon shelter in dark substrate or are found in schools swimming against the current. Around 4-12 days after hatching individuals begin to feed exogenously and are dispersed downstream. These larvae are often found in the deepest water, usually within the channel (Taubert and Dadswell 1980; O'Connor et al. 1981; Kieffer and Kynard 1993; Parker and Kynard 2014). Young of the year remain in freshwater habitats upstream of the salt wedge for about one year (Dadswell et al. 1984; Kynard 1997). The age at which juveniles begin to utilize habitat associated with the salt/fresh water interface varies with river system from age one to eight (Dadswell 1979; Flournoy et al. 1992; Collins et al. 2002). Overwintering habitat and behavior of shortnose sturgeon varies with latitude: fish in northern rivers form tight aggregations with little movement and will inhabit either freshwater or saline reaches of the river, while fish in the south are more active and are found predominantly near the fresh/saltwater interface (Collins and Smith 1993; Weber et al. 1998; Kynard et al. 2012).

The general pattern of coastal migration of shortnose sturgeon indicates movement between groups of rivers proximal to each other across the geographic range (Quattro et al. 2002; Wirgin et al. 2005; Dionne et al. 2013; Altenritter et al. 2015). NMFS's 2010 biological assessment of shortnose sturgeon grouped the species into five regional population clusters: Gulf of Maine, Connecticut/Housatonic rivers, Hudson River, Delaware River/Chesapeake Bay, and Southeast. King et al. (2014) identified three metapopulations: 1) Maine rivers, 2) Delaware River and Chesapeake Bay proper, and 3) the Southeast assemblage. The shortnose sturgeon status review team recommends that recovery and management actions consider each riverine population as a management/recovery unit (SSSRT 2010).

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

The 2010 biological assessment of shortnose sturgeon (SSSRT 2010) identified five regional population clusters of shortnose sturgeon. See Table 4 for abundance estimates for populations within each of these population clusters.

Table 4. Shortnose sturgeon populations and estimated abundances.

Regional Population Cluster	Location[a]	Abundance Estimate (Upper/Lower 95% CI)[b]	(Source) Year of Collection Data
Gulf of Maine	Penobscot River Kennebec Complex Merrimack River	1,049 (673 / 6,939) 9,488 (6,942 / 13,358) 2000 (NA)	(NMFS 2012e) 2006 – 2007 (Squiers 2004) 1998 – 2000 (SSSRT 2010) 2009
Connecticut and Housatonic Rivers	Connecticut River – upper* Connecticut River – lower*	143 (14 / 360) 1,297 (NA)	(Kynard et al. 2012) 1994 – 2001 (Savoy and Benway 2004) 1996 – 2002
Hudson River	Hudson River	30,311 (NA)	(SSSRT 2010) 1980
Delaware River/Chesapeake Bay	Delaware River	12,047 (10,757 / 13,580)	(Brundage 2006) 1999 – 2003
Southeast Rivers	Cape Fear River Cooper River Lake Marion Savannah River Ogeechee River Altamaha River	50 (NA) 301 (150 / 659) Unknown (NA) 940 adults (535 / 1753) 147 (104 / 249) 1,209 (556 / 2759)	(SSSRT 2010) NA (Cooke et al. 2004) 1996 – 1998 (SSSRT 2010) NA (Bahr and Peterson 2017) 2015 (Fleming et al. 2003) 1999 – 2000 (Bednarski 2012) 2004 – 2010

[a]Locations listed here are those for which population estimates are available. Additional waterbodies with confirmed shortnose sturgeon include Piscataqua River, Housatonic River, Chesapeake Bay, Susquehanna River, Potomac River, Roanoke River, Chowan River, Tar/Pamlico River, Neuse River, New River, North River, Santee River, ACE Basin – Edisto (Smith et al. 2002), Satilla River, St. Mary's River, St. Johns River (SSSRT 2010).
[b]Abundance estimates are established using different techniques and should be viewed with caution. Estimates listed here are those identified by NMFS in the 2010 Biological Assessment of Shortnose Sturgeon (SSSRT 2010).
**The Connecticut River population of shortnose sturgeon is separated into an upstream and downstream segment bisected by the Holyoke Dam.*

Genetic diversity estimates for shortnose sturgeon have been shown to be moderately high in both mitochondrial (Quattro et al. 2002; Wirgin et al. 2005, 2010) and nuclear genomes (King et al. 2014). The mtDNA and nDNA studies performed to date suggest that dispersal is a very important factor in maintaining these high levels of genetic diversity.

Shortnose sturgeon occur along the East Coast of North America in rivers, estuaries and the sea. They were once present in most major rivers systems along the Atlantic coast (Evermann and Bean 1898; Scott and Scott 1988). Their current distribution extends north to the Saint John River, New Brunswick, Canada, and south to the St. Johns River, FL (NMFS 1998a). Currently, the distribution of shortnose sturgeon across their range is disjunct, with northern populations separated from southern populations by a distance of about 400 kilometers near their geographic center in North Carolina and Virginia. Some river systems host populations which rarely leave freshwater while in other areas coastal migrations between river systems are common. Spawning locations have been identified within a number of river systems (SSSRT 2010).

Status

Shortnose sturgeon remain listed as endangered throughout their range, with populations in the Northeast being larger and generally more stable than populations in the Southeast. All populations are affected by mortality incidental to other activities, including dredging, power plant intakes and shad fisheries where those still occur, and impacts to habitat and water quality that affect the ability of sturgeon to use habitats and impacts to individuals that are present in those habitats. While the species is overall considered to be stable (i.e., its trend has not changed recently, and we are not aware of any new or emerging threats that would change the trend in the future), we lack information on abundance and population dynamics in many rivers. We also do not fully understand the extent of coastal movements and the importance of habitat in non-natal rivers to migrant fish. While the species has high levels of genetic diversity, the lack of effective movement between populations increases the vulnerability of the species should there be a significant reduction in the number of individuals in any one population or metapopulation as recolonization is expected to be very slow. All populations, regardless of size, are faced with threats that result in the mortality of individuals and/or affect the suitability of habitat and may restrict the further growth of the population. Additionally, there are several life history traits and factors that combine to make the species particularly sensitive to existing and future threats; these factors include: the small size of many populations, existing gaps in the range, late maturation, long residence time in rivers from egg to adulthood, the sensitivity of adults to very specific spawning cues that can result in years with no recruitment if conditions are not met, and the impact of losses of young of the year and juvenile cohorts prior to reaching spawning age on population persistence and stability.

The decline in abundance and slow recovery of shortnose sturgeon has been attributed to pollution, overfishing, bycatch in commercial fisheries, and an increase in industrial uses of the nation’s large coastal rivers during the 20th century (e.g., hydropower, nuclear power, treated sewage disposal, dredging, construction) (SSSRT 2010). In addition, the effects of climate change may adversely impact shortnose sturgeon by reducing the amount of available habitat, exacerbating existing water quality problems, and interfering with migration and spawning cues (SSSRT 2010). Without substantial mitigation and management to improve access to historical habitats and water quality of these systems, shortnose sturgeon populations will likely continue to be depressed. This is particularly evident in some southern rivers that are suspected to no longer support reproducing populations of shortnose sturgeon (SSSRT 2010). The number of river systems in which spawning has been confirmed has been reduced to around 12 locations (SSSRT 2010).

Recovery Goals
The long-term recovery objective for the shortnose sturgeon is to recover all 19 populations to levels of abundance at which they no longer require protection under the ESA. Each population may become a candidate for downlisting when it reaches a minimum population size that: 1) is large enough to prevent extinction, and 2) will make the loss of genetic diversity unlikely. The minimum population size for each population segment has not yet been determined (NMFS 1998a; SSSRT 2010).

4.2.3 Status of Atlantic Sturgeon

The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is one of two subspecies of *A. oxyrinchus*, the other being the Gulf sturgeon, *A. o. desotoi*. It is distributed along the eastern coast of North America from Hamilton Inlet, Labrador, Canada to Cape Canaveral, Florida (77 FR 5880). We have delineated U.S. populations of Atlantic sturgeon into five DPSs (77 FR 5880 and 77 FR 5914, February 6, 2012). They are the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs (see Figure 13). The results of genetic studies suggest that natal origin influences the distribution of Atlantic sturgeon in the marine environment. However, genetic data as well as tracking and tagging data demonstrate sturgeon from each DPS and Canada occur throughout the full range of the subspecies (Wirgin et al. 2015a, 2015b; Kazyak et al. 2021). Therefore, sturgeon originating from any of the five DPSs can be affected by threats in the marine, estuarine, and riverine environment that occur far from natal spawning rivers.

The New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered, and the Gulf of Maine DPS is listed as threatened (77 FR 5880 and 77 FR 5914, February 6, 2012). The effective date of the listings was April 6, 2012. The DPSs do not include Atlantic sturgeon spawned in Canadian rivers. Therefore, Canadian spawned fish are not included in the listings.

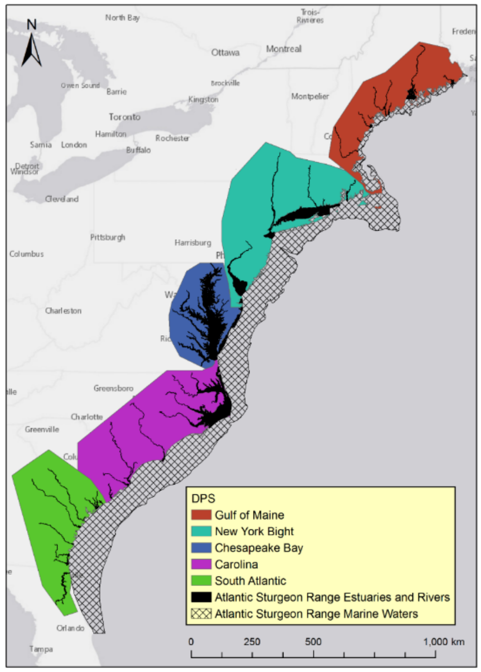


Figure 13. U.S. range of Atlantic sturgeon DPSs. This figure shows the general northern and southern boundaries of each DPS at the coastline. The extent to which each DPS is depicted inland is for general illustration purposes only, since the regulatory definitions of each DPS do not include a western boundary.

Information available from the 2007 Atlantic sturgeon status review (ASSRT 2007), 2012 final listing rules (77 FR 5880 and 77 FR 5914, February 6, 2012), 2017 ASMFC benchmark stock assessment (ASMFC 2017), 2017 critical habitat designations (82 FR 39160, August 17, 2017; NMFS 2017a, 2017b), and 2022 five-year reviews for the Gulf of Maine, New York Bight, and Chesapeake Bay DPSs (NMFS 2022a, 2022b, 2022c) were used to summarize the life history, population dynamics, and status of the species. Five-year reviews for the Carolina and South Atlantic DPSs are currently in development and not yet available.

Life history

Atlantic sturgeon are a long-lived (approximately 60 years), late maturing, and estuarine-dependent anadromous fish (Sulak and Randall 2002; ASSRT 2007; Balazik et al. 2010; Hilton et al. 2016). Sexual maturity is reached between the ages of 5 to 34 years. Sturgeon originating from rivers in lower latitudes (e.g., South Carolina rivers) mature faster than those originating from rivers located in higher latitudes (e.g., Saint Lawrence River) (NMFS 2017a, 2017b).

Atlantic sturgeon spawn in freshwater habitats (ASSRT 2007; NMFS 2017a, 2017b) at sites with flowing water and hard bottom substrate (Vladykov and Greeley 1963; Gilbert 1989; Smith and Clugston 1997; Bain et al. 2000; Hatin et al. 2002; Mohler 2003; Greene et al. 2009; Balazik et al. 2012a). Water depths of spawning sites are highly variable, but may be up to 27 meters (Leland 1968; Scott and Crossman 1973; Crance 1987; Bain et al. 2000). This is supported by tagging records, which show that Atlantic sturgeon return to their natal rivers to spawn (ASSRT 2007). Spawning intervals range from one to five years in males (Smith 1985; Collins et al. 2000a; Caron et al. 2002) and two to five years in females (Vladykov and Greeley 1963; Van Eenennaam et al. 1996; Stevenson and Secor 1999). Males spawn more frequently than females, and females can spawn in consecutive years, but female spawning periodicity is more variable than males (Breece et al. 2021). The number of eggs produced by females ranges from 400,000 to approximately 4 million depending on body size (and age) (Van Eenennaam et al. 1996; Van Eenennaam and Doroshov 1998; Hilton et al. 2016). Therefore, observations of large-sized sturgeon are particularly important given that egg production correlates with age and body size (Smith et al. 1982; Van Eenennaam et al. 1996; Van Eenennaam and Doroshov 1998; Dadswell 2006).

Some Atlantic sturgeon river populations may have up to two spawning seasons comprised of different spawning adults (Collins et al. 2000a; Balazik and Musick 2015), although the majority likely have just one, either in the spring or fall.[3] There is evidence of spring and fall spawning for the Chesapeake and South Atlantic DPSs (77 FR 5914, February 6, 2012; Collins et al. 2000a; ASSRT 2007; Balazik et al. 2017), spring spawning for the Gulf of Maine and New York Bight DPSs (NMFS 2017a), and fall spawning for the Chesapeake and Carolina DPSs (Smith et al. 1984; Balazik et al. 2012b). In the Chesapeake Bay DPS, spawning occurs in the James River as well as a few others, and there is evidence that most of the populations spawn in the late summer to fall (hereafter referred to as "fall spawning") rather than in the spring. Fall spawning activity has been documented in the newly discovered spawning populations in the Pamunkey River, a tributary of the York River, and in Marshyhope Creek, a tributary of the Nanticoke River (Hager et al. 2014; Richardson and Secor 2016; Secor et al. 2022). The James River is currently the only river of the Chesapeake Bay DPS where evidence suggests there is both spring and fall spawning with separate spawning populations. The results of genetic analyses show that there is some limited gene flow between the populations but, overall, the spawning populations are genetically distinct (Balazik et al. 2012b, 2017; Balazik and Musick 2015).

Water temperature appears to play the primary role in triggering the timing of spawning migrations (Hilton et al. 2016). Spawning migrations generally occur during February-March in southern systems, April-May in Mid-Atlantic systems, and May-July in Canadian systems (Hilton et al. 2016). Male sturgeon begin upstream spawning migrations when waters reach approximately 6°C (43°F) (Hilton et al. 2016), and remain on the spawning grounds throughout the spawning season (Bain 1997). Females begin spawning migrations when temperatures are closer to 12°C to 13°C (54° to 55°F) (Dovel and Berggren 1983; Smith 1985), make rapid spawning migrations upstream, and quickly depart following spawning (Bain 1997).

Following spawning, males move downriver to the lower estuary and remain there until outmigration in the fall (Smith et al. 1982; Dovel and Berggren 1983; Smith 1985; Bain 1997; Bain et al. 2000; Hatin et al. 2002; Greene et al. 2009; Balazik et al. 2012b; Breece et al. 2013; Ingram et al. 2019). Females move downriver and may leave the estuary and travel to other coastal estuaries until outmigration to marine waters in the fall (Smith et al. 1982; Dovel and Berggren 1983; Smith 1985; Bain 1997; Bain et al. 2000; Hatin et al. 2002; Greene et al. 2009; Balazik et al. 2012b; Breece et al. 2013; NMFS 2017a, 2017b). Atlantic sturgeon deposit eggs on hard bottom substrate. They hatch into the yolk sac larval stage approximately 94 to 140 hours after deposition (Vladykov and Greeley 1963; Murawski and Pacheco 1977; Smith et al. 1980; Van Den Avyle 1984; Mohler 2003). Once the yolk sac is absorbed (eight to twelve days post-

[3] Although referred to as spring spawning and fall spawning, the actual time of Atlantic sturgeon spawning may not occur during the astronomical spring or fall season (Balazik and Musick 2015).

hatching), sturgeon are larvae. Shortly after, they become young of year and then juveniles. The juvenile stage can last months to years in the brackish waters of the natal estuary (Holland and Yelverton 1973; Dovel and Berggren 1983; Waldman et al. 1996; Collins et al. 2000b; Secor et al. 2000; Kynard and Horgan 2002; Mohler 2003; Dadswell 2006; ASSRT 2007; Hatin et al. 2007; Greene et al. 2009; Calvo et al. 2010; Schueller and Peterson 2010). Upon reaching the sub-adult phase, individuals enter the marine environment, mixing with adults and sub-adults from other river systems (Bain 1997; Dovel and Berggren 1983; Hatin et al. 2007; McCord et al. 2007; NMFS 2017a, 2017b). Once sub-adult Atlantic sturgeon have reached maturity (i.e., adult stage), they will remain in marine or estuarine waters that are typically less than 50 meters (164 feet) deep, only returning far upstream to the spawning areas when they are ready to spawn (Bain 1997; Savoy and Pacileo 2003; ASSRT 2007; Dunton et al. 2012, 2015; Breece et al. 2016).

The life history of Atlantic sturgeon can be divided into seven general categories as described in Table 5 below (adapted from ASSRT 2007).

Table 5. Descriptions of Atlantic sturgeon life history stages (TL = total length, FL = fork length). The sizes are only guidelines for the life stages, which are more dependent on sturgeon behavior (e.g., if an individual sturgeon is measured to be < 1,000 mm FL, but is reported to have traveled in offshore marine waters, it is most likely a subadult and not a juvenile). See https://www.fisheries.noaa.gov/consultations/section-7-atlantic-sturgeon-greater-atlantic-region-general-life-stage-behavior for more information.

Age Class	Size	Duration	Description
Egg	~2 mm – 3 mm diameter (Van Eenennnaam et al. 1996)	Hatching occurs ~3-6 days after egg deposition and fertilization (ASSRT 2007, p. 4)	Fertilized or unfertilized
Yolk-sac larvae (YSL)	~6 mm – 14 mm (Bath et al. 1981)	8-12 days post hatch (ASSRT 2007, p.4)	Negative phototaxis; nourished by yolk sac
Post yolk-sac larvae (PYSL)	~14 mm < 60 mm TL (Bath et al. 1981; Snyder 1988)	12-40 days post hatch	Free swimming; feeding; silt/sand bottom, deep channel; fresh water
Young of Year (YOY)	≥ 60 mm < 410 mm TL (Snyder 1988, ASSRT 2007)	From 40 days to 1 year	Fish that are > 3 months and < 1 year old, that are capable of capturing and consuming live food, and are not tolerant of saline water

Age Class	Size	Duration	Description
Juveniles	≥ 410 mm TL ≤ 1,000 mm FL (ASSRT 2007; Sweka et al. 2007)	1 year to time at which first coastal migration is made	Fish that are at least 1 year old, are not sexually mature, and do not make coastal migrations. Tolerant of saline water.
Sub-adults	1,000-1,300 mm FL (Bain et al. 1999; Sweka et al. 2007)	From first coastal migration to sexual maturity	Fish that are not sexually mature, but make coastal migrations
Adults	≥ 1,300 mm FL (Bain et al. 1999)	Post-maturation	Fish that are sexually mature

Population dynamics
A population estimate was derived from the NEAMAP trawl surveys (Kocik et al. 2013).[4] For this Opinion, as we did in the prior 2016 and 2021 Opinions, we are relying on the population estimates derived from the NEAMAP swept area biomass assuming a 50% catchability (i.e., net efficiency x availability) rate. We consider that the NEAMAP surveys sample an area utilized by Atlantic sturgeon, but do not sample all the locations and times where Atlantic sturgeon are present, and that the trawl net captures some, but likely not all, of the Atlantic sturgeon present in the sampling area. Therefore, we assume that net efficiency and the fraction of the population exposed to the NEAMAP surveys in combination result in a 50% catchability (NMFS 2013b). The 50% catchability assumption reasonably accounts for the robust, yet not complete sampling of the Atlantic sturgeon oceanic temporal and spatial ranges and the documented high rates of encounter with NEAMAP survey gear. As these estimates are derived directly from empirical data with fewer assumptions than have been required to model Atlantic sturgeon populations to date, we have determined that these estimates continue to serve as the best available information. Based on the above approach, the overall abundance of Atlantic sturgeon in U.S. Atlantic waters is estimated to be 67,776 fish (see Table in 16 in Kocik et al. 2013). Based on genetic frequencies of occurrence in the sampled area, this overall population estimate was subsequently partitioned by DPS (Table 6). Given the proportion of adults to sub-adults in the NEFSC observer data (approximate ratio of 1:3), we have also estimated the number of adults and sub-adults originating from each DPS. However, this cannot be considered an estimate of the total number of sub-adults because it only considers those sub-adults that are of a size that are present and vulnerable to capture in commercial trawl and gillnet gear in the marine environment.

[4] Since fall 2007, NEAMAP trawl surveys (spring and fall) have been conducted from Cape Cod, Massachusetts to Cape Hatteras, North Carolina in nearshore waters at depths up to 18.3 meters (60 feet). Each survey employs a spatially stratified random design with a total of 35 strata and 150 stations.

Table 6. Summary of calculated population estimates based upon the NEAMAP survey swept area model assuming 50% efficiency.

DPS	Estimated Ocean Population Abundance	Estimated Ocean Population of Adults	Estimated Ocean Population of Sub-adults (of size vulnerable to capture in fisheries)
Gulf of Maine	7,455	1,864	5,591
New York Bight	34,566	8,642	25,925
Chesapeake Bay	8,811	2,203	6,608
Carolina	1,356	339	1,017
South Atlantic	14,911	3,728	11,183
Canada	678	170	509

It is important to note, the NEAMAP-based estimates do not include young-of-the-year (YOY) fish and juveniles in the rivers; however, those segments of the Atlantic sturgeon populations are at minimal risk from the proposed actions since they are rare to absent within the action area. The NEAMAP surveys are conducted in waters that include the preferred depth ranges of sub-adult and adult Atlantic sturgeon and take place during seasons that coincide with known Atlantic sturgeon coastal migration patterns in the ocean. However, the estimated number of sub-adults in marine waters is a minimum count because it only considers those sub-adults that are captured in a portion of the action area and are present in the marine environment, which is only a fraction of the total number of sub-adults. In regards to adult Atlantic sturgeon, the estimated population in marine waters is also a minimum count as the NEAMAP surveys sample only a portion of the action area, and therefore a portion of the Atlantic sturgeon's range.

Precise estimates of population growth rate (intrinsic rates) are unknown for the five listed DPSs of Atlantic sturgeon due to a lack of long-term abundance data. The ASMFC (2017) stock assessment referenced a population viability assessment (PVA) that was done to determine population growth rates for the five DPSs based on a few long-term survey programs, but most results were statistically insignificant or utilized a model that would not converge. In any event, the population growth rates reported from that PVA ranged from -1.8% to 4.9% (ASMFC 2017).

The genetic diversity of Atlantic sturgeon throughout its range has been well-documented (Bowen and Avise 1990; Ong et al. 1996; Waldman et al. 1996; Waldman and Wirgin 1998; ASSRT 2007; O'Leary et al. 2014). Overall, these studies have consistently found populations to be genetically diverse, and the majority can be readily differentiated. Relatively low rates of gene flow reported in population genetic studies (Wirgin et al. 2002; Fritts et al. 2016; Savoy et al. 2017) indicate that Atlantic sturgeon return to their natal river to spawn, despite extensive mixing in coastal waters.

The range of all five listed DPSs extends from Canada through Cape Canaveral, Florida. All five DPSs use the action area. Based on a recent genetic mixed stock analysis (Kazyak et al. 2020a, 2021), we expect Atlantic sturgeon throughout the action area originate from the five DPSs at the following frequencies: Gulf of Maine 8.7%; New York Bight 71.4%; Chesapeake Bay 10.7%; Carolina 2.6%; and South Atlantic 5.6%. Approximately 1.0% of the Atlantic sturgeon throughout the action area are expected to originate from Canadian rivers or management units. The authors of this recent analysis used 12 microsatellite markers to characterize the stock composition of 1,704 Atlantic sturgeon encountered across the U.S. Atlantic coast dating back to 1980. The primary method to determine the origin of Atlantic sturgeon when they are encountered away from natal habitats is through the use of genetic assignment testing, as was done in Kazyak et al. (2020a, 2021). However, one caveat with genetic assignment testing is that not all populations have been discovered and not all discovered populations were used for this assessment. Assignment testing can only assign an individual to a known or defined category. Even if there is very little in common with the best match, that is where that sample is assigned.

Depending on life stage, sturgeon may be present in marine and estuarine ecosystems. The action area for this Opinion occurs in marine waters; therefore, this section will focus only on the distribution of Atlantic sturgeon life stages (sub-adult and adult) in marine waters; it will not discuss the distribution of Atlantic sturgeon life stages (eggs, larvae, juvenile, sub-adult, adult) in freshwater ecosystems, specifically, their movements into/out of natal river systems. For more information on Atlantic sturgeon distribution in freshwater ecosystems, refer to ASSRT (2007); 77 FR 5880 (February 6, 2012); 77 FR 5914 (February 6, 2012); NMFS (2017); and ASMFC (2017).

The marine range of U.S. Atlantic sturgeon extends from Labrador, Canada, to Cape Canaveral, Florida. As Atlantic sturgeon travel long distances in these waters, all five DPSs of Atlantic sturgeon have the potential to be anywhere in this marine range. Results from genetic studies show that, regardless of location, multiple DPSs can be found at any one location along the Northwest Atlantic coast, although the Hudson River population from the New York Bight DPS dominates (Dovel and Berggren 1983; Kynard et al. 2000; Stein et al. 2004a; Dadswell 2006; ASSRT 2007; Laney et al. 2007; Dunton et al. 2010, 2012, 2015; Erickson et al. 2011; Wirgin et al. 2012, 2015a, 2015b; Waldman et al. 2013; O'Leary et al. 2014; ASMFC 2017).

Based on fishery-independent, fishery dependent, tracking, and tagging data, Atlantic sturgeon appear to primarily occur inshore of the 50 meter depth contour (Stein et al. 2004a, 2004b; Laney et al. 2007; Dunton et al. 2010, 2012; Erickson et al. 2011; Waldman et al. 2013; O'Leary et al. 2014; Wirgin et al. 2015a, 2015b). However, they are not restricted to these depths and excursions into deeper (e.g., 75 meters) continental shelf waters have been documented (Timoshkin 1968; Collins and Smith 1997; Colette and Klein-MacPhee 2002; Stein et al. 2004a, 2004b; Erickson et al. 2011). Data from fishery-independent surveys and tagging and tracking studies also indicate that some Atlantic sturgeon may undertake seasonal movements along the coast (Dunton et al. 2010; Erickson et al. 2011; Wippelhauser 2012; Oliver et al. 2013; Post et al. 2014; Hilton et al. 2016). For instance, studies found that satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight, at depths greater than 20 meters, during winter and spring; while, in the summer and fall, Atlantic sturgeon concentrations shifted to the northern portion of the Mid-Atlantic Bight at depths less than 20 meters (Erickson et al. 2011).

In the marine range, several marine aggregation areas occur adjacent to estuaries and/or coastal features formed by bay mouths and inlets along the U.S. eastern seaboard (i.e., waters off North Carolina, Chesapeake Bay; Delaware Bay; New York Bight; Massachusetts Bay; Long Island Sound; and Connecticut and Kennebec River Estuaries). Depths in these areas are generally no greater than 25 meters (Bain et al. 2000; Savoy and Pacileo 2003; Stein et al. 2004a, 2004b; Laney et al. 2007; Dunton et al. 2010; Erickson et al. 2011; Wippelhauser 2012; Oliver et al. 2013; Waldman et al. 2013; O'Leary et al. 2014; Wippelhauser and Squiers 2015). Although additional studies are still needed to clarify why Atlantic sturgeon aggregate at these sites, there is some indication that they may serve as thermal refuge, wintering sites, or marine foraging areas (Stein et al. 2004a; Dunton et al. 2010; Erickson et al. 2011).

Status

Atlantic sturgeon were once present in 38 river systems and, of these, spawned in 35 (ASSRT 2007). They are currently present in 36 rivers and are probably present in additional rivers that provide sufficient forage base, depth, and access (ASSRT 2007). The benchmark stock assessment evaluated evidence for spawning tributaries and sub-populations of U.S. Atlantic sturgeon in 39 rivers. They confirmed (eggs, embryo, larvae, or YOY observed) spawning in ten rivers, considered spawning highly likely (adults expressing gametes, discrete genetic composition) in nine rivers, and suspected (adults observed in upper reaches of tributaries, historical accounts, presence of resident juveniles) spawning in six rivers. Spawning in the remaining rivers was unknown (ten) or suspected historical (four) (ASMFC 2017). The decline in abundance of Atlantic sturgeon has been attributed primarily to the large U.S. commercial fishery, which existed for the Atlantic sturgeon through the mid-1990s. Based on management recommendations in the Interstate Fishery Management Plan (ISFMP), adopted by the ASMFC in 1990, commercial harvest in Atlantic coastal states was severely restricted and ultimately eliminated from most coastal states (ASMFC 1998a). In 1998, the ASMFC called for a coastwide moratorium on fishing for Atlantic sturgeon in state waters to allow 20 consecutive cohorts of females to reach sexual maturity and spawn, which would facilitate restoration of the age structure (ASMFC 1998a, 1998b). This was expected to take 20-40 years. In 1999, NMFS closed the U.S. EEZ to Atlantic sturgeon retention, pursuant to the ACA (64 FR 9449; February 26, 1999). However, many state fisheries for sturgeon were closed prior to this due to the fishing moratorium and the very low abundance of sturgeon in most rivers and watersheds.

The most significant threats to Atlantic sturgeon are incidental catch, dams that block access to spawning habitat in southern rivers, poor water quality, dredging of spawning areas, water withdrawals from rivers, and vessel strikes. Climate change related impacts on water quality (e.g., temperature, salinity, dissolved oxygen, contaminants) also have the potential to affect Atlantic sturgeon populations using impacted river systems.

In support of the above, the ASMFC released a new benchmark stock assessment for Atlantic sturgeon in October 2017 (ASMFC 2017). Based on historic removals and estimated effective population size, the 2017 stock assessment concluded that all five Atlantic sturgeon DPSs are depleted relative to historical levels (Table 7). However, the 2017 stock assessment does provide some evidence of population recovery at the coastwide scale, and mixed population recovery at the DPS scale (ASMFC 2017). The 2017 stock assessment also concluded that a variety of factors (e.g., bycatch, habitat loss, and ship strikes) continue to impede the recovery rate of Atlantic sturgeon (ASMFC 2017).

Table 7. Stock status determination for the coastwide stock and DPSs (from the ASMFC's Atlantic Sturgeon Stock Assessment Overview, October 2017).

	Mortality Status	Biomass/Abundance Status	
Population	Probability that $Z > Z_{50\%EPR}$ 80%	Relative to Historical Levels	Average probability of terminal year of indices > 1998* value
Coastwide	7%	Depleted	95%
Gulf of Maine	74%	Depleted	51%
New York Bight	31%	Depleted	75%
Chesapeake Bay	30%	Depleted	36%
Carolina	75%	Depleted	67%
South Atlantic	40%	Depleted	Unknown (no suitable indices)

*** For indices that started after 1998, the first year of the index was used as the reference value. EPR= Eggs Per Recruit.**

Despite the depleted status, the ASMFC assessment did include signs that the coastwide index is above the 1998 value (95% probability). The Gulf of Maine, New York Bight, and Carolina DPS indices also all had a greater than 50% chance of being above their 1998 value; however, the index from the Chesapeake Bay DPS (highlighted red) only had a 36% chance of being above the 1998 value. There were no representative indices for the South Atlantic DPS. Total mortality from the tagging model was very low at the coastwide level. Small sample sizes made mortality estimates at the DPS level more difficult. The New York Bight, Chesapeake Bay, and South Atlantic DPSs all had a less than 50% chance of having a mortality rate higher than the threshold. The Gulf of Maine and Carolina DPSs (highlighted red) had a 74-75% probability of being above the mortality threshold (ASMFC 2017).

In 2022, pursuant to Section 4(c)(2)(A) of the ESA, we published five-year reviews for the Gulf of Maine, New York Bight, and Chesapeake Bay DPSs of Atlantic sturgeon. As part of the five-year reviews, we are required to consider new information that has becoame available since each DPS of Atlantic sturgeon was listed in February 2012. In addition to previously available information, this Opinion includes updates from new information that has become available since the ESA-listing and critical habitat designations, and is considered the best available scientific information. The findings of the five-year reviews are included in our discussion below for each DPS. The complete five-year reviews for the three DPSs, isare available on our website at: https://www.fisheries.noaa.gov/action/5-year-review-new-york-bight-chesapeake-bay-and-gulf-maine-distinct-population-segments.

Critical Habitat

Critical habitat has been designated for the five DPSs of Atlantic sturgeon in certain rivers of the eastern U.S. (82 FR 39160, August 17, 2017). These areas are outside of the action area.

Recovery Goals

Recovery Plans have not yet been drafted for any of the Atlantic sturgeon DPSs. A recovery outline (see https://www.fisheries.noaa.gov/resource/document/recovery-outline-atlantic-sturgeon-distinct-population-segments) has been developed as interim guidance to direct recovery efforts, including recovery planning, until a full recovery plan is approved.

4.2.3.1 Gulf of Maine DPS of Atlantic Sturgeon

The Gulf of Maine DPS of Atlantic sturgeon includes Atlantic sturgeons spawned in the watersheds that drain into the Gulf of Maine from the Maine/Canadian border and extending southward to Chatham, Massachusetts. Within this range, Atlantic sturgeon historically spawned in the Penobscot, Kennebec, Androscoggin, Sheepscot, and Merrimack Rivers (ASSRT 2007). Spawning habitat is available and accessible in the Penobscot, Androscoggin, Kennebec, Merrimack, and Piscataqua (inclusive of Cocheco and Salmon Falls) Rivers. Spawning has been documented in the Kennebec River, and recent information from (Wippelhauser et al. 2017) confirms the location of occurrence (between RKM 70 and 75 (RM 43.5 and 46.6)). During this study, between 2009-2011, eight sturgeon, including one male in spawning condition, were also captured in the Androscoggin River estuary, which suggests that spawning may be occurring in the Androscoggin River as well (Wippelhauser et al. 2017). However, additional evidence, such as capture of a spawning female, sturgeon eggs or larvae, is not yet available to confirm that spawning for the Gulf of Maine DPS is occurring in that river. Studies are on-going to determine whether Atlantic sturgeon are spawning in the other rivers within the DPS, but as of now, nothing is confirmed.

Bigelow and Schroeder (2002) surmised that Atlantic sturgeon likely spawned in Gulf of Maine Rivers in May through July. More recent captures of Atlantic sturgeon in spawning condition within the Kennebec River suggest that spawning more likely occurs in June through July (ASMFC 1998; NMFS and U.S. FWS 1998; Wippelhauser et al. 2017). Evidence for the timing and location of Atlantic sturgeon spawning in the Kennebec River includes: (1) the capture of five adult male Atlantic sturgeon in spawning condition (i.e., expressing milt) in July 1994 below the (former) Edwards Dam; (2) capture of 31 adult Atlantic sturgeon from June 15, 1980, through July 26, 1980, in a small commercial fishery directed at Atlantic sturgeon from the South Gardiner area (above Merrymeeting Bay) that included at least four ripe males and one ripe female captured on July 26, 1980; (3) capture of nine adults during a gillnet survey conducted from 1977-1981, the majority of which were captured in July in the area from Merrymeeting Bay and upriver as far as Gardiner, Maine (NMFS and U.S. FWS 1998; ASMFC 2007); and (4) as mentioned above, the capture of three Atlantic sturgeon larvae between RKM 72 and RKM 75 (RM 44.7 and RM 46.6) in July 2011 (Wippelhauser et al. 2017). The low salinity values for waters above Merrymeeting Bay are consistent with values found in rivers where successful Atlantic sturgeon spawning is known to occur. Additionally, limited new information regarding spawning periodicity indicates that over a four-year period from 2010-2014, one fish was detected in three consecutive years on the Kennebec River spawning grounds. The majority of fish (12 out of 21) were only detected during one season (Wippelhauser et al. 2017). The data confirms variability in spawning periodicity.

Atlantic sturgeon that spawn elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT 2007). Additionally, Atlantic sturgeon that spawn in the Gulf of Maine DPS have been detected off of Delaware (Wirgin et al. 2015a; Kazyak et al. 2021) and as far south as Cape Hatteras. The movement of subadult and adult sturgeon between rivers, including to and from the Kennebec River and the Penobscot River, demonstrates that coastal and marine migrations are key elements of Atlantic sturgeon life history for the Gulf of Maine DPS as well as likely throughout the entire range (ASSRT 2007, Fernandes et al. 2010). The Saco River supports a large aggregation of Atlantic sturgeon that forage on sand lance in Saco Bay and within the first few kilometers of the Saco River, primarily from May through October. Some sturgeon also overwinter in Saco Bay (Little 2013; Hylton et al. 2018) which suggests that the river provides important wintering habitat as well, particularly for subadults. However, none of the new information indicates recolonization of the Saco River for spawning. It remains questionable whether sturgeon larvae could survive in the Saco River even if spawning were to occur because of the presence of the Cataract Dam at RKM 10 (RM 6.2) of the river (Little 2013), which limits access to the freshwater reach. Some sturgeon that spawn in the Kennebec have subsequently been detected foraging in the Saco River and Bay (Novak et al. 2017; Wippelhauser et al. 2017).

Data collected from 11 dead adult Atlantic sturgeon in the Bay of Fundy (seven individuals with age ranges from 17 to 28 years) further informs the DPS mixing that occurs throughout the marine range and in Canadian waters (Stewart et al. 2017). Dadswell et al. (2016) describes seasonal aggregations and movement (generally May through September) of Gulf of Maine DPS sturgeon in the Bay of Fundy. This information supports the 2012 listing rule's finding that 35% of Atlantic sturgeon captured in Canadian fisheries are of Gulf of Maine DPS origin (Wirgin et al. 2012).

Multiple threats play a role in shaping the current status of Gulf of Maine DPS Atlantic sturgeon. Historical records provide evidence of commercial fisheries for Atlantic sturgeon in the Kennebec and Androscoggin Rivers dating back to the 17^{th} century (Squiers et al. 1979). In 1849, 160 tons of sturgeon was caught in the Kennebec River by local fishermen (Squiers et al. 1979). Following the 1880s, the sturgeon fishery was almost non-existent due to a collapse of the sturgeon stocks. All directed Atlantic sturgeon fishing as well as retention of Atlantic sturgeon bycatch has been prohibited since 1998.

In the marine range, Gulf of Maine DPS Atlantic sturgeon are incidentally captured in federal and state-managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein et al. 2004a; ASMFC 2007). Incidentally caught Atlantic sturgeon in state-managed fisheries are reported to the ASMFC through voluntary reporting (ASMFC 2019), and in federally managed fisheries through the Northeast Fishery Management plans. There are strict regulations on the use of fishing gear in Maine state waters that incidentally catch sturgeon. In addition, there have been reductions in fishing effort in state and federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear (ASMFC 2007). Atlantic sturgeon from the Gulf of Maine DPS are not commonly taken as bycatch in areas south of Chatham, Massachusetts, with only 8% (e.g., 7 of 84 fish) of interactions observed in the New York region being assigned to the Gulf of Maine DPS (Wirgin and King 2011). Tagging results also indicate that Gulf of Maine DPS fish tend to remain within the waters of the Gulf of Maine and only occasionally venture to points south. However, data on Atlantic sturgeon incidentally caught in trawls and intertidal fish weirs fished in the Minas Basin area of the Bay of Fundy (Canada) indicate that approximately 35% originated from the Gulf of Maine DPS (Wirgin et al. 2012), as stated above. Thus, a significant number of the Gulf of Maine DPS fish appear to migrate north into Canadian waters where they may be subjected to a variety of threats including bycatch. Dadswell et al. (2016) describes characteristics of the seasonal aggregation of sturgeon in the Bay of Fundy. Dadswell et al. does not identify the natal origin of each of the 1,453 Atlantic sturgeon captured and sampled for their study. However, based on Wirgin et al. (2012) and Stewart et al. (2017), NMFS considers the results of Dadswell et al. as representative of the movement of the Gulf of Maine DPS of Atlantic sturgeon. Dadswell et al. determined subadult and adult Atlantic sturgeon occur seasonally (approximately May to September) in the Bay of Fundy for foraging, and many return in consecutive years. Fork length (FL) of the 1,453 sampled sturgeon ranged from 45.8 to 267 centimeters (18 to 105 inches), but the majority (72.5%) were less than 150 centimeters (59 inches) FL. The age of the sturgeon (i.e., 4 to 54 years old) is also indicative of the two different life stages. Detailed seasonal movements of sturgeon to and from the Bay of Fundy are described in Beardsall et al. (2016).

Habitat disturbance and direct mortality from anthropogenic sources are significant concerns to Atlantic sturgeon. Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Many rivers in the Gulf of Maine DPS have navigation channels that are maintained by dredging. Dredging outside of Federal channels and in-water construction occurs throughout the Gulf of Maine DPS. While some dredging projects operate with observers present to document fish mortalities, many do not. To date, we have not received any reports of Atlantic sturgeon killed during dredging projects in the Gulf of Maine region; however, as noted above, not all projects are monitored for interactions with fish. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects. We are also not able to quantify any consequences to habitat. However, studies by Reine et al. (2014) and Balazik et al. (2020) indicate that sturgeon are not attracted to dredge activity and that dredging (i.e., associated noise and turbidity) was not a barrier to passage, even though fish can become impinged or entrained in the dredging gear, itself.

Connectivity is disrupted by the presence of dams on some rivers in the Gulf of Maine region, including the Merrimack River. While there are also dams on the Kennebec and Androscoggin Rivers, these dams are near the site of natural falls and likely represent the maximum upstream extent of sturgeon occurrence even if the dams were not present. Because no Atlantic sturgeon are known to occur upstream of any hydroelectric projects in the Gulf of Maine region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. While not expected to be killed or injured during passage at the dam, the extent that Atlantic sturgeon are affected by the existence of dams and their operations in the Gulf of Maine region is currently unknown. The tracking of spawning condition Atlantic sturgeon downstream of the Brunswick Dam in the Androscoggin River suggests however, that Atlantic sturgeon spawning may be occurring in the vicinity of at least that project and therefore, may be affected by project operations. Until it was breached in July 2013, the range of Atlantic sturgeon in the Penobscot River was limited by the presence of the Veazie Dam. Since the removal of the Veazie Dam and the Great Works Dam, sturgeon can now travel as far upstream as the Milford Dam. Atlantic sturgeon primarily occur within the mesohaline reach of the river, particularly in areas with high densities of sturgeon prey which means that the Penobscot River is likely an important foraging area for Atlantic sturgeon belonging to the Gulf of Maine DPS (Altenritter et al. 2017). There is no current evidence that spawning is occurring in the Penobscot River. Acoustic tag detections suggest that the adults that forage in the Penobscot River travel to the Kennebec River to spawn (Altenritter et al. 2017). The Essex Dam on the Merrimack River blocks access to approximately 58% of historically accessible habitat in this river. Atlantic sturgeon occur in the Merrimack River but spawning has not been documented. Like the Penobscot, it is unknown how the Essex Dam affects the likelihood of spawning occurring in this river.

Gulf of Maine DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Gulf of Maine over the past decades (Lichter et al. 2006; EPA 2008). Many rivers in Maine, including the Androscoggin River, were heavily polluted in the past from industrial discharges from pulp and paper mills. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds, as developing eggs and larvae are particularly susceptible to exposure to contaminants.

The threat of vessel strike appears to be less for Atlantic sturgeon belonging to the Gulf of Maine DPS compared to the New York Bight or Chesapeake Bay DPSs based on the number of Atlantic sturgeon vessel struck carcasses that are found in Gulf of Maine rivers, and given the differences in vessel activity in the respective natal rivers. Nevertheless, some strikes do occur within the Gulf of Maine and sturgeon belonging to the Gulf of Maine can also be struck in other areas of their range including higher salinity waters of the Hudson River Estuary, Delaware River Estuary, and Chesapeake Bay.

We described in the listing rule that potential changes in water quality as a result of global climate change (temperature, salinity, dissolved oxygen, contaminants, etc.) in rivers and coastal waters inhabited by Atlantic sturgeon will likely affect riverine populations, and we expected these effects to be more severe for southern portions of the U.S. range. However, new information shows that the Gulf of Maine is one of the fastest warming areas of the world as a result of global climate change (Pershing et al. 2015; Brickman et al. 2021). Markin and Secor (2020) further demonstrate the consequences of temperature on the growth rate of juvenile Atlantic sturgeon, and informs how global climate change may impact growth and survival of Atlantic sturgeon across their range. Their study showed that all juvenile Atlantic sturgeon had increased growth rate with increased water temperature regardless of their genetic origins. However, based on modeling and water temperature data from 2008 to 2013, they also determined that there is an optimal water temperature range, above and below which juveniles experience a slower growth rate, and they further considered how changes in growth rate related to warming water temperatures associated with global climate change might affect juvenile survival given the season (e.g., spring or fall) in which spawning currently occurs.

There are no abundance estimates for the Gulf of Maine DPS or for the Kennebec River spawning population. Wippelhauser and Squiers (2015) reviewed the results of studies conducted in the Kennebec River System from 1977-2001. In total, 371 Atlantic sturgeon were captured, but the abundance of adult Atlantic sturgeon in the Kennebec spawning population could not be estimated because too few tagged fish were recaptured (i.e., 9 of 249 sturgeon).

Another method for assessing the number of spawning adults is through determinations of effective population size[5], which measures how many adults contributed to producing the next generation based on genetic determinations of parentage from the offspring. Effective population size is always less than the total abundance of a population because it is only a measure of parentage, and it is expected to be less than the total number of adults in a population because not all adults successfully reproduce. Measures of effective population size are also used to inform whether a population is at risk for loss of genetic diversity and inbreeding. The effective population size of the Gulf of Maine DPS was assessed in two studies based on sampling of adult Atlantic sturgeon captured in the Kennebec River in multiple years. The studies yielded very similar results which were an effective population size of: 63.4 (95% CI=47.3-91.1) (ASMFC 2017) and 67 (95% CI=52.0-89.1) (Waldman et al. 2019).

Summary of the Gulf of Maine DPS
Spawning for the Gulf of Maine DPS occurs in Kennebec and may occur Androscoggin and in other rivers, such as the Penobscot, but has not been confirmed. In the Stock Assessment, the Commission concluded that the abundance of the Gulf of Maine DPS is "depleted" relative to historical levels and there is a 51% probability that abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium (ASMFC 2017). The Commission also noted that the Gulf of Maine is particularly data poor among all five DPSs. Atlantic sturgeon continue to be present in the Kennebec River; in addition, they are captured in directed research projects in the Penobscot River, and are observed in rivers where they were unknown to occur or had not been observed to occur for many years (e.g., the Saco, Presumpscot, and Charles Rivers). The Saco River supports a large aggregation of Atlantic sturgeon that forage on sand lance in Saco Bay and within the first few kilometers of the Saco River, primarily from May through October with some overwintering as well (Little 2013; Hylton et al. 2018). However, none of the new information indicates recolonization of the Saco River for spawning.

Some of the impacts from the threats that contributed to the decline of the Gulf of Maine DPS have been removed (e.g., directed fishing), or reduced because of improvements in water quality and removal of dams (e.g., the Edwards Dam on the Kennebec River in 1999). There are strict regulations on the use of fishing gear in Maine state waters that incidentally catch sturgeon. In addition, there have been reductions in fishing effort in state and federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear

[5] Effective Population Size is the number of individuals that effectively participates in producing the next generation. See https://www.sciencedirect.com/topics/earth-and-planetary-sciences/effective-population-size. It is less than the total number of individuals in the population.

(ASMFC 2007). Atlantic sturgeon from the Gulf of Maine DPS are not commonly taken as bycatch in areas south of Chatham, Massachusetts, and tagging results indicate that Gulf of Maine DPS fish tend to remain within the waters of the Gulf of Maine and only occasionally venture to points south. However, data on Atlantic sturgeon incidentally caught in trawls and intertidal fish weirs fished in the Minas Basin area of the Bay of Fundy (Canada) indicate that approximately 35% originated from the Gulf of Maine DPS (Wirgin et al. 2012). Dadswell et al. (2016) describes characteristics of the seasonal aggregation of sturgeon in the Bay of Fundy and NMFS considers the results of Dadswell et al. as representative of the movement of the Gulf of Maine DPS of Atlantic sturgeon. Dadswell et al. determined subadult and adult Atlantic sturgeon occur seasonally (approximately May to September) in the Bay of Fundy for foraging, and many return in consecutive years.

As noted previously, studies have shown that in order to rebuild, Atlantic sturgeon can only sustain low levels of bycatch and other anthropogenic mortality (Boreman 1997; ASMFC 2007; Kahnle et al. 2007; Brown and Murphy 2010). We have determined that the Gulf of Maine DPS is at risk of becoming endangered in the foreseeable future throughout all of its range (i.e., is a threatened species) based on the following: (1) significant declines in population sizes and the protracted period during which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect recovery. We reviewed new information for the 5-Year Review that became available since the listing and we concluded that the status of the DPS has likely neither improved nor declined from what it was when the DPS was listed in 2012. We, therefore, continued to recommend classification for the Gulf of Maine DPS of Atlantic sturgeon as "threatened" (NMFS 2022a).

4.2.3.2 New York Bight DPS of Atlantic Sturgeon

The New York Bight DPS includes the following: all anadromous Atlantic sturgeon spawned in the watersheds that drain into coastal waters (including bays and sounds) from Chatham, Massachusetts to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (Murawski and Pacheco 1977; Secor et al. 2002; ASSRT 2007). Spawning still occurs in the Delaware and Hudson Rivers, but there is no recent evidence (within the last 15 years) of spawning in the Taunton River (ASSRT 2007). However, in 2014 new inconclusive information regarding potential Connecticut River spawning was received. Additionally, Atlantic sturgeon that are spawned elsewhere continue to use habitats within the Connecticut and Taunton Rivers as part of their overall marine range (ASSRT 2007; Savoy 2007; Wirgin and King 2011).

There is uncertainty related to trends in abundance for the New York Bight DPS (ASMFC 2017). The Commission concluded for their 2017 Atlantic Sturgeon Stock Assessment that abundance of the New York Bight DPS is "depleted" relative to historical levels but, there is a relatively high probability (75%) that the New York Bight DPS abundance has increased since the implementation of the 1998 fishing moratorium, and a 31% probability that mortality for the New York Bight DPS exceeds the mortality threshold used for the assessment (ASMFC 2017). Moreover, new information suggests that the Commission's conclusions primarily reflect the status and trend of only the DPS's Hudson River spawning population. The ASMFC did not estimate the abundance of the New York Bight DPS or otherwise quantify the trend in abundance because of the limited available information.

At this time, there are no overall abundance estimates for the entire New York Bight DPS. There are, however, some abundance estimates for specific life stages (e.g., natal juvenile abundance, spawning run abundance, and effective population size). In 1995, sampling crews on the Hudson River estimated that there were 9,500 juvenile Atlantic sturgeon in the estuary. Because 4,900 of these were stocked hatchery-raised fish, about 4,600 fish were of wild origin. Based on the juvenile assessments from Bain et al. (2000), the Hudson River suffered a series of recruitment failures, which triggered the ASMFC fishing moratorium in 1998 to allow the populations to recover. Based on commercial fishery landings from the mid-1980s to the mid-1990s, the total abundance of adult Hudson River Atlantic sturgeon was estimated to be 870 individuals (Kahnle et al. 2007). Using side scan sonar technology in conjunction with detections of previously tagged Atlantic sturgeon, Kazyak et al. (2020b) estimated the 2014 Hudson River spawning run size to be 466 sturgeon (95% CI = 310-745). While the spawning run estimate by Kazyak et al. (2020b) cannot be directly compared with the estimated total abundance of adults in the early 1990s to determine if adult abundance has changed since the fishery was closed, it is clear that adult abundance is still several magnitudes lower than historical abundances. There is evidence to support the notion that the Hudson River spawning population is more robust than the Delaware River spawning population. This is further supported by the fact that Atlantic sturgeon originating from the Hudson River spawning population are more prevalent in mixed aggregations than sturgeon originating from the Delaware River spawning population.

At the time of listing, catch-per-unit-effort (CPUE) data suggested that recruitment remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid-late 1980s (Sweka et al. 2007; ASMFC 2010). In examining the CPUE data from 1985-2007, there are significant fluctuations during this time. There appears to be a decline in the number of juveniles between the late 1980s and early 1990s while the CPUE is generally higher in the 2000s as compared to the 1990s. Given the significant annual fluctuation, it is difficult to discern any trend. Despite the CPUEs from 2000-2007 being generally higher than those from 1990-1999, they are low compared to the late 1980s. However, the New York State Department of Environmental Conservation (DEC) has conducted annual surveys for Atlantic sturgeon juveniles in the Hudson River since 2004. Recent analyses suggest that the catch rate of juvenile Atlantic sturgeon belonging to the Hudson River spawning population has increased, with double the average catch rate for the period from 2012-2019 compared to the previous eight years, from 2004-2011 (Pendleton and Adams 2021). Thus, the fishing moratorium may have resulted in an increase in recruitment of female spawners (and consequently number of juveniles produced) or the increase may have been because survival of early life stages and/or juveniles has increased (for unknown reasons) in the Hudson River since 2004.

White et al. (2022) recently estimated the number of adults (Ns) in the Delaware River that successfully reproduced in order to create a cohort of offspring by using genetic pedigrees constructed from progeny genotypes. Ns estimates the number of successful breeders and is not synonymous with effective population size (Ne) or effective number of breeders (Nb) as these metrics describe genetic processes (e.g., inbreeding and genetic drift; Jamieson and Allendorf 2012, Wang et al. 2016; Waldman et al. 2019). White et al. (2022, in press) estimated that Ns ranged from 42 (95% CI: 36-64) spawners in 2014 to 130 (95% CI: 116-138) spawners in 2017 during the years from 2013 to 2019. Because Ns only includes adults that generate at least one offspring during a single breeding season, it sets a lower bound on the size of the spawning run. Nevertheless, the genetics information indicates that at least 42 to 130 adults successfully contributed to the 2014- and 2017-year classes. White et al. (2022) concluded that bias in the data when sample size of offspring is small may result in the Ns being underestimated, as such, the Ns for Delaware River Atlantic sturgeon is likely between 125 and 250. Hale et al. (2016) estimated that 3,656 (95% CI = 1,935-33,041) early juveniles (age zero to one) utilized the Delaware River estuary as a nursery in 2014.

The effective population size (Ne) measures the genetic behavior (inbreeding and genetic drift) of a stable population with a 50/50 sex ratio, random mating, and equal reproductive success among individuals (i.e., an idealized population). Thus, the Ne is not a population estimate but is used in conservation biology as a measure of the population's short- or long-term viability. Since the Ne is based on an 'idealized' population, the actual population of reproductive individuals needed for a particular Ne will usually, but not always, be larger than Ne. However, there is a general relationship between the size of the census population and the size of Ne. White et al. (2021) found that the differences in estimated Ne between Atlantic sturgeon populations roughly corresponded to the differences in total population size. As such, the Hudson River has one of the largest estimates of Ne while the Delaware River has one of the smallest estimates. Based on genetic analyses of two different life stages, subadults and natal juveniles, Ne for the Hudson River population has been estimated to be 198 (95% CI=171.7-230.7; O'Leary et al. 2014) and 156 (95% CI=138.3-176.1; Waldman et al. 2019), respectively, while estimates for the Delaware River spawning population from the same studies are 108.7 (95% CI=74.7-186.1; O'Leary et al. 2014) and 40 (95% CI=34.7-46.2; Waldman et al. 2019), respectively. Genetic testing can differentiate between individuals originating from the Hudson or Delaware River and available information suggests that the straying rate is moderate between these rivers (Grunwald et al. 2008). However, the small sample size and the potential inclusion of non-natal fish in the samples may bias the calculations for the Delaware and Hudson Rivers (L. Lankshear, personal communication, April 2023).

The differences in estimated population size for the Hudson and Delaware River spawning populations and in Ne support the notion that the Hudson River spawning population is the more robust of the two spawning groups, although the White et al. (2021) study did not address the status of short and long term viability of either population. This trend is further supported by genetic analyses that demonstrates Atlantic sturgeon originating from the Hudson River spawning population were more prevalent in mixed aggregations than sturgeon originating from the Delaware River spawning population, even when sampling occurred in areas and at times that targeted adults belonging to the Delaware River spawning population (Wirgin et al. 2015a, 2018). The Waldman et al. (2019) calculations of maximum effective population size, and comparison of these to four other spawning populations outside of the New York Bight DPS further supports our previous conclusion that the Delaware River spawning population is less robust than the Hudson River, which is likely the most robust of all of the U.S. Atlantic sturgeon spawning populations.

New information from Breece et al. (2021) supports evidence of males having shorter spawning periodicity than females, but that females have more variability in the timing and number of spawning runs they make in the Hudson River. Salvage data from 2016 of a female Atlantic sturgeon in the Delaware River provided further support for the timing of spring spawning. Although the most recent Stock Assessment noted that movement of tagged fish and anecdotal reports suggest a fall spawning in the Delaware River; no further information is available to confirm whether it is occurring at this time.

In 2014, the Connecticut Department of Energy and Environmental Protection (CT DEEP) captured Atlantic sturgeon in the river that, based on their size, had to be less than one year old. Therefore, given the established life history patterns for Atlantic sturgeon which include remaining in lower salinity water of their natal river estuary for more than one year, the sturgeon were likely spawned in the Connecticut River. However, genetic analysis for 45 of the smallest fish (ranging from 22.5 to 64.0 centimeters (9 to 25 inches) TL) indicated that the sturgeon were most closely related to Atlantic sturgeon belonging to the South Atlantic DPS (Savoy et al. 2017). The conventional thinking is that the Connecticut River was most likely to be recolonized by Atlantic sturgeon from the Hudson River spawning population because: (1) it is the closest of the known spawning rivers to the Connecticut; the most robust of all of the spawning populations; and, (2) it occurs within the same, unique, ecological setting. Furthermore, the majority of the Atlantic sturgeon that aggregate in the Lower Connecticut River and Long Island Sound originate from the New York Bight DPS (primarily the Hudson River spawning population) whereas less than 10% originate from the South Atlantic DPS (Waldman et al. 2013). The genetic results for the juvenile sturgeon are, therefore, counter to prevailing information regarding straying and the affinity of Atlantic sturgeon for natal homing. The genetic analyses of the juvenile sturgeon also showed that many (i.e., 82%) were full siblings which means that relatively few adults contributed to this cohort. Based on the genetic analysis of the captured juveniles using the calculations utilized for the Hudson and Delaware Rivers, the effective population (Ne) size for the Connecticut River was estimated to be 2.4 sturgeon (Savoy et al. 2017). The CT DEEP is conducting a multiyear investigation to further inform the status and origin of Atlantic sturgeon spawning in the river. At this time, we are not able to conclude whether the juvenile sturgeon detected are indicative of sustained spawning in the river or whether they were the result of a single spawning event due to unique straying of the adults from the South Atlantic DPS's spawning rivers.

As previously mentioned, there is no abundance estimate for the New York Bight DPS. As such, for the purposes of ESA Section 7 consultations, we estimated adult and subadult abundance of the New York Bight DPS based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters (Damon-Randall et al. 2013, Kocik et al. 2013). We use the mixed stock marine analysis as a proxy for in river composition because we do not have a subadult and adult mixed stock analysis for in-river usage. Therefore, we define the subadult and adult abundance of the New York Bight DPS as 34,567 sturgeon. This number encompasses many age classes since subadults can be as young as one year old when they first enter the marine environment, and adults can live as long as 64 years (Balazik et al. 2012a, Hilton et al. 2016). For example, in their study of Atlantic sturgeon captured in the geographic New York Bight, Dunton et al. (2016) determined that 742 of the Atlantic sturgeon captured represented 21 estimated age classes and that, individually, the sturgeon ranged in age from 2 to 35 years old.

A number of threats to Atlantic sturgeon exist in marine waters including bycatch in fishing gear. Atlantic sturgeon bycatch in fisheries authorized under Northeast FMPs is estimated to be 4% of adults. As presented in the mixed stock analysis results by Wirgin and King (2011), over 40% of the Atlantic sturgeon bycatch interactions in the Mid-Atlantic Bight region were sturgeon from the New York Bight DPS. In addition to capture in fisheries operating in federal waters, bycatch and mortality also occur in state fisheries; however, the primary fishery that impacted juvenile sturgeon (shad) in the Hudson River, has now been closed and there is no indication that it will reopen soon. Commercial shad fishery continues in the Delaware Bay but is closed in the Delaware River. In the Hudson River, sources of potential mortality include vessel strikes and entrainment in dredges. Impingement at water intakes, including the Danskammer, Roseton, Indian Point, Salem, and Hope Creek (on the Delaware river) power plants also occurs. Recent information from surveys of juveniles indicates that the number of young Atlantic sturgeon in the Hudson River is increasing compared to recent years, but is still low compared to the 1970s. There is currently not enough information regarding any life stage to establish a trend for the entire Hudson River population.

Several additional threats play a role in shaping the current status and trends observed in the Delaware River and Estuary. In-river threats include habitat disturbance from dredging, and impacts from historical pollution and impaired water quality, and climate change (Lichter et al. 2006; EPA 2008). Both the Hudson and Delaware rivers, as well as other rivers in the New York Bight region, were heavily polluted in the past from industrial and sanitary sewer discharges. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds, as developing eggs and larvae are particularly susceptible to contaminant exposure. Annual differences in the capture rates of age 0-1 Atlantic sturgeon in the fall and comparisons to annual dissolved oxygen levels during the preceding summer months provide additional evidence that low dissolved oxygen levels are causing or contributing to the death of the young sturgeon in the Delaware River in some years (Stetzar et al. 2015; Moberg and DeLucia 2016; Park 2020). On December 1, 2022, the EPA issued a determination that revised Water Quality Standards are necessary for the Delaware River Estuary to meet the requirements of the Clean Water Act. Specifically, the EPA determined that the aquatic life designated uses and corresponding dissolved oxygen criterion in Zones 3, 4, and RKM 126.8 to 112.7 (RM 78.8 to 70.0) of Zone 5 of the Delaware River Estuary must be revised to protect the propagation of resident and migratory fish species, including Atlantic and shortnose sturgeon, which are likely experiencing adverse effects under the currently applicable Water Quality Standards that were established in 1967.

On the Delaware River, a dredged navigation channel extends from Trenton seaward through the tidal river (Brundage and O'Herron 2009), and the river receives significant shipping traffic. A dredged navigation channel is present in the Hudson River as well. Although dredging occurs regularly, some projects have observers and some do not. At this time, we have reports of one Atlantic sturgeon entrained during hopper dredging operations in Ambrose Channel, New Jersey, and four fish were entrained in the Delaware River during maintenance and deepening activities in 2017 and 2018. Modeling by Breece et al. (2013) demonstrates that the Delaware River salt front is likely to advance even further upriver with climate change, which would reduce the amount of transitional salinity habitat available to natal juveniles, and individuals using the aforementioned habitat for specific behaviors. Coupled with other climate and anthropogenic changes, such as drought and channel deepening, the already limited amount of tidal freshwater habitat available for spawning could be reduced and the occurrence of low dissolved oxygen within early juvenile rearing habitat could increase.

Vessel strikes have been identified as a major threat in the Hudson and Delaware Rivers for migrating sturgeon and individuals aggregating on limited spawning or overwintering grounds. Vessel strikes occur in the Delaware River and Bay. One-hundred and three (103) Atlantic sturgeon mortalities believed to be the result of vessel strikes were documented in the Delaware River from 2005 to 2019, and at least 65 of these fish were large adults and subadults (data provided by DNREC, 2020). Based on evidence of Atlantic sturgeon vessel strikes since the listing, it is now apparent that vessel strikes are also occurring in the Hudson River. For example, the New York Department of Environmental Conservation (DEC) reported that at least 17 dead Atlantic sturgeon with vessel strike injuries were found in the river in 2019 of which at least 10 were adults. Additionally, 108 Atlantic sturgeon carcasses were observed on the Hudson River and reported to the NYSDEC between 2013 and 2017. Of these, 71 were suspected of having been killed by vessel strike (NMFS 2019a). Genetic analysis has not been completed on any of these individuals to date, given that the majority of Atlantic sturgeon in the Hudson River belong to the New York Bight DPS, we assume that the majority of the dead sturgeon reported to NYSDEC belonged to the New York Bight DPS. Given the time of year in which the fish were observed (predominantly May through July), it is likely that many of the adults were migrating through the river to the spawning grounds.

Based on genetic analyses, Atlantic sturgeon belonging to the New York Bight DPS have been identified among those captured in the Bay of Fundy, Canada as well as in U.S. waters that include Long Island Sound, the lower Connecticut River, and in marine waters off of western Long Island, New Jersey, Delaware, Virginia, and North Carolina. However, the New York Bight DPS was more prevalent relative to the other DPSs in Mid-Atlantic marine waters, bays, and sounds (Dunton et al. 2012, 2019; Waldman et al. 2013; Wirgin et al. 2015b, 2018). These findings support the conclusion of Wirgin et al. (2015a) that natal origin influences the distribution of Atlantic sturgeon in the marine environment, and suggest that some parts of its marine range are more useful to and perhaps essential to the New York Bight DPS.

Further evidence was presented by Erickson et al. (2011). Thirteen of the fifteen adult Atlantic sturgeon, that they captured and tagged in the tidal freshwater reach of the Hudson River (i.e., belonging to the Hudson River spawning population), remained in the Mid-Atlantic Bight during the 6 months to one year time period of data collection. Of the remaining two fish, one traveled as far north as Canadian waters where its tag popped up in June, nearly one year after being tagged. The second fish traveled south beyond Cape Hatteras[6] before its tag popped up, about 7 months after being tagged. Collectively, all of the tagged sturgeon occurred in marine and estuarine Mid-Atlantic Bight aggregation areas that have been the subject of sampling used for

[6] As explained in Erickson et al. (2011), relocation data for both of these fish were more limited for different reasons. Therefore, more exact locations could not be determined.

the genetic analyses, including in waters off Long Island, the coasts of New Jersey and Delaware, the Delaware Bay and the Chesapeake Bay.

Breece et al. (2016) further investigated the distribution and occurrence of Atlantic sturgeon in the Mid-Atlantic Bight based on associated habitat features, as well as the habitat features associated with presence of adults in the Delaware River, and their distribution and movements within Delaware Bay. The research provides evidence of specific, dynamic habitat features that Atlantic sturgeon are sensitive to in their aquatic environments such as substrate composition and distance from the salt front in the river estuary, water depth and water temperature in Delaware Bay, and depth, day-of-year, sea surface temperature, and light absorption by seawater in marine waters (Breece et al. 2013, 2017, 2018). Their model, based on the features identified for the marine environment, was highly predictive of Atlantic sturgeon distribution in the Mid-Atlantic Bight from mid-April through October. Since the majority of Atlantic sturgeon occurring in the Mid-Atlantic Bight belong to the New York Bight DPS, these studies provide: (1) new information describing the environmental factors that influence the presence and movements of New York Bight DPS Atlantic sturgeon in the Mid-Atlantic Bight, the Delaware Bay and the Delaware River; (2) a modeling approach for predicting occurrence and distribution of New York Bight DPS Atlantic sturgeon, particularly in the spring through early fall; and, (3) information to better assess consequences to the New York Bight DPS given known, expected, or predicted changes to their habitat.

Summary of the New York Bight DPS

Atlantic sturgeon originating from the New York Bight DPS spawn in the Hudson and Delaware rivers. While genetic testing can differentiate between individuals originating from the Hudson or Delaware River, White et al. (2021) found that their genetic analysis could not distinguish Delaware River Atlantic sturgeon from Hudson River Atlantic sturgeon as clearly as they could distinguish Atlantic sturgeon from other rivers included in the study. This more recent study reinforces the findings of Grunwald et al. (2008) that there is moderate straying between river systems, which further supports the single DPS represented in the New York Bight.

There is uncertainty related to trends in abundance for the New York Bight DPS (ASMFC 2017). The 2017 ASMFC Atlantic Sturgeon Stock Assessment states that the abundance of the New York Bight DPS is “depleted” relative to historical levels, but there is a relatively high probability (75%) that the New York Bight DPS abundance has increased since the implementation of the 1998 fishing moratorium. However, new information suggests that these conclusions primarily reflect the status and trend of only the Hudson River spawning population (NMFS 2022b). Some of the impacts from the threats that contributed to the decline of the New York Bight DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). In addition, there have been reductions in fishing effort in state and federal waters, which may result in a reduction in bycatch mortality of Atlantic sturgeon. Nevertheless, areas with persistent, degraded water quality, habitat impacts from dredging, global climate change, continued bycatch in state and federally-managed fisheries, and vessel strikes remain significant threats to the New York Bight DPS.

Additional information is available that informs the consequences of climate change on the New York Bight DPS. There is already evidence of habitat changes in the Delaware River from other anthropogenic activities. Modeling by Breece et al. (2013) demonstrates that the Delaware River salt front is likely to advance even further upriver with climate change, which would reduce the amount of transitional salinity habitat available to natal juveniles and would potentially restrict habitat for other necessary behaviors. With already limited tidal freshwater habitat available for spawning, habitat could be further reduced and the occurrence of low dissolved oxygen within early juvenile rearing habitat could increase. As evidenced by the studies of Hare et al. (2016) and Balazik et al. (2010), the Delaware spawning population is unlikely to redistribute to another river even if their habitat in the Delaware River is increasingly insufficient to support successful spawning and rearing for the New York Bight DPS due to climate change.

In the marine range, New York Bight DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein et al. 2004b; ASMFC 2007). For Atlantic sturgeon, the model-based estimates of annual bycatch in gillnet and bottom trawl gear published in ASMFC (2017) represent the best available information for and analysis of bycatch. From 2011-2015, the average annual bycatch of Atlantic sturgeon in bottom otter trawl gear was 777.4 sturgeon under the best fit model. From 2011-2015, the average annual bycatch of Atlantic sturgeon in gillnet gear was 627.6 sturgeon under best fit model (ASMFC 2017).

The best performing model for each gear type was applied to Vessel Trip Reports (VTRs) to predict Atlantic sturgeon bycatch across all trips. The total bycatch of Atlantic sturgeon from bottom otter trawls ranged between 624-1,518 fish over the 2000-2015 time series. The proportion of the encountered Atlantic sturgeon recorded as dead ranged from 0-18% (average 4%). This resulted in annual dead discards ranging from 0-209 fish. The total bycatch of Atlantic sturgeon from gillnets ranged from 253-2,715 fish. The proportion of Atlantic sturgeon recorded as dead ranged from 12-51% (average 30%), resulting in annual dead discards ranging from 110-690 fish. Otter trawls and gillnets caught similar sizes of Atlantic sturgeon, with most fish in the 3.3-6.6 feet (100-200 centimeters) total length range, although both larger and smaller individuals were captured. Wirgin and King (2011), indicates that over 40% of the Atlantic sturgeon bycatch interactions in the Mid-Atlantic Bight region were sturgeon from the New York Bight DPS. Individual-based assignment and mixed stock analysis of samples collected from sturgeon captured in Canadian fisheries in the Bay of Fundy indicated that approximately 1-2% were from the New York Bight DPS (Wirgin et al. 2012). At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats.

In May 2023, the NEFSC released an updated set of Atlantic sturgeon bycatch estimates for the time period of 2000-2021. Atlantic sturgeon bycatch estimates for Northeast gillnet and trawl gear from the most recent five-year period of 2016-2021, excluding 2020 due to COVID-19 impacts to data collection, were approximately 1,126 fish per year for gillnets (327 mortalities) and 719 for trawls (19 mortalities). This estimate was produced using the same methods as previous NEFSC analyses (Miller and Shepherd 2011; ASMFC 2017). The bycatch estimates for gillnet gear are significantly higher than those for the previous five-year period of 2011-2015.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and altering the benthic forage base. Both the Hudson and Delaware rivers have navigation channels that are maintained by dredging. Dredging is also used to maintain channels in the nearshore marine environment. Dredging outside of Federal channels and in-water construction occurs throughout the New York Bight region. While some dredging projects operate with observers present to document fish mortalities, many do not. We have reports of one Atlantic sturgeon entrained during hopper dredging operations in Ambrose Channel, New Jersey, and four fish were entrained in the Delaware River during maintenance and deepening activities in 2017 and 2018. At this time, we do not have any additional information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects. We are also not able to quantify any consequences to habitat.

In the Hudson and Delaware Rivers, dams do not block access to historical habitat. The Holyoke Dam on the Connecticut River blocks further upstream passage; however, the extent that Atlantic sturgeon would historically have used habitat upstream of Holyoke is unknown. Connectivity may be disrupted by the presence of dams on several smaller rivers in the New York Bight region. Because no Atlantic sturgeon occur upstream of any hydroelectric projects in the New York Bight region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area.

New York Bight DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Hudson and Delaware over the past decades (Lichter et al. 2006; EPA 2008). With improved water quality and toxic discharges limited through regulations, reduced in-water pollutants may be less of a concern, but legacy pollutants may exist long term in the benthic environment. When pollutants are present on spawning and nursery grounds, where sensitive life stages occur, there is potential for long-term impacts to developing individuals.

Vessel strikes occur in the Delaware River and Bay, and many mortalities have been identified as large adults and subadults. The New York DEC has also reported that dead Atlantic sturgeon with vessel strike injuries in the river in 2019, confirming that vessel strikes are also an issue on the Hudson River. Given the time of year in which the fish were observed (predominantly May through July), it is likely that many of the adults were migrating through the river to the spawning grounds, and are assumed to be of New York Bight DPS origin.

Studies have shown that to rebuild, Atlantic sturgeon can only sustain low levels of anthropogenic mortality (Boreman 1997; ASMFC 2007; Kahnle et al. 2007; Brown et al. 2012). There are no empirical abundance estimates of the number of Atlantic sturgeon in the New York Bight DPS. For the listing of the New York Bight DPS, we determined that the DPS is currently at risk of extinction due to: (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and (3) the impacts and threats that have, and will continue to affect population recovery (77 FR 5880, February 6, 2012). We reviewed new information for the 5-Year Review that became available since the listing and we concluded that the status of the DPS has likely neither improved nor declined from what it was when the DPS was listed in 2012. We, therefore, continued to recommend classification for the New York Bight DPS of Atlantic sturgeon as "endangered" (NMFS 2022b).

4.2.3.3 Chesapeake Bay DPS of Atlantic Sturgeon

The Chesapeake Bay DPS of Atlantic sturgeon includes Atlantic sturgeon spawned in the watersheds that drain into the Chesapeake Bay and into coastal waters (including bays and sounds) from the Delaware-Maryland border at Fenwick Island to Cape Henry, Virginia. The marine range of Atlantic sturgeon from the Chesapeake Bay DPS extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. Recent data confirms that Chesapeake Bay Atlantic sturgeon are most prevalent in the marine environment throughout the Mid-Atlantic Bight from Delaware to Cape Hatteras (Kazyak et al. 2021). The riverine range of the Chesapeake Bay DPS and the adjacent portion of the marine range are shown in Figure 13. Within this range, Atlantic sturgeon historically spawned in the Susquehanna, Potomac, James, York, Rappahannock, and Nottoway Rivers (ASSRT 2007). Based on the review by Oakley (2003), 100% of Atlantic sturgeon habitat is currently accessible in these rivers since most of the barriers to passage (i.e., dams) are located upriver of where spawning is expected to have historically occurred (ASSRT 2007). Spawning still occurs in the James River, amongst the additional spawning populations for the Chesapeake Bay DPS, and there is evidence that most of the Chesapeake Bay DPS spawning populations spawn in the late summer to fall (hereafter referred to as "fall spawning") rather than in the spring. Fall spawning activity has been documented in the newly discovered spawning populations in the Pamunkey River, a tributary of the York River, and in Marshyhope Creek, a tributary of the Nanticoke River (Hager et al. 2014; Richardson and Secor 2016; Secor et al. 2022). The James River is currently the only river of the Chesapeake Bay DPS where evidence suggests there is both spring and fall spawning with separate spawning populations. The results of genetic analyses show that there is some limited gene flow between the populations but, overall, the spawning populations are genetically distinct (Balazik et al. 2012a, 2017; Balazik and Musick 2015). New detections of acoustically-tagged adult Atlantic sturgeon along with historical evidence suggests that Atlantic sturgeon belonging to the Chesapeake Bay DPS may be spawning in the Mattaponi and Rappahannock rivers as well (Hilton et al. 2016, ASMFC 2017, Kahn 2019). However, information for these populations is limited and the research is ongoing.

Age to maturity for Chesapeake Bay DPS Atlantic sturgeon is unknown. However, Atlantic sturgeon riverine populations exhibit clinal variation with faster growth and earlier age to maturity for those that originate from southern waters, and slower growth and later age to maturity for those that originate from northern waters (75 FR 61872; October 6, 2010). Age at maturity is five to 19 years for Atlantic sturgeon originating from South Carolina rivers (Smith et al. 1982) and 11 to 21 years for Atlantic sturgeon originating from the Hudson River (Young et al. 1988). Recent data indicates that Chesapeake Bay DPS juvenile Atlantic sturgeon remain in the natal estuary between one and four years before emigrating to the marine environment (Balazik et al. 2012b), and that males mature at about age 10 and females at age 15 (Balazik et al. 2012b; Hilton et al. 2016). New information regarding spawning periodicity is supported by the fact that acoustically-tagged males have made annual returns to spawning locations. Tagged females have returned approximately every two to three years, with some returning annually (Balazik et al. 2017; Kahn et al. 2019, 2021; Secor et al. 2022). Additionally, Kahn et al. (2021)

used detections of tagged male and female sturgeon to inform the sex ratio in the Pamunkey River spawning population (males make up approximately 51% (95% CI=0.43-0.58 of the adult population).

There is currently no total abundance estimate for the Chesapeake Bay DPS; however, we estimated subadult and adult abundance in marine waters and concluded that approximately 8,811 sturgeon comprise the DPS (Kocik et al. 2013). There are also several estimates of effective population size for Atlantic sturgeon that are spawned in the James River although only one study examined the effective population size of both the spring and fall spawning populations. Nevertheless, the estimates of effective population size from separate studies and based on different age classes are similar. These are: 62.1 (95% CI=44.3-97.2) based on sampling of subadults captured off of Long Island across multiple years; 32 (95% CI=28.8-35.5) based on sampling of natal juveniles and adults in multiple years (Waldman et al. 2019); 40.9 (95% CI=35.6-46.9) based on samples from a combination of juveniles and adults (ASMFC 2019); and 44 (95% CI=26-79) and 46 (95% CI=32-71) for the spring and fall spawning populations, respectively, based on sampling of adults (Balazik et al. 2017). There is a single estimate of 12.2 (95% CI = 6.7-21.9) for the Nanticoke River system (Secor et al. 2022), and also a single estimate of 7.8 (95% CI=5.3-10.2) for the York River system based on samples from adults captured in the Pamunkey River (ASMFC 2017).

Based on research captures of tagged adults, an estimated 75 Chesapeake Bay DPS Atlantic sturgeon spawned in the Pamunkey River in 2013 (Kahn et al. 2014). More recent information provided annual run estimates for the Pamunkey River from 2013 to 2018. The results suggest a spawning run of up to 222 adults but with yearly variability, likely due to spawning periodicity (Kahn 2019).

Research in the Nanticoke River system suggests a small adult population based on a small total number of captures (i.e., 26 sturgeon) and the high rate of recapture across several years of study (Secor et al. 2022). By comparison, 373 different adult-sized Atlantic sturgeon (i.e., total count does not include recaptures of the same fish) were captured in the James River from 2009 through spring 2014 (Balazik and Musick 2015). This is a minimum count of the number of adult Atlantic sturgeon in the James River during the time period because capture efforts did not occur in all areas and at all times when Atlantic sturgeon were present in the river.

New information regarding the importance of temperature on spawning and movement of sturgeon indicates that a relatively narrow temperature range (20°C to 25°C (68°F to 77°F)) triggers spawning, (Balazik et al. 2012a, 2020; Hager et al. 2020; Secor et al. 2022), and new research has also demonstrated that limited hard-bottom habitat for Atlantic sturgeon spawning activities exist in Chesapeake Bay tributaries (Austin 2012; Bruce et al. 2016; Secor et al. 2022). Further informing potential spawning locations is research regarding the upriver range of the species based on detections of tagged adult Atlantic sturgeon (Hager et al. 2014; NMFS 2017a; Balazik et al. 2021; Secor et al. 2022), which supports the notion that available, suitable spawning habitat is sparse.

Several threats play a role in shaping the current status of Chesapeake Bay DPS Atlantic sturgeon. Historical records provide evidence of the large-scale commercial exploitation of

Atlantic sturgeon from the James River and Chesapeake Bay in the 19th century (Hildebrand and Schroeder 1928; Vladykov and Greeley 1963; ASMFC 1998; Secor et al. 2002; Bushnoe et al. 2005; ASSRT 2007) as well as subsistence fishing and attempts at commercial fisheries as early as the 17th century (Secor et al. 2002; Bushnoe et al. 2005; ASSRT 2007, Balazik et al. 2010). Habitat disturbance caused by in-river work, such as dredging for navigational purposes, is thought to have reduced available spawning habitat in the James River (Holton and Walsh 1995; Bushnoe et al. 2005; ASSRT 2007). At this time, we do not have information to quantify this loss of spawning habitat.

Decreased water quality also threatens Atlantic sturgeon of the Chesapeake Bay DPS, especially since the Chesapeake Bay system is vulnerable to the consequences of nutrient enrichment due to a relatively low tidal exchange and flushing rate, large surface-to-volume ratio, and strong stratification during the spring and summer months (ASMFC 1998; Pyzik et al. 2004; ASSRT 2007; EPA 2008). These conditions contribute to reductions in dissolved oxygen levels throughout the Bay. The availability of nursery habitat, in particular, may be limited given the recurrent hypoxia (low dissolved oxygen) conditions within the Bay (Niklitschek and Secor 2005, 2010). Heavy industrial development during the 20th century in rivers inhabited by sturgeon impaired water quality and impeded these species' recovery.

Although there have been improvements in some areas of the Bay's health, the ecosystem remains in poor condition. In 2022, the Chesapeake Bay Foundation gave the overall health index of the Bay a grade of 32% (D+) based on the best available information about the Chesapeake Bay for indicators representing three major categories: pollution, habitat, and fisheries (Chesapeake Bay Foundation 2022). The score remained unchanged from 2020; however, of the 13 indicators assessed, three improved, three declined, and seven stayed the same. While 32% is one percent lower than the state of the Bay score in 2018, this was an 18.5% increase from the first State of the Bay report in 1998, which gave the Bay a score of 27% (D). According to the Chesapeake Bay Foundation, the unchanged score is largely a result of failures to make needed changes on farmland to reduce pollution, but noted improvements due to the promising results from oyster reef restoration, regulations allowing the striped bass population to rebuild by 2029, less phosphorous in the water and a smaller dead zone. Highlights from the 2022 report are summarized below:

- Monitoring data indicated that the 2022 dead zone was the tenth smallest in the past 38 years;
- Water clarity dropped one point in the report due to average water clarity in the Bay decreasing slightly in 2022 compared to 2020;
- In the pollution category nitrogen, toxics, and dissolved oxygen indicators were unchanged, the phosphorus indicator improved, and overall water clarity declined. Recent farm conservation funding at the federal and state levels should help reduce nitrogen and phosphorus pollution, which fuels harmful algal blooms that remove dissolved oxygen from the water;
- In the fisheries category, the rockfish (striped bass) and oyster indicators rose, while the blue crab indicator declined (Chesapeake Bay Foundation 2022); and
- In the habitat category, scores for underwater grasses, forest buffers, and wetlands remained unchanged, but resource lands fell slightly by a point. Resource lands refer to forests, natural open areas, and well-managed farmland. The drop in score was largely

due to approximately 95,000 acres of farms and forests transitioning to development across the Bay watershed during the most recent reporting period, from 2013/14 to 2017/18.

At this time, we do not have sufficient information to quantify the extent that degraded water quality affects habitat or individuals in the James River or throughout the Chesapeake Bay.

Vessel strikes have been observed in the James River (ASSRT 2007). Eleven Atlantic sturgeon were reported to have been struck by vessels from 2005-2007. More than 100 Atlantic sturgeon carcasses have been salvaged in the James River since 2007 and additional carcasses were reported but could not be salvaged (Greenlee et al. 2019). Many of the salvaged carcasses had evidence of a fatal vessel strike. In addition, vessel struck Atlantic sturgeon have been found in other parts of the Chesapeake Bay DPS's range including in the York and Nanticoke river estuaries, within Chesapeake Bay, and in marine waters near the mouth of the Bay since the DPS was listed as endangered (NMFS Sturgeon Salvage Permit Reporting; Secor et al. 2022). The best available information supports the conclusion that sturgeon are struck by small (e.g., recreational) as well as large vessels. NMFS has only minimum counts of the number of Atlantic sturgeon that are struck and killed by vessels because only the sturgeon that are found dead with evidence of a vessel strike are counted. New research, including a study conducted along the Delaware River that intentionally placed Atlantic sturgeon carcasses in areas used by the public, suggests that most Atlantic sturgeon carcasses are not found and, when found, many are not reported to NMFS or to our sturgeon salvage co-investigators (Balazik, pers. comm. in ASMFC 2017; Balazik et al. 2012a; Fox et al. 2020). There has been an increased number of vessel struck sturgeon reported in the James River in recent years (ASMFC 2017). However, it is unknown to what extent the numbers reflect increased carcass reporting.

In the marine and coastal range of the Chesapeake Bay DPS from Canada to Florida, fisheries bycatch in federally and state-managed fisheries poses a threat to the DPS, reducing survivorship of subadults and adults and potentially causing an overall reduction in the spawning population (Stein et al. 2004b; ASMFC 2007).

Summary of the Chesapeake Bay DPS

There are no overall abundance estimates for the entire Chesapeake Bay DPS or for the spawning populations in the James River or the Nanticoke River system; however, estimates from the marine environment and effective population size are available. A study on effective population size for Atlantic sturgeon that are spawned in the James River examined the effective population size of both the spring and fall spawning populations, whereas in other rivers, only the fall pawning run was considered.

At this time, spawning for the Chesapeake Bay DPS is known to occur in only the James and Pamunkey Rivers and in the Nanticoke River system. Spawning may be occurring in other rivers, such as the Mattaponi, Rappahannock, and Potomac, but has not been confirmed for any of those. There are anecdotal reports of increased sightings and captures of Atlantic sturgeon in the James River. However, this information has not been comprehensive enough to develop a population estimate for the James River or to provide sufficient evidence to confirm increased abundance.

Based on research captures of tagged adults, an estimated 75 Chesapeake Bay DPS Atlantic sturgeon spawned in the Pamunkey River in 2013 (Kahn et al. 2014). The results suggest a spawning run of up to 222 adults but with yearly variability, likely due to spawning periodicity (Kahn 2019). Research in the Nanticoke River system suggests a small adult population based on a small total number of captures (i.e., 26 sturgeon) and the high rate of recapture across several years of study (Secor et al. 2022). By comparison, 373 different adult-sized Atlantic sturgeon (i.e., total count does not include recaptures of the same fish) were captured in the James River from 2009 through spring 2014 (Balazik and Musick 2015).

Some of the impacts from the threats that facilitated the decline of the Chesapeake Bay DPS have been removed (e.g., directed fishing) or reduced because of improvements in water quality since passage of the CWA. Areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in U.S. state and federally-managed fisheries, Canadian fisheries, and vessel strikes remain significant threats to the Chesapeake Bay DPS of Atlantic sturgeon. Of the 35% of Atlantic sturgeon incidentally caught in the Bay of Fundy, about 1% were Chesapeake Bay DPS fish (Wirgin et al. 2012). Studies have shown that Atlantic sturgeon can only sustain low levels of bycatch mortality (Boreman 1997; ASMFC 2007; Kahnle et al. 2007). The Chesapeake Bay DPS is currently at risk of extinction given (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect the potential for population recovery. We reviewed new information for the 5-Year Review that became available since the listing and we concluded that the status of the DPS has likely neither improved nor declined from what it was when the DPS was listed in 2012. We, therefore, continued to recommend classification for the Chesapeake Bay DPS of Atlantic sturgeon as “endangered” (NMFS 2022c).

4.2.3.4 Carolina DPS of Atlantic Sturgeon

The Carolina DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) from Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. The marine range of Atlantic sturgeon from the Carolina DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the Carolina DPS and the adjacent portion of the marine range are shown in Figure 13. Sturgeon are commonly captured 64.4 kilometers (40 miles) offshore (D. Fox, Delaware State University, pers. comm.). Records providing fishery bycatch data by depth show the vast majority of Atlantic sturgeon bycatch via gillnets is observed in waters less than 50 meters (164 feet) deep (Stein et al. 2004a; ASMFC 2007), but Atlantic sturgeon are recorded as bycatch out to 500 fathoms.

Rivers known to have current spawning populations within the range of the Carolina DPS include the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, and Pee Dee Rivers. We determined spawning was occurring if young-of-the-year were observed or mature adults were present in freshwater portions of a system (Table 8). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. There may also be spawning populations in the Neuse, Santee, and Cooper Rivers, though it is uncertain. Historically, both the Sampit and Ashley Rivers were documented to have spawning populations at one time. However, the spawning population in the Sampit River is believed to be extirpated, and the current status of the spawning population in the Ashley River is unknown. Both rivers may be used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. Fish from the Carolina DPS likely use other river systems than those listed here for their specific life functions.

Table 8. Major rivers, tributaries, and sounds within the ranges of the Carolina DPS and currently available data on the presence of Atlantic sturgeon spawning population in each system.

River/Estuary	Spawning Population	Data
Roanoke River, VA/NC; Albemarle Sound, NC	Yes	collection of 15 YOY (1997-1998); single YOY (2005)
Tar-Pamlico River, NC; Pamlico Sound	Yes	one YOY (2005)
Neuse River, NC; Pamlico Sound	Unknown	
Cape Fear River, NC	Yes	upstream migration of adults in the fall, carcass of a ripe female upstream in mid-September (2006)
Waccamaw River, SC; Winyah Bay	Yes	age-1, potentially YOY (1980s)
Pee Dee River, SC; Winyah Bay	Yes	running ripe male in Great Pee Dee River (2003)
Sampit, SC; Winyah Bay	Extirpated	
Santee River, SC	Unknown	
Cooper River, SC	Unknown	
Ashley River, SC	Unknown	

Historical landings data indicate that between 7,000 and 10,500 adult female Atlantic sturgeon were present in North Carolina prior to 1890 (Armstrong and Hightower 2002, Secor et al. 2002). Secor et al. (2002) estimates that 8,000 adult females were present in South Carolina during that same time frame. Prior reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the Carolina DPS. Currently, the Atlantic sturgeon spawning population in at least one river system within the Carolina DPS has been extirpated, with potential extirpation in an additional system. The abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, are estimated to be less than 3% of what they were historically (ASSRT 2007). We have estimated that there are a minimum of 1,356 Carolina DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters (Kocik et al. 2013).

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast in the mid- to late 19th century, from which they have never rebounded. Continued bycatch of Atlantic sturgeon in commercial fisheries is an ongoing impact to the Carolina DPS. More robust fishery independent data on bycatch are available for the Northeast and Mid-Atlantic than in the Southeast where high levels of bycatch underreporting are suspected.

Although there are statutory and regulatory provisions that authorize reducing the impact of dams on riverine and anadromous species, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Water quality continues to be a problem in the Carolina DPS, even with existing controls on some pollution sources. Current regulatory regimes are not effective in controlling water allocation issues (e.g., no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution, etc.).

Summary of the Status of the Carolina DPS of Atlantic Sturgeon
Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. Their late age at maturity provides more opportunities for individuals to be removed from the population before reproducing. While a long life-span also allows multiple opportunities to contribute to future generations, this is hampered within the Carolina DPS by habitat alteration and bycatch. This DPS was severely depleted by past directed commercial fishing, and faces ongoing impacts and threats from habitat alteration or inaccessibility, bycatch, and the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch that have prevented river populations from rebounding and will prevent their recovery.

The presence of dams has resulted in the loss of more than 60% of the historical sturgeon habitat on the Cape Fear River and in the Santee-Cooper system. Dams are contributing to the status of the Carolina DPS by curtailing the extent of available spawning habitat and further modifying the remaining habitat downstream by affecting water quality parameters (such as depth, temperature, velocity, and dissolved oxygen) that are important to sturgeon. Dredging is also contributing to the status of the Carolina DPS by modifying Atlantic sturgeon spawning and nursery habitat. Habitat modifications through reductions in water quality are contributing to the status of the Carolina DPS due to nutrient-loading, seasonal anoxia, and contaminated sediments. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch is also a current threat to the Carolina DPS that is contributing to its status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may use multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins). This may result in either reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality. While many of the threats to the Carolina DPS have been ameliorated or reduced due to existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch and habitat alterations are currently not being addressed through existing mechanisms. Further, despite NMFS's authority under the Federal Power Act to prescribe fish passage and existing controls on some pollution sources, access to habitat and improved water quality continues to be a problem. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the Carolina DPS.

4.2.3.5 South Atlantic DPS of Atlantic Sturgeon

The South Atlantic DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto Rivers (ACE) Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. The marine range of Atlantic sturgeon from the South Atlantic DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the South Atlantic DPS and the adjacent portion of the marine range are shown in Figure 13.

Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, and Satilla Rivers. We determined spawning was occurring if young-of-the-year were observed, or mature adults were present, in freshwater portions of a system (Table 9). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. Historically, both the Broad-Coosawatchie and St. Mary's Rivers were documented to have spawning populations at one time; there is also evidence that spawning may have occurred in the St. Johns River or one of its tributaries. Recent evidence shows that a small number of fish have returned to the St. Mary's River, and may use the river for spawning. Both the St. Mary's and St. Johns Rivers are used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. The use of the Broad-Coosawatchie by sturgeon from other spawning populations is unknown at this time. The presence of historical and current spawning populations in the Ashepoo River has not been documented; however, this river may currently be used for nursery habitat by young Atlantic sturgeon originating from other spawning populations. Fish from the South Atlantic DPS likely use other river systems than those listed here for their specific life functions.

Secor (2002) estimates that 8,000 adult females were present in South Carolina before the collapse of the fishery in 1890. However, because fish from South Carolina are included in both the Carolina and South Atlantic DPSs, it is likely that some of the historical 8,000 fish would be attributed to both the Carolina DPS and South Atlantic DPS. The sturgeon fishery had been the third largest fishery in Georgia. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the South Atlantic DPS. We have estimated that there are a minimum of 14,911 South Atlantic DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters (Kocik et al. 2013).

Table 1. Major river, tributaries, and sounds within the range of the South Atlantic DPS and currently available data on the presence of an Atlantic sturgeon spawning population in each system.

River/Estuary	Spawning Population	Data
ACE (Ashepoo, Combahee, and Edisto Rivers) Basin, SC; St. Helena Sound	Yes	1,331 YOY (1994-2001); gravid female and running ripe male in the Edisto (1997); 39 spawning adults (1998)
Broad-Coosawhatchie Rivers, SC; Port Royal Sound	Unknown	
Savannah River, SC/GA	Yes	22 YOY (1999-2006); running ripe male (1997)
Ogeechee River, GA	Yes	age-1 captures, but high inter-annual variability (1991-1998); 17 YOY (2003); 9 YOY (2004)
Altamaha River, GA	Yes	74 captured/308 estimated spawning adults (2004); 139 captured/378 estimated spawning adults (2005)
Satilla River, GA	Yes	4 YOY and spawning adults (1995-1996)
St. Marys River, GA/FL	Unknown	
St. Johns River, FL	Extirpated	

The directed Atlantic sturgeon fishery caused initial severe declines in southeast Atlantic sturgeon populations. Although the directed fishery is closed, bycatch in other commercial fisheries continues to impact the South Atlantic DPS. Statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species such as Atlantic sturgeon, but these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the South Atlantic DPS, even with existing controls on some pollution sources. Current regulatory regimes are not effective in controlling water allocation issues (e.g., no permit requirements for water withdrawals under 100,000 gpd in Georgia, no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution).

Summary of the Status of the South Atlantic DPS of Atlantic Sturgeon

Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. Their late age at maturity provides more opportunities for individuals to be removed from the population before reproducing. While a long lifespan also allows multiple opportunities to contribute to future generations, this is hampered within the South Atlantic DPS by habitat alteration, bycatch, and from the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch.

Dredging is contributing to the status of the South Atlantic DPS by modifying spawning, nursery, and foraging habitat. Habitat modifications through reductions in water quality and dissolved oxygen are also contributing to the status of the South Atlantic DPS, particularly during times of high water temperatures, which increase the detrimental consequences on Atlantic sturgeon habitat. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch also contributes to the South Atlantic DPSs status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may use multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality. While many of the threats to the South Atlantic DPS have been ameliorated or reduced due to the existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch and habitat alteration are currently not being addressed through existing mechanisms. Further, access to habitat and good water quality continues to be a problem even with NMFS's authority under the Federal Power Act to prescribe fish passage and existing controls on some pollution sources. There is a lack of regulation for some large water withdrawals, which threatens sturgeon habitat. Existing water allocation issues will likely be compounded by population growth, drought, and, potentially, climate change. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the South Atlantic DPS.

4.2.4 Status of the Gulf of Maine DPS of Atlantic Salmon

The Atlantic salmon is an anadromous fish, migrating up rivers from the ocean to spawn. There are three Atlantic salmon DPSs in the U.S.: Long Island Sound, Central New England, and the Gulf of Maine (Fay et al. 2006). The Gulf of Maine (GOM) DPS of Atlantic salmon is genetically distinct from other Atlantic salmon DPSs and populations. As of 2014, non-native Atlantic salmon were still present in the Central New England and Long Island Sound population segments as an artifact of a reintroduction program that existed in the Connecticut and Merrimack Rivers from 1967 to 2012. In 2013, the U.S. FWS discontinued the federal programs to rebuild these stocks. However, Atlantic salmon persist in some rivers in the Long Island Sound and Central New England DPS because of state efforts. The Atlantic salmon used to support these programs are not part of the listed entity and, therefore, are not protected under the ESA. Only the Gulf of Maine population segment supports native salmon populations (U.S. FWS and NMFS 2019). The GOM DPS, found in watersheds throughout Maine (Figure 14), is the only DPS listed under the ESA. Therefore, this is the only DPS considered in this Opinion.

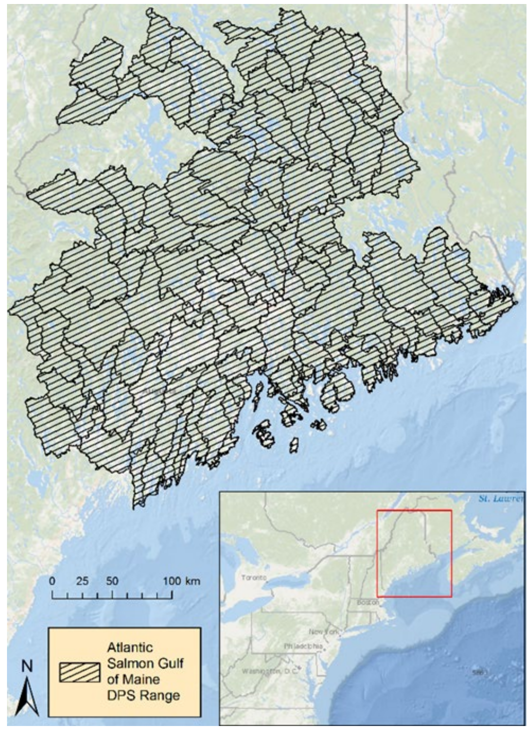


Figure 14. Range of Gulf of Maine DPS of Atlantic salmon.

The GOM DPS of Atlantic salmon was initially listed as endangered on November 17, 2000 (65 FR 69459). In 2009, NMFS and U.S. FWS expanded the geographic range for the GOM DPS. The GOM DPS is defined as all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, and wherever these fish occur in the estuarine and marine environment. The marine range of the GOM DPS extends from the Gulf of Maine, throughout the Northwest Atlantic Ocean, to the coast of Greenland. Included in the GOM DPS are all associated conservation hatchery populations used to supplement these natural populations. Excluded from the GOM DPS are landlocked Atlantic salmon and those salmon raised in commercial hatcheries for the aquaculture industry (74 FR 29344, June 19, 2009).

In describing the GOM DPS, there are three salmon habitat recovery units (SHRUs). The three SHRUs are the Downeast Coastal SHRU, Penobscot Bay SHRU, and Merrymeeting Bay SHRU. The SHRU delineations were designed to: 1) ensure that a recovered Atlantic salmon population has widespread geographic distribution to help maintain genetic variability; and 2) provide protection from demographic and environmental variation. A widespread distribution of salmon across the three SHRUs will provide a greater probability of population sustainability in the future, which will be needed to achieve recovery of the GOM DPS.

We used information available in the 2006 status review (Fay et al. 2006), the recovery plan (U.S. FWS and NMFS 2019), and recent scientific publications to summarize the life history, population dynamics and status of the species, as follows.

Life History
Atlantic salmon spend most of its adult life in the ocean and return to freshwater to reproduce. Its complex life history includes territorial rearing in rivers to extensive feeding migrations on the high seas. During their life cycle, Atlantic salmon go through several distinct phases that are identified by specific changes in behavior, physiology, morphology, and habitat requirements. They return to rivers in Maine from the Atlantic Ocean primarily between May and early July (Baum and Atlantic Salmon Board 1997), although, they may enter any time from early spring to late summer. Spawning typically occurs in late October through November, and eggs hatch in late March or April (Fay et al. 2006). After spawning, the adults move downstream toward the sea. After reaching the ocean, few survive as indicated by the lack of repeat spawners in the GOM DPS (NMFS and U.S. FWS 2005).

After hatching, Atlantic salmon go through several stages in the river before entering the ocean. Smoltification (the physiological and behavioral changes required for the transition to saltwater) usually occurs at age two for the GOM DPS Atlantic salmon (USASAC 2005). Once entering the marine environment, they travel mainly at the surface of the water column (Renkawitz and Sheehan 2012) and may form shoals, possibly of fish from the same river (Shelton et al. 1997). Atlantic salmon can experience high mortality during the transition to saline environments for reasons that are not well understood (Kocik et al. 2009; Thorstad et al. 2012).

During the late summer and autumn of the first year, North American Atlantic salmon are concentrated in the Labrador Sea and off the west coast of Greenland (Reddin 1985; Reddin and Short 1991; Reddin and Friedland 1992; Renkawitz and Sheehan 2012). The following spring, first year winter and older fish are generally located in the Gulf of St. Lawrence, off the coast of Newfoundland, and on the east coast of the Grand Banks (Reddin 1985; Dutil and Coutui 1988; Ritter 1989; Reddin and Friedland 1992; Friedland et al. 1999).

Population Dynamics
The historic distribution of Atlantic salmon in Maine has been described extensively (Baum 1997). In short, substantial populations of Atlantic salmon existed in nearly every river in Maine that was large enough to maintain a spawning population. The upstream extent of the species' distribution extended far into the headwaters of even the largest rivers. Today, the spatial distribution of Atlantic salmon is limited by obstructions to passage and low abundance levels. Within the range of the GOM DPS, the Kennebec, Androscoggin, Union, Narraguagus, and Penobscot Rivers contain dams that severely limit passage of salmon to significant amounts of spawning and rearing habitat.

Contemporary abundance levels of Atlantic salmon within the GOM DPS are several orders of magnitude lower than historical abundance estimates. For example, Foster and Atkins (1869) estimated that roughly 100,000 adult salmon returned to the Penobscot River alone before the river was dammed, whereas estimates of abundance for the entire GOM DPS have rarely exceeded 5,000 individuals in any given year since 1967 (Fay et al. 2006; USASAC 2013). In the early 1990s, marine survival rates decreased, leading to the declining trend in adult abundance observed throughout the 1990s and early 2000s. Adult returns have fluctuated over the past decade.

Adult returns of Atlantic salmon from 1997 to 2018 ranged from 450 to 4,178. In 2018, there were 869 returns to rivers in the United States. Most (99.2%) returns were to the GOM DPS (USASAC 2019). From 2010-2019, the ten year average returns was 1,247 adults, with 120 returns to the Downeast Coastal SHRU, 56 to the Merrymeeting Bay SHRU, and 1,071 to the Penobscot Bay SHRU (Kircheis et al. 2020). The counts include both wild and hatchery-origin fish. The DPS encompasses all anadromous Atlantic salmon in a freshwater range covering the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River and includes all associated conservation hatchery populations used to supplement these natural populations (U.S. FWS and NMFS 2019). Most (88.1% in 2018 and 76% in 2019) returns were hatchery smolt origin. The remaining returns originated from natural reproduction, 0+ fall stocked parr, hatchery fry, or eggs (USASAC 2019, 2020). Each year, the Penobscot River supported the majority of adult returns (92-98%); the Narraguagus River supported between 0.8-4.1% of adult (Fay et al. 2006). In 2017, over 4 million juvenile salmon (eggs, fry, parr and smolts) and 4,849 adults were stocked in the Connecticut, Merrimack, Saco, Penobscot and five other coastal rivers in Maine. Over 5.5 million juvenile and 5,715 adults were released U.S. rivers in 2018 (USASAC 2019); over 4.7 million juvenile and 5,710 adults were released into U.S. rivers in 2019 (USASAC 2020). Low abundances of both hatchery-origin and naturally reared adult salmon returns to Maine demonstrate continued poor marine survival.

Status
Atlantic salmon face a number of threats to their survival, which are outlined in the recovery plan (U.S. FWS and NMFS 2019). The most significant threats to the GOM DPS of Atlantic salmon include, among others: lack of access to spawning and rearing habitat; reduced habitat complexity; sedimentation of spawning/rearing habitat; degraded water quality; water withdrawal; recreational bycatch; poaching; foreign intercept fishery; competition from introduced species; disease; predation; improper hatchery practices; and climate change.

Genetic diversity is monitored by assessing sea-run adults for the Penobscot River and juvenile fish for other populations. Allelic diversity has remained relatively constant since the mid-1990s; though, slight decreases were detected in the East Machias and Dennys populations (USASAC 2019).The GOM DPS of Atlantic salmon currently exhibits critically low spawner abundance, poor marine survival, and is confronted with a variety of additional threats. The abundance of GOM DPS Atlantic salmon has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is small and displays no sign of growth. The spatial distribution of the GOM DPS has been severely reduced relative to historical distribution patterns. The conservation hatchery program assists in slowing the decline and helps stabilize populations at low levels, but has not contributed to an increase in the overall abundance of salmon and has not been able to halt the decline of the naturally reared component of the GOM DPS. Continued reliance on the conservation hatchery program could prevent extinction in the short term, but recovery of the GOM DPS must be accomplished through increases in naturally reared salmon. Based on the information above, the species would likely have a low resilience to additional perturbations.

Critical Habitat
Critical habitat for the GOM DPS of Atlantic salmon has been designated and is described in Section 4.1, where we determined that the proposed actions are not likely to adversely affect it.

Recovery Goals
As with other plans, the overall goal of the recovery plan is delisting (U.S. FWS and NMFS 2019). The interim goal is to downlist the DPS from endangered to threatened. Complete down listing/delisting criteria for each SHRU's recovery goals are included in the recovery plan. Reclassification objectives include maintaining sustainable, naturally reared populations with access to suitable habitat in at least two of the SHRUs, ensuring management options for marine survival are better understood, and reducing/eliminating threats that pose an imminent risk of extinction. Delisting criteria include maintaining self-sustaining, wild populations with access to suitable habitat for all SHRUs, ensuring necessary management options for marine survival are in place, and reducing/eliminating threats that pose a risk of endangerment to the DPS (U.S. FWS and NMFS 2019). Recovery actions include:

1. Enhance connectivity between ocean and freshwater habitats important for recovery.
2. Increase adult spawners through the freshwater production of smolts.
3. Increase Atlantic salmon survival through increased ecosystem understanding and identification of spatial and temporal constraints to salmon marine productivity to inform and support management actions that improve survival.
4. Collaborate with partners and engage interested parties in recovery efforts.
5. Ensure federal agencies and associated programs continue to recognize and uphold federal Tribal Trust responsibilities.
6. Provide demographic support and maintain genetic diversity appropriate for recovery through the conservation hatchery program.
7. Maintain the genetic diversity and promote increased fitness of Atlantic salmon populations over time.
8. Identify funding programs that support State, local and NGO conservation efforts.

4.3 Species and Critical Habitats Not Affected by the Proposed Actions

In their December 2020 BA, the NEFSC determined that the proposed actions will not affect the U.S. DPS of smalltooth sawfish or its designated critical habitat in Florida waters. We agree with that determination and will not discuss the species or critical habitat further. We further assert that the proposed actions will not overlap with, and thus will not affect, ESA-listed Nassau grouper, South Atlantic DPS green sea turtles, or seven Atlantic corals and their critical habitats, species which are addressed in our 2021 "batched fisheries" Opinion on ten GARFO fisheries. The NEFSC also made a *not likely to adversely affect* determination for Johnson's seagrass and a *may affect, but will not destroy or adversely modify* determination for Johnson's seagrass critical habitat. On April 14, 2022, Johnson's seagrass and its critical habitat were delisted under the ESA (87 FR 22137) and thus will not be discussed further in this Opinion.

5.0 ENVIRONMENTAL BASELINE

The environmental baseline for this Opinion refers to the condition of ESA-listed species and designated critical habitats in the action area, without the consequences that are caused by the proposed action. The environmental baseline includes the past and present impacts of all federal, state, or private actions and other human activities in the action area; the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation; and the impacts of state or private actions which are contemporaneous with the consultation in process. The consequences to ESA-listed species or designated critical habitats from ongoing agency activities or existing agency facilities that are not within that agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

The *Environmental Baseline* includes the effects of several activities that may affect the survival and recovery of sea turtles, shortnose sturgeon, Atlantic sturgeon, and Atlantic salmon in the action area. The activities that shape the *Environmental Baseline* of this consultation generally include: federal fisheries management plans; aquaculture; dredging, sand mining, and beach nourishment activities; research and other permitted activities; federal vessel operations; military operations; offshore oil and gas; offshore energy development; non-federally regulated fisheries; maritime industry; pollution; coastal development; and recovery activities associated with reducing impacts to listed species.

The overall impacts that each federal, state, and private action or other human activities have on ESA-listed sea turtles, sturgeon, and salmon is not fully known. For actions outside the action area, the impacts of human activities on these species are discussed and incorporated into the status of each species considered in this Opinion (sections 4.2.1 through 4.2.4). Sections 4.2.1 through 4.2.4 also recognize the benefits of recovery activities already being implemented for these species. In some cases, the benefits of a recovery action may not be evident in the status of the respective species for years or even decades, given the relatively late age at which some species reach maturity (e.g., sea turtles) and depending on the age class(es) affected. This section characterizes actions within the action area and their impacts on ESA-listed species.

5.1 Federal Actions that have Undergone Section 7 Consultation

NMFS has conducted a number of section 7 consultations to address the effects of federal actions on threatened and endangered species in the action area. Each of those consultations sought to develop ways to avoid and reduce impacts of the action on listed species.

As described in section 2.0, we have also previously consulted on past fisheries and ecosystem research that has been conducted or funded by the NEFSC. Gears used in these research activities (i.e., bottom and pelagic trawls, gillnets, pots/traps, hook and line gear, and dredges, among others) are known to affect ESA-listed species, with some interactions causing injury and death. Therefore, the *Environmental Baseline* for this action also includes the effects of the past carrying out and funding of NEFSC research activities.

5.1.1 Authorization of Fisheries through Fishery Management Plans

NMFS authorizes the operation of several fisheries in the action area under the authority of the Magnuson-Stevens Fishery Conservation Act and through FMPs and their implementing regulations. Commercial and recreational fisheries in the action area employ gear that is known to harass, injure, and/or kill sea turtles, Atlantic sturgeon, and Atlantic salmon. However, adverse effects from these fisheries on shortnose sturgeon are not anticipated.

In the Northwest Atlantic, NMFS GARFO manages federal fisheries from Maine to Cape Hatteras, North Carolina; however, the management areas for some of these fisheries range from Maine through Virginia, while others extend as far south as Key West, Florida. The NMFS Southeast Regional Office (SERO) manages federal fisheries from Cape Hatteras, North Carolina to Texas, including Puerto Rico and the U.S. Virgin Islands. Fisheries managed by NMFS GARFO and SERO overlap in some parts of the action area.

Both regions have conducted ESA section 7 consultation on all federal fisheries authorized under an FMP or ISFMP. NMFS SERO has formally consulted on the following fisheries: (1) coastal migratory pelagics (NMFS 2015a, 2017c); (2) snapper/grouper (NMFS 2016c); (3) dolphin/wahoo (NMFS 2003); (4) southeast shrimp trawl (NMFS 2021b); (5) Atlantic highly migratory species, excluding pelagic longline (NMFS 2020a); and (6) pelagic longline Atlantic highly migratory species (NMFS 2020b). NMFS GARFO has formally consulted on the American lobster, Northeast multispecies, monkfish, spiny dogfish, Atlantic bluefish, Northeast skate complex, Atlantic mackerel/squid/butterfish, summer flounder/scup/black sea bass, Atlantic deep-sea red crab, and Jonah crab fisheries (inclusive of the NEFMC Omnibus EFH Amendment 2) (GARFO batched fisheries; NMFS 2021c) and Atlantic sea scallop fishery (NMFS 2021d).

In these past Opinions, only those on the Atlantic highly migratory species (excluding pelagic longline), snapper/grouper, GARFO batched fisheries, and Atlantic sea scallop fisheries (NMFS 2016c, 2020a, 2021b, 2021c) concluded that there was a potential for collisions between fishing vessels and an ESA-listed species (specifically, sea turtles). Any effects to their prey and/or habitat were found to be insignificant and discountable. We have also determined that the GARFO Atlantic herring, Atlantic surfclam and ocean quahog, and golden and blueline tilefish fisheries are not likely to adversely affect any ESA-listed species or designated critical habitats.

Impacts to Sea Turtles

Each of the most recent GARFO and SERO fishery consultations noted above have considered adverse effects to loggerhead, Kemp's ridley, green, and leatherback sea turtles. In each of the fishery Opinions, we concluded that the ongoing actions were likely to adversely affect but not likely to jeopardize the continued existence of any sea turtle species. Each of these Opinions included an ITS exempting a certain amount of lethal or non-lethal take resulting from interactions with the fisheries. These ITSs are summarized below (Table 10). Unless specifically noted, all numbers denote an annual number of captures that may be lethal or non-lethal. The NEFSC has estimated the take of sea turtles in scallop dredge, bottom trawl, and sink gillnet gear in the Greater Atlantic Region (Table 11). Each of these estimates was used in developing the ITS for the two current GARFO fishery Opinions (Atlantic sea scallop and batched fisheries).

Table 10. Most recent Opinions prepared by NMFS GARFO and SERO for federally managed fisheries in the action area and their respective ITSs for sea turtles.

	Date	Loggerhead (NWA DPS)	Kemp's ridley	Green (North Atlantic DPS)	Leatherback
GARFO FMPs					
Atlantic sea scallop	June 17, 2021	1,095 (385 lethal) over a 5 year period in dredge gear; 13 (6 lethal) over a 5-year period in bottom trawl gear; up to 2 (2 lethal) over a 5 year period due to vessel strikes	28 (11 lethal) over a 5 year period in dredge gear; 2 (1 lethal) over a 5-year period in bottom trawl gear; up to 2 (2 lethal) over a 5 year period due to vessel strikes	1 (1 lethal) over a 5 year period in dredge gear; 1 (1 lethal) over a 5-year period in bottom trawl gear; up to 2 (2 lethal) over a 5 year period due to vessel strikes	1 (1 lethal) over a 5 year period in dredge gear; 1 (1 lethal) over a 5-year period in bottom trawl gear; up to 2 (2 lethal) over a 5 year period due to vessel strikes
American Lobster, Atlantic Bluefish, Atlantic Deep-Sea Red Crab, Mackerel/Squid/Butterfish, Monkfish, Northeast Multispecies, Northeast Skate Complex, Spiny Dogfish, Summer Flounder/Scup/Black Sea Bass, and Jonah Crab Fisheries and Omnibus EFH Amendment 2 (Batched Fisheries)	May 27, 2021	1,995 (1,289 lethal) over a 5 year period in trawl, gillnet, and pot/trap gear; up to 3 (3 lethal) over a 5 year period due to vessel strikes	292 (214 lethal) over a 5 year period in trawl and gillnet gear; up to 3 (3 lethal) over a 5 year period due to vessel strikes	42 (24 lethal) over a 5 year period in trawl and gillnet gear; up to 3 (3 lethal) over a 5 year period due to vessel strikes	142 (93 lethal) over a 5 year period in trawl, gillnet, and pot/trap gear; up to 3 (3 lethal) over a 5 year period due to vessel strikes
SERO FMPs					
Coastal migratory pelagics*	June 18, 2015, later amended 2017	27 over 3 years (7 lethal)	8 over 3 years (2 lethal)	31 over 3 years (9 lethal)	1 over 3 years (1 lethal)
South Atlantic snapper-grouper	December 1, 2016	629 (208 lethal) over 3 years	180 (59 lethal) over 3 years	111 (42 lethal) over 3 years	6 (5 lethal) over 3 years
Southeastern U.S. Shrimp Fisheries and Sea Turtle Conservation Regulations	April 26, 2021	72,670 (1,700 lethal) over a 5 year period	84,495 (8,505 lethal) over a 5 year period	21,214 (1,700 lethal) over a 5 year period	130 (5 lethal) over a 5 year period
HMS fisheries, excluding pelagic longline	January 10, 2020	91 (51 lethal) over 3 years	22 (11 lethal) over 3 years	46 (21 lethal) over 3 years	7 (3 lethal) over 3 years
HMS, pelagic longline	May 15, 2020	1080 (280 lethal) over 3 years	21 (8 lethal) combination of Kemp's ridley, green (includes NA and SA DPS), hawksbill, or olive ridley over 3 years		996 (275 lethal) over 3 years
South-Atlantic dolphin-wahoo	August 27, 2003	12 (2 lethal) annually	3 (1 lethal) combination of Kemp's ridley, green, or hawksbill annually		12 (1 lethal) annually

* The coastal migratory pelagic consultation states a total of 31 green sea turtle takes of both DPSs combined is expected, but no more than 30 from the North Atlantic DPS and no more than two from the South Atlantic DPS

Table 11. Estimates of average annual sea turtle interactions in scallop dredge, bottom trawl, and sink gillnet fishing gear. Numbers in parentheses are adult equivalents.

Gear	Years	Area	Estimated Interactions (adult equivalents)	Mortalities (adult equivalents)	Source
Sea Scallop Dredge	2015-2019	Mid-Atlantic	Loggerhead: 155 (31)	Loggerhead: 53 (11)	Murray (2021)
Bottom Trawl	2014-2018	Mid-Atlantic and Georges Bank	Loggerhead: 116.6 (36.4) Kemp's ridley:9.2 Green: 3.2 Leatherbacks: 5.2	Loggerhead: 54.4 (17.4) Kemp's ridley: 4.6 Green: 1.6 Leatherbacks:2.6	Murray (2020)
Sink Gillnet	2017-2021	Mid-Atlantic	Loggerhead: 142 (2.5) Kemp's ridley: 91 Green: 49 Leatherbacks: 26 Unid. hardshell: 32	Loggerhead: 88 Kemp's ridley: 56 Green: 30 Leatherbacks: 16 Unid. hardshell: 20	Murray (2023)

The anticipated take of sea turtles for the two GARFO Opinions in Table 10 includes gear interactions in federal waters by federally-permitted vessels, as well as vessel collision interactions in federal and state waters. It should be noted that the distribution and likelihood of observed sea turtle takes are highly variable such that interactions in some years could be higher if greater fishing effort is expended (due to less travel time and ease of access to a wider range of vessels) or sea turtles are present in greater numbers in those waters. The amount of observer coverage allocated to different areas may also be a factor in how many sea turtle interactions are documented in certain waters for these fisheries.

Impacts to Atlantic sturgeon

Commercial fisheries that operate in the action area for this consultation capture and kill Atlantic sturgeon originating from each of the five listed DPSs. Given this, consultations on fisheries in the Greater Atlantic and Southeast Regions consider the take of Atlantic sturgeon (Table 12).

In a review of bycatch rates on fishing trips from 1989 to 2000, Atlantic sturgeon were recorded in both gillnet and trawl gears, and bycatch rates varied by gear type and target species. Bycatch was highest for sink gillnets in specific areas of the coast. Mortality was higher in sink gillnets than trawls (Stein et al. 2004b). More recent analyses were completed in 2011, 2016, and 2023.

In 2011, the NEFSC prepared a bycatch estimate for Atlantic sturgeon captured in federally managed commercial sink gillnet and otter trawl fisheries from Maine through Virginia. This estimate indicated that from 2006-2010, an annual average of 3,118 Atlantic sturgeon were captured in these fisheries with 1,569 in sink gillnet and 1,548 in otter trawls. The mortality rate in sink gillnets was estimated at approximately 20% and the mortality rate in otter trawls was estimated at 5%. Based on this estimate, 391 Atlantic sturgeon were estimated to be killed annually in federal fisheries in the Greater Atlantic Region (Miller and Shepherd 2011).

An updated, although unpublished, Atlantic sturgeon bycatch estimate in Northeast sink gillnet and otter trawl fisheries for 2011-2015 was prepared by the NEFSC in 2016. Using this information, the authors of the recent Atlantic Sturgeon Benchmark Stock Assessment (ASMFC 2017) estimated that 1,139 fish (295 lethal; 25%) were caught in gillnet fisheries and 1,062 fish (41 lethal; 4%) were caught in otter trawl fisheries each year from 2000-2015. Atlantic sturgeon bycatch estimates for Northeast gillnet and trawl gear from 2011-2015 (approximately 761 fish per year for gillnets, 777 for trawls) were substantially lower than those from 2006-2010 (approximately 1,074 fish per year for gillnets, 1,016 for trawls) (ASMFC 2017). It should be noted that the models used in 2011 and 2016 differed. The 2011 analysis used a generalized linear model. In this model, the species mix considered comprises those species currently managed under a federal FMP. In the model used in the 2017 ASMFC stock assessment, the species considered as covariates were those species caught most on observed hauls encountering Atlantic sturgeon (ASMFC 2017).

Table 12. Most recent Opinions prepared by NMFS GARFO and SERO for federally managed fisheries in the action area that result in takes of the five DPSs of Atlantic sturgeon and their respective ITSs.

	Date	**Gulf of Maine DPS**	**New York Bight DPS**	**Chesapeake Bay DPS**	**Carolina DPS**	**South Atlantic DPS**
GARFO FMPs						
American Lobster, Atlantic Bluefish, Atlantic Deep-Sea Red Crab, Mackerel/Squid/Butterfish, Monkfish, Northeast Multispecies, Northeast Skate Complex, Spiny Dogfish, Summer Flounder/Scup/Black Sea Bass, and Jonah Crab Fisheries and Omnibus EFH Amendment 2 (Batched Fisheries)	May 27, 2021	615 (75 lethal) over a 5 year period in trawl and gillnet gear	5,020 (590 lethal) over a 5 year period in trawl and gillnet gear	755 (85 lethal) over a 5 year period in trawl and gillnet gear	180 (20 lethal) over a 5 year period in trawl and gillnet gear	395 (45 lethal) over a 5 year period in trawl and gillnet gear
Atlantic sea scallop	June 17, 2021	5 takes over a 5-year period in scallop dredge or trawl gear from any of the five DPSs (one lethal take every 20 years from any of the five DPSs)				
SERO FMPs						
Coastal migratory pelagics	June 18, 2015	2 (12)* every 3 years; 0 lethal	4 (12)* every 3 years; 0 lethal	3 (12)* every 3 years; 0 lethal	4 (12)* every 3 years; 0 lethal	10 (12)* every 3 years; 0 lethal
Southeastern U.S. Shrimp Fisheries and Sea Turtle Conservation Regulations	April 26, 2021	2 (0 lethal) over a 5 year period	7 (2 lethal) over a 5 year period	19 (4 lethal) over a 5 year period	66 (15 lethal) over a 5 year period	103 (24 lethal) over a 5 year period
HMS fisheries, excluding pelagic longline	January 10, 2020	34 (8 lethal) every 3 years	170 (36 lethal) every 3 years	40 (9 lethal) every 3 years	10 (5 lethal) every 3 years	75 (19 lethal) every 3 years

* The coastal migratory pelagics Opinion estimates a total take of 12 Atlantic sturgeon across all five DPSs. The Opinion considered the percent each DPS, presented as a range, is expected to be in the action area. To be conservative, the Opinion considered the high end of the range in apportioning take between DPSs, which is the number before each parenthesis (i.e., the number before the parenthesis is the maximum number of individuals per DPS that may be taken that would not trigger reinitiation). However, in total, no more than 12 Atlantic sturgeon are anticipated to be taken in the fishery every three years (NMFS 2015a, 2017c).

In May 2023, the NEFSC released an updated set of Atlantic sturgeon bycatch estimates for the time period of 2000-2021. Atlantic sturgeon bycatch estimates for Northeast gillnet and trawl gear from the most recent five-year period of 2016-2021, excluding 2020 due to COVID-19 impacts to data collection, were approximately 1,126 fish per year for gillnets (327 mortalities) and 719 for trawls (19 mortalities). This estimate was produced using the same methods as previous NEFSC analyses (Miller and Shepherd 2011; ASMFC 2017). The bycatch estimates for gillnet gear are significantly higher than those for the previous five-year period of 2011-2015 and, therefore, consultation on the 2021 Batched Fisheries Opinion is being reinitiated.

At this time, fisheries regulated by NMFS SERO for which a bycatch estimate is available for Atlantic sturgeon are the Atlantic HMS, southeast shrimp trawl, and coastal migratory pelagic fisheries. In their 2020 Opinion on the Atlantic HMS fisheries (excluding pelagic longline), NMFS SERO estimated that a total of 329 interactions, of which 77 are expected to be lethal, are likely to occur every three years as a result of these fisheries. The level of interactions and mortalities were expected to be greatest within the NYB DPS, followed by the SA, CB, GOM, and Carolina DPSs. In their 2021 Opinion on the southeast shrimp trawl fishery, NMFS SERO estimated a total of 197 interactions (45 lethal) over a five-year period as a result of the fishery. The level of interactions, captures, and mortalities were expected to be greatest within the SA DPS, followed by the Carolina, CB, NYB, and GOM DPSs. In their 2015 Opinion on the coastal migratory pelagics fishery, NMFS SERO estimated a total of 12 non-lethal interactions every three years as a result of the fishery. The level of interactions and mortality were expected to be greatest within the SA DPS, followed by the Carolina and NYB, CB, and GOM DPSs. Other fisheries in the Southeast Region that operate with sink gillnets or otter trawls are also likely to interact with Atlantic sturgeon and be an additional source of mortality in the action area.

Impacts to Atlantic Salmon
Atlantic salmon originating from the Gulf of Maine DPS may be captured and die in commercial trawl and gillnet fisheries operating in the action area. In the 2021 GARFO batched fisheries Opinion, based on observer reports assessed, we anticipated the observed take of up to two individuals (two lethal) over a five-year average in gillnet and bottom trawl gear combined. The NEFOP and ASM observers have not recorded any interactions from 2014 through 2022. The anticipated level of incidental take of Atlantic salmon for the recreational components of the GARFO batched fisheries could not be estimated at the time.

5.1.2 Aquaculture

Aquaculture has the potential to impact ESA-listed species through entanglement and/or other interactions with aquaculture gear (e.g., buoys, nets, and vertical lines), introduction or transfer of pathogens, increased vessel traffic and noise, impacts to habitat and benthic organisms, and water quality (Lloyd 2003; Clement 2013; Price and Morris 2013; Price et al. 2017). Current data suggest that documented interactions and entanglements of ESA-listed sea turtles with aquaculture gear are rare (Price et al. 2017). However, there are several reports of sea turtles in the North Atlantic entangled in aquaculture gear (Price et al. 2017), including one entanglement of a leatherback within the action area in 2014 and a few others in Canadian waters between 2009 and 2013. This information includes documented interactions only and may not be reflective of actual interactions, which could be higher. There are also concerns about aquaculture interactions with large whales and Atlantic sturgeon as it relates to gear entanglements, changes to water features related to migration and residency, and habitat conversion. Aquaculture projects have the potential to modify critical habitat through impacts to water quality and habitat conversion. Some components of aquaculture gear and gear used in commercial fisheries are similar; therefore, information on interactions in the similar gear types may provide information on the risk aquaculture poses.

In the U.S., marine aquaculture production increased an average of 1.7% per year from 2013-2018; however, globally, the U.S. remains a relatively minor aquaculture producer (NMFS 2021e). Farmed items in the Atlantic include finfish (e.g. Atlantic salmon, steelhead trout), shellfish (e.g. American and European oyster, quahog, blue mussels, softshell clams, sea and bay scallops, and quahogs), and sea vegetables (e.g., sugar kelp). Trials with other species, such as cod and halibut have occurred previously and there is known interest to farm other marine fish species in the future, such as sea trout and black sea bass. Hatchery-raised species are also used to support important commercial and recreational fisheries, as well as for habitat and endangered species restoration. Aquaculture products are grown for medical research, pharmaceuticals, food additives, ornamentals, and aquarium commerce.

The 2018 Census on Aquaculture collected national data about the industry (USDA 2019). In this survey, aquaculture is the farming of aquatic organisms, including baitfish, crustaceans, food fish, mollusks, ornamental fish, sport/game fish, and other products. It includes algae and sea vegetables but does not include other aquatic plants. The 2018 Census reports 774 saltwater farms and 51,674 acres of saltwater aquaculture from Maine through Florida. It should be noted that this includes the west coast of Florida, and that for some states (Delaware, New Jersey), the acreage is not reported to preserve confidentiality (USDA 2019). In addition, the farms reported may be in estuaries that are outside the action area.

Aquaculture in the Greater Atlantic Region is, at present, primarily in state waters. Currently, there is one U.S. Army Corps of Engineers (USACE) permit for a pilot scale blue mussel aquaculture operation in federal waters of the Atlantic coast (i.e., between 3 and 200 nautical miles offshore). This project is located eight miles off Rockport, Massachusetts, and has placed three longlines in the water. The permittee submitted an application to USACE in December 2019 to expand the operation to a total of 20 longlines, but at the time of this consultation has not yet submitted a completed biological assessment to initiate the section 7 consultation process.

As provided in Table 13, there are four categories of aquaculture gear used in the Greater Atlantic Region: floating gear, net pen, shell on bottom, and cage on bottom. Based on ESA section 7 consultations conducted in the Greater Atlantic Region between 2015 and January of 2019,[7] we compiled a list of states that have aquaculture farms, and, per state, the number and type of aquaculture gear used (Table 14). This was an estimate of aquaculture farms as of 2021 and a more recent estimate is not currently available.

The species grown in various gear types include shellfish, finfish, and seaweeds (Table 13). Floating gear includes surface longlines, submerged longlines, and a floating upweller system. Aquaculture longlines are not the same as longline gear used in fisheries. In aquaculture, surface longlines consist of horizontal longline suspended on/near the surface of the water with buoy lines or poles at each end. Various types of cages or flip bags may be used to keep organisms

[7] Counts include experimental and/or gear that are no longer deployed.

inside an enclosed space. In deeper and higher energy locations, submerged longlines are used. Their design consists of horizontal longlines suspended below the surface with moorings/marker buoys (i.e., vertical lines) at each end. Some may have another mooring in the middle of their run. The longlines are suspended below the water surface and use a series of buoys to maintain the depth. This gear category also includes a floating upweller system (FLUPSY). This system is a dock or pier with tanks used to grow shellfish in open water while protecting them from predation. The FLUPSY has a motor that pulls water through the bottom of the tanks. As the water moves through the system, it provides a continuous food supply to the shellfish by transporting algae.

Table 13.2 Examples of organisms grown for each aquaculture gear type.

Gear type	Examples of grown organisms
Floating gear	Kelp, mussels, oysters, scallops
Net pens	Fish (e.g., Atlantic salmon)
Shell on bottom	Oysters, clams, mussels
Cage on bottom	Oysters, clams

Table 14. Aquaculture Gear in the Greater Atlantic Region.

State	Type of Aquaculture Gear					Total
	Floating Gear	Net Pen	Shell on bottom	Cage on bottom	Multimode	
ME	1	1	2	1	0	5
MA	10	0	1	3	0	15
CT	9	0	3	10	0	22
RI	1	0	0	1	1	3
NY	1	0	3	3	0	7
NJ	3	0	0	8	11	22
MD	7	0	115	33	8	163
VA	2	0	59	1	1	63
Total	34	1	183	60	21	299

Net pens are a type of enclosure culture and involve holding organisms captive within an enclosed space while maintaining a free exchange of water. They are enclosed on the bottom and sides by wooden, mesh or net screens. These types of gear are in direct contact with the surrounding environment. Shell on bottom refers to a technique used to grow shellfish, such as oysters, on the bottom of the ocean floor without cages. Shell on bottom also includes cases used for oyster bed restoration and maintenance, artificial oyster reefs creation, and spat collector installation. Cage on bottom also refers to a technique used to grow shells on the bottom of the ocean floor where cages are used.

Aquaculture sites may use a combination of gear categories, referred to here as multimode. For instance, both cage on bottom and floating gear were used to grow oysters in the waters near Maryland, so this case was included in this “Multimode” category.

5.1.3 Dredging, Sand Mining, and Beach Nourishment Activities

The construction and maintenance of federal navigation channels and sand mining ("borrow") areas to aid in beach nourishment activities may result in the take of sea turtles and Atlantic sturgeon. There are several navigational dredge types used in the action area. A hopper dredge uses pumps to force water and sediment up the dragarm and into the hopper. Hopper dredges may be equipped with screens for unexploded ordinance on the intake (UXO screens). Cutterhead dredges have a rotating cutter apparatus surrounding the intake of a suction pipe and may be hydraulic or mechanical. Bucket and clamshell dredges are mechanical devices that use buckets to excavate dredge materials (NMFS 2019a). Most dredging and dredged material placement projects in the action area are authorized or carried out by the USACE. These projects are under the jurisdiction of districts within the North Atlantic and South Atlantic Divisions.

Due to their design and operation, hopper dredges are the most likely to adversely affect ESA-listed species in the action area. Hard-shelled sea turtles may be injured or killed by hopper dredges when the draghead is placed, impinged on the screen, or entrained in the draghead. It is also possible that sea turtles may become entrained in other intake ports of these dredges. Adverse effects to sea turtles from cutterhead, bucket, and clamshell dredges are extremely unlikely. Atlantic sturgeon, on the other hand, may become entrained during hopper or cutterhead dredging or captured by clamshell or bucket dredges. Sediment suspension, blasting, and relocation trawling associated with dredging projects may also impact these species (NMFS 2019a). Relocation trawling may be undertaken to move sea turtles and Atlantic sturgeon out of the area being dredged and placing them in an area outside the dredge area. Although done primarily to benefit sea turtles and Atlantic sturgeon, relocation trawling interactions and captures are still considered takes as part of the proposed actions.

NMFS has completed numerous ESA section 7 consultations with the USACE, NASA, and the U.S. Navy to consider the effects of these dredging, sand mining, and nourishment projects on ESA-listed species in the Northeast and Mid-Atlantic (NMFS 2006, 2012f [completed], 2012g [completed], 2012h, 2014a, 2014b, 2018a, 2019a, 2019b, 2020c, 2020d, 2022d). Takes of sea turtles and Atlantic sturgeon during relocation trawling activities are also included in the consultations and are described below.

A regional biological opinion on the USACE's dredging and material placement activities in the South Atlantic was completed in 2020 (NMFS 2020e), and includes activities from North Carolina to Texas. This South Atlantic Regional Biological Opinion (SARBO) concluded that the proposed actions would adversely affect, but not likely jeopardize the continued existence of sea turtles or Atlantic sturgeon. Anticipated take of these species are included in the table below.

Aside from commercial fishing and fisheries research activities, these dredging projects represent one of the largest sources of incidental take for sea turtles and Atlantic sturgeon in the action area, and, potentially, one of the largest sources of lethal take. Active Opinions covering dredging, beach nourishment, and shoreline restoration/stabilization projects in the action area and the associated ITSs for sea turtles and Atlantic sturgeon are presented below (Table 15).

Table 15. NMFS formal consultations on dredging and disposal projects that occur in the action area and the anticipated take of ESA-listed species. Consultations listed are for currently active projects. Unless otherwise noted, the anticipated takes are over the life of the project.

Project	Date of Opinion	NWA DPS Loggerhead	Kemp's ridley	North Atlantic DPS Green	Leatherback	Atlantic Sturgeon	Life of Project
USACE New York and New Jersey Harbor Deepening Channel Improvements (HDCI) Navigation Study	1/26/2022	Up to 6 (or 5 and 1 Kemp's ridley) (lethal)	Up to 1 (lethal)			3 subadults (lethal) from any of the five listed DPSs	2025-2039
USACE Maintenance Dredging at Bath Iron Works, Maine	9/20/2020					3 GOM DPS juveniles, sub-adults, or adults (3 lethal)	2019-2029
USACE New York Coastal Storm Risk Management – Beach Nourishment Projects	9/3/2020	Non-lethal: 35 (trawling); Lethal: 3 (hopper dredge entrainment)	Non-lethal: 7 (trawling); Lethal: 1 (hopper dredge entrainment)		Non-lethal: 14 (trawling)	Non-lethal: 1,533 adults or sub-adults (trawling); Lethal: 3 sub-adults (hopper dredge entrainment), 82 adults or sub-adults (trawling) across all 5 listed DPSs	2020-2039
USACE Deepening and Maintenance of the Delaware River Federal Navigation Channel	11/22/2019	37 (37 lethal)	3 (3 lethal)			1763 non-lethal NYB DPS (relocation trawling and tagging); 8 lethal GOM DPS, 67 lethal NYB DPS, 21 lethal CB DPS, and 20 lethal SA DPS (dredging) 1.3% of each year class post yolk-sac larvae NYB DPS	2020-2070
U.S. Navy; USACE Maintenance Dredging of the Kennebec River FNP	10/25/2019					5 GOM DPS juveniles, sub-adults, or adults (5 lethal)	2019-2029
USACE Atlantic Coast of Maryland Shoreline Protection Project	11/30/2006	22 (22 lethal)	2 (2 lethal)				2008-2044
NASA Wallops Island Shoreline Restoration/ Infrastructure Protection Program	8/3/2012	9 (9 lethal) of which no more than 1 (1 lethal) may be a Kemp's ridley				2 (2 lethal) GOM, NYB, CB, Carolina, or SA DPS	2012-2062

USACE Sea Bright Offshore Borrow Area Beach Nourishment	3/7/2014	8 (8 lethal) combination of loggerheads and Kemp's ridleys (but no more than 3 Kemp's ridleys total)				2 NYB DPS and 1 CB, GOM, Carolina, or SA DPS (Elberon to Loch Arbour, all lethal); 2 of any DPS (Port Monmouth and Union Beach, all lethal)	50 years
USACE New Jersey and Delaware Beach Nourishment Program	6/26/2014	29 (29 lethal)	2 (2 lethal)	1 (1 lethal)		1 GOM DPS (1 lethal); 9 NYB DPS (9 lethal); 3 CB DPS (3 lethal); 3 SA DPS (3 lethal)	2014-2064
USACE Dredging of Chesapeake Bay Entrance Channels and Beach Nourishment	10/15/2018	1,722 (785 lethal)	352 (77 lethal)	58 (20 lethal)		100 (24 lethal) GOM DPS; 350 (94 lethal) NYB DPS; 100 (34 lethal) CB DPS; 50 (13 lethal) Carolina DPS; 150 (40 lethal) SA DPS	50 years
		Relocation Trawling: 1,250 (50 lethal) total; of these, up to 937 captures (37 lethal) of loggerheads, 275 captures (11 lethal) of Kemp's ridleys, and 37 captures (2 lethal) of green sea turtles				Relocation Trawling: 700 (0 lethal) total; Of these, ≤ 100 GOM, ≤ 350 NYB DPS, ≤ 100 CB DPS; ≤50 Carolina DPS; ≤150 SA DPS	
USACE SARBO	3/27/2020	5,484 (214 lethal) and 65 lost egg clutches over 3 years	1,456 (116 lethal) and 1 lost egg clutch over 3 years	860 (118 lethal) and 3 lost egg clutches over 3 years	369 (4 lethal) and 6 lost egg clutches over 3 years	2 (1 lethal) GOM DPS; 39 (5 lethal) NYB DPS; 105 (14 lethal) CB DPS; 366 (47 lethal) Carolina DPS; 572 (73 lethal) SA DPS over 3 years	

5.1.4 Research and Other Permitted Activities

Research activities either conducted or funded by Federal agencies within the action area may adversely affect ESA-listed sea turtles and fish, and may require a section 7 consultation. Several section 7 consultations on research activities have recently been completed, as described below.

NEFSC Fisheries and Ecosystem Research
In October 2021, we completed a programmatic Opinion (NMFS 2021a) on all fisheries and ecosystem research activities to be conducted and funded by the NEFSC from October 2021 to October 2026. Based on the information presented in the Opinion, we anticipated that these fisheries and ecosystem research projects, over the five-year period, would result in the capture of:

- up to 85 NWA DPS of loggerhead sea turtles (ten lethal);
- up to 95 Kemp's ridley sea turtles (15 lethal);
- up to 10 North Atlantic DPS of green sea turtles (non-lethal);
- up to 10 leatherback sea turtles (five lethal);
- up to 10 shortnose sturgeon (one lethal);
- up to 595 Atlantic sturgeon (30 lethal)
    - up to 425 from the NYB DPS (21 lethal),
    - up to 33 from the SA DPS (two lethal),
    - up to 130 from the CB DPS (three lethal),
    - up to 52 from the GOM DPS (three lethal),
    - up to 15 from the Carolina DPS (one lethal), and
    - up to six Canadian origin (non-listed); and
- up to six Gulf of Maine DPS Atlantic salmon (two lethal).

U.S. FWS Funded State Fisheries Surveys
Under the Dingell-Johnson Sport Fish Restoration Grant program and State Wildlife Grant programs, the U.S. FWS Region 5 provides an annual apportionment of funds to 13 Northeast states and the District of Columbia. Vermont and West Virginia are the only two Northeast states that do not use these funds to conduct surveys in marine, estuarine, or riverine waters where ESA-listed species under NMFS jurisdiction are present. The 11 other states (Maine, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia) and the District of Columbia are anticipated to carry out a total of 113 studies, mostly on an annual basis, under these grant programs. There are several broad categories of fisheries surveys including: hook and line; long line; beach seine; haul seine; bottom trawl; surface trawl; fishway trap; fish lift; boat, backpack, and/or barge electrofishing; fyke net; dip net; gill net; push net; hoop net; trap net; cast net; plankton net; pound net; and fish and/or eel pot/trap. These surveys occur in rivers, bays, estuaries, and nearshore ocean waters of those 11 states and the District of Columbia.

We completed an Opinion on this grant program in October 2018 (NMFS 2018b). It bundled together twelve independent actions carried out by the U.S. FWS (i.e., awarding of each grant fund to each state or district is an independent action) and provided an ITS by activity and a summary by state. Overall, we anticipate that the surveys described in the Opinion, which will be carried out by the states from 2018 to 2022 will result in the capture of:

- Up to 37 sea turtles;
- Up to 55 shortnose sturgeon (including eight in beach/haul seine studies, one in the Westfield River fish passage facility, ten in bottom trawl studies, two in gill net studies, and 34 interactions during electrofishing activities); and
- Up to 427 Atlantic sturgeon (including two in beach/haul seine studies, 266 in bottom trawl studies, 158 in gill net studies, and one interaction during electrofishing activities).

The only mortalities that we anticipate to occur are six Atlantic sturgeon (originating from any of the five DPSs) during gillnet surveys carried out by New York, New Jersey, Maryland, and Virginia. A new Opinion for the 2023-2027 time period is currently in production.

Section 10(a)(1)(A) Permits

NMFS has issued research permits under section 10(a)(1)(A) of the ESA, which authorizes activities for scientific purposes or to enhance the propagation or survival of the affected species. The permitted activities do not operate to the disadvantage of the species and are consistent with the purposes of the ESA, as outlined in section 2 of the Act. Active section 10(a)(1)(A) permits for sea turtles and sturgeon are provided in Tables 16 and 17, respectively. No section 10 permits authorizing serious injury or mortality of marine mammals are currently active.

We searched for research permits on the NMFS online application system for Authorization and Permits for Protected Species. The search criteria used confined our search to active permits that include take of sea turtles and Atlantic sturgeon within the Atlantic Ocean. Search criteria also limited the search to research states from Maine to North Carolina. However, many research activities include both the Gulf of Mexico and the Atlantic Ocean, and the requested take did not always specify the waters where take would occur. Thus, some of the requested sea turtle take in Table 17 below includes take for activities outside the action area (i.e., off the Southeast U.S. or in the Gulf of Mexico).

The requested take reported in Tables 16 and 17 only includes take authorized under section 10(a)(1)(A) of the ESA. Permits related to stranding and salvage programs are described in that section. In addition, several research projects included take authorized under other authorities (e.g., under section 7 of the ESA). These takes are included elsewhere in this Opinion and, therefore, are not included here to avoid double counting of take provided under the ESA.

Table 16. Active section 10(a)(1)(A) permits authorizing take of sea turtles for scientific research.

Permittee	File #	Project	Area	Sea Turtle Takes	Research Timeframe
NMFS Southeast Fisheries Center	16733	Demographic and life history studies of sea turtle populations in the Atlantic Ocean, Gulf of Mexico, Caribbean Sea, and tributaries.	Atlantic Ocean DE,MD,NC, NJ,NY,VA	Sample annually 925 loggerheads, 560 greens, 455 Kemp's ridleys, 65 hawksbills, 60 leatherbacks, 10 olive ridleys, and 24 unidentified/hybrid hardshells. In addition, we plan to observe during aerial, vessel, and acoustic surveys annually 2620 loggerheads, 565 greens, 615 Kemp's ridleys, 287 hawksbills, 665 leatherbacks, 37 olive ridleys, and 2170 unidentified hardshells.	5 years, 08/13/2013 to 08/13/2019

NMFS Northeast Fisheries Science Center	17225	Conservation engineering to reduce sea turtle and Atlantic sturgeon bycatch in fisheries in the Northeast Region	U.S. locations including offshore waters	Over the course of the permit: Northern area (NH to NC): 8 green, 8 Kemp's, 8 leatherbacks, 26 loggerheads; no lethal (capture covered under other authorities) over the course of the permit Southern area (SC to GA): 10 green, 8 hawksbill, 62 Kemp's, 8 leatherback, 148 loggerhead. Unintentional (incidental) mortality: 6 unidentified	5 years, 01/01/2017 to 12/31/2021
Coonamessett Farm Foundation, Inc.	18526	Understanding Impact of the Sea Scallop Fishery on Loggerhead Sea Turtles through Satellite Tagging	Western Atlantic waters / Mid-Atlantic Bight from Cape Hatteras, North to NY LIS; and from coastal waters to the shelf break	A maximum of 200 loggerhead (20 captured and sonic tagged/80 approached unsuccessfully and 100 observed and tracked with ROV). Non-Target species: 2 Kemps ridley, green (captured and sonic tagged); 8 Kemp's ridley, green, leatherback, and/or unidentified (approached unsuccessfully); and 20 Kemp's ridley, green, leatherback, and unidentified (observed and tracked with ROV) sea turtles are requested per year.	5 years, 05/27/2015 to 05/31/2020
Robert DiGiovanni Jr, Atlantic Marine Conservation Society	20294	Marine mammal and sea turtle surveys to assess seasonal abundance and distribution in the Mid-Atlantic region.	Atlantic Ocean / Focal area: New York Bight and surrounding waters; Research can occur off MA,RI, CT, NY, NJ, DE, MD, VA and NC	Aerial Surveys: 125 Kemp's ridley, leatherback 85, 450 loggerhead, 450 unidentified.	5 years, 06/02/2017 to 06/01/2022
NMFS Southeast Fisheries Center (SEFSC)	20339	Application for a scientific research and enhancement permit under the ESA; development and testing of gear aboard commercial fishing vessels.	Project A: Turtle Excluder Device (TED) Evaluations in Atlantic and Gulf of Mexico Trawl Fisheries Project B research will occur solely within longline commercial fisheries where the incidental capture is already authorized by an existing ESA Section 7 biological opinion.	Project A, annual take numbers: 220 (70 of these to include capture) loggerheads, 105 (25 of these captures) Kemp's ridleys, 85 (20 of these captures) leatherbacks, 50 (15 of these captures) greens, 30 (10 of these captures) hawksbills, 30 (10 of these captures) olive ridleys, and 75 (25 of these captures) unidentified/hybrid turtles. A subset of these animals will be captured during trawl research authorized under this permit as noted in the parentheses; the rest of the turtles will be captured within fisheries managed by federal authority. Project B, annual take numbers: 30 loggerheads, 10 Kemp's ridleys, 30 leatherbacks, 10 greens, 10 hawksbills, 10 olive ridleys, and 10 unidentified/hybrid turtles. Total over 5 yrs., unintentional mortality: 2 green, 1 hawksbill, 2 Kemp's, 1 leatherback, 3 loggerhead, and 1 olive.	5 years, 05/23/2017 to 05/31/2022

Virginia Aquarium and Marine Science Center	20561	2018 Renewal Request for Virginia Aquarium Sea Turtle Research Permit	Atlantic Ocean, Long Island Sound, Delaware Bay, Chesapeake Bay, North Carolina Sounds / Estuarine and ocean waters from shore to the continental shelf off of NY, NJ, DE, MD, VA and northern NC including inshore brackish waters of bays, sounds and river mouths.	Up to 72 turtles annually (25 green, 22 Kemp's ridley, 25 loggerhead) would be captured, sampled, and tagged. Up to one leatherback sea turtle may be opportunistically captured, sampled, and tagged. 18 turtles will be captured under other authority annually (5 green, 8 Kemp's, and 5 loggerhead)	10 years, 08/24/2018 to 09/30/2027
NMFS Northeast Fisheries Science Center (NEFSC)	21233	Demographic and life history studies of sea turtle populations in the Atlantic Ocean, Gulf of Mexico, Caribbean Sea, and tributaries	Project: 1) Cape Lookout Bight, NC 2) Gulf Stream Surveys, NC 3) North Carolina In-water Studies 4) Leatherback Studies, GOM and Atlantic 5) Biscayne National Park and Chassahowitzka National Wildlife Refuge 6) Florida Keys National Marine Sanctuary 7) Trawl captures in Gulf of Mexico 8) Programmatic In-water Studies	Project 1, 2, and 3: 555 loggerheads, 390 greens, 18 leatherbacks, 360 Kemp's ridleys, 21 hawksbills, 11 olive ridleys, and 18 unidentified hardshell/hybrids Project 4: 50 total leatherbacks captured and satellite tagged per year (25 GOM, 25 Atlantic). And, up to 50 leatherbacks may be observed/pursued during vessel surveys but not captured during unsuccessful capture attempts. Up to 50 leatherbacks may be observed/pursued during aerial surveys but not captured. Possibly up to 25 leatherbacks captured under other authority (e.g., Pelagic Longline Fishery bycatch) Project 5: Up to 140 green turtles, 22 hawksbills, 85 Kemp's ridley and 115 loggerheads will be captured and processed and released in Biscayne National Park or Chassahowitzka annually. Up to 100 green, 50 loggerhead, and 20 Kemp's ridley turtles could be pursued without capture during vessel surveys and capture efforts annually. Project 6: Up to 60 greens, 35 hawksbills, 15 Kemp's ridleys and 30 loggerheads will be captured, processed, and released in the Florida Keys annually. Up to 5 hawksbills could be pursued without capture during survey and capture efforts. Project 7: Capture annually with trawl gear in the Gulf of Mexico 10 greens, 2 hawksbills, 10 Kemp's ridleys, 10 loggerheads, and 2 leatherbacks. Project 8: Up to 60 green turtles, 25 hawksbills, 60 Kemp's ridley, and 60 loggerheads will be captured, processed, and released annually. Up to 25 green turtles, 10 hawksbills, 25 Kemp's ridley, 25 leatherbacks, and 50 loggerheads will be processed and released after being legally captured under another authority (e.g., commercial fisheries, other Section 10 permits)	10 years, 08/07/2018 to 09/30/2027

				annually. All: unintentional lethal take over the life of the permit (all capturing and processing) of 2 loggerheads, 2 Kemp's ridleys, 2 greens, 1 leatherback, 1 olive ridley, and 1 hawksbill	

Table 17. Active section 10(a)(1)(A) permits authorizing take of Atlantic sturgeon for scientific research.

Permittee	File #	Project	Area	Atlantic Sturgeon Takes	Research Timeframe
NMFS Northeast Fisheries Science Center	17225	Conservation engineering to reduce sea turtle and Atlantic sturgeon bycatch in fisheries in the Northeast Region	Western Atlantic waters (Massachusetts through Georgia, including inside COLREGs lines).	Northern area (NH to NC): Non-lethal – 223 sub-adult/adult (capture under other authority) over the course of the permit Southern area (SC to GA): Non-lethal: 204 juvenile/sub-adult/adult over the course of the study Unintentional (incidental) mortality: 6 juvenile/sub-adult/adult over the course of the permit	5 years, 01/01/2017 to 12/31/2021
Connecticut Department of Energy and Environmental Protection, Marine Fisheries	19641	Application to conduct scientific research and monitoring of Shortnose Sturgeon (*Acipenser brevirostrum*) and Atlantic Sturgeon (*A. oxyrinchus oxyrinchus*) in Connecticut Waters and Long Island Sound.	All Connecticut waters	Non-lethal - 300 adult, sub-adult and juvenile annually Unintentional (incidental) mortality: 1 adult/ sub-adult and 1 juvenile annually	10 years, 06/20/2016 to 03/31/2027
University of Maine	20347	Sturgeon of the Gulf of Maine	Gulf of Maine	100 (1 lethal) adults and sub-adults annually 20 (1 lethal) juveniles annually	10 years; 3/31/2017-3/31/2027
Stony Brook University	20351	Atlantic and Shortnose Sturgeon Population Dynamics and Life History in New York and Coastal Marine an Riverine Waters	New York (Long Island Sound), New Jersey, Delaware	685 (up to 30 lethal) juveniles, sub-adults, adults annually	10 years; 02/27/2016-03/31/2027
Delaware State University	20548	Reproduction, habitat use, and inter-basin exchange of Atlantic and Shortnose Sturgeons in the mid-Atlantic	Coastal New York, New Jersey, Delaware	600 (up to 1 lethal) juvenile, sub-adult, and adult annually	10 years; 03/31/2017-03/31/2027
NMFS, Office of Protected Resources	19642	Characterizing juvenile, sub-adult, and adult life stages of endangered Atlantic and Shortnose Sturgeon in the York, Rappahannock, Potomac, and Susquehanna Rivers, their tributaries, the Chesapeake Bay, and the Atlantic Coast.	Atlantic Ocean	200 non-lethal; any life stage (capture under other authority over the course of the permit	5 years; 07/01/2016-06/30/2021

Scientific research on ESA-listed Atlantic salmon has been authorized under the U.S. FWS' endangered species blanket permit (No. 697823) under section 10(a)(1)(A), and covers a number of research projects carried out by NMFS and other research partners contracted by NMFS (e.g., University of Maine). However, the U.S. FWS is anticipating re-structuring their permits. Specifically, the U.S. FWS plans to issue new permits to cover only research directly under the NMFS' direct supervision. The U.S. FWS is also planning to issue separate permits for different research activities conducted through other agencies or partners such as U.S. Geological Survey, Maine Department of Marine Resources (MDMR), and the University of Maine. This will provide a more efficient way of tracking individual take and will allow the U.S. FWS to have a better understanding of ongoing research and level of take associated with these activities through annual reporting requirements.

U.S. FWS is also authorized to conduct the conservation hatchery program at the Craig Brook and Green Lake National Fish Hatcheries. The mission of the hatcheries is to raise Atlantic salmon parr and smolts for stocking into selected Atlantic salmon rivers in Maine. Over 90% of adult returns to the GOM DPS are currently provided through production at the hatcheries. Approximately 600,000 smolts are stocked annually in the Penobscot River. The hatcheries provide a significant buffer from extinction for the species.

NMFS currently cooperates in research on Atlantic salmon in the Penobscot River to document changes in fish populations resulting from both the removal of the Veazie and Great Works projects, as well as the construction of the fish bypass at the Howland project. The study uses boat electrofishing techniques to document baseline conditions in the river prior to construction at the dams. Following dam removal and construction of the fish bypass, researchers will re-sample the river. This research will provide a better understanding of how dam removals and fish bypasses benefit Atlantic salmon.

NMFS also is monitoring biomass and species composition in the estuary to look at system-wide effects of dam removal projects. Although these activities will result in some take of Atlantic salmon, these takes are authorized by the existing ESA permit. The information gained from these activities will be used to further salmon conservation actions in the GOM DPS.

Section 10(a)(1)(B) Permits

Section 10(a)(1)(B) of the ESA authorizes NMFS, under some circumstances, to permit non-federal parties to take otherwise prohibited fish and wildlife if such taking is "incidental to, and not the purpose of carrying out otherwise lawful activities" (50 CFR 217-222). As a condition for issuance of a permit, the permit applicant must develop a conservation plan that minimizes negative impacts to the species. There are currently two active section 10(a)(1)(B) permits in the action area (Table 18). Active permits and permit applications are posted online for all species as they become available at https://www.fisheries.noaa.gov/national/endangered-species-conservation/incidental-take-permits.

Table 18. Active Section 10(a)(1)(B) permits.

Permittee	File #	Project	Area	Annual Endangered Species Takes	Dates
North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries	18102	Inshore anchored gillnet shallow water fishery	State waters of North Carolina: Management unit A - Albemarle, Currituck, Croatan, Roanoke B - Pamlico Sound and the northern portion of Core Sound C - Pamlico, Pungo, Bay, and Neuse river drainages D - southern Core Sound, Back Sound, Bogue Sound, North River, and Newport River E - Atlantic Intracoastal Waterway and adjacent sounds and the New, Cape Fear, Lockwood Folly, White Oak, and Shallotte rivers	Large and small mesh fisheries combined Atlantic sturgeon Carolina DPS Total Lethal: 138 per year Total Non-lethal: 2,124 per year Unit A: 110 lethal and 2,063 non-lethal per year Unit B: 11 lethal and 27 non-lethal per year Unit C: 9 lethal and 10 non-lethal per year Unit D: 4 lethal and 12 non-lethal per year Unit E: 4 lethal and 12 non-lethal per year Atlantic sturgeon other DPS Total Lethal: 31 per year Total Non-lethal: 634 Unit A: 31 lethal and 618 non-lethal Unit B: 0 lethal and 12 non-lethal Unit C: 0 lethal and 4 non-lethal Unit D: no take Unit E: no take	2014-2024
North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries	16230	Inshore anchored gillnet shallow water fishery	State waters of North Carolina: inshore waters 6 management units	Combined take for small and large mesh gillnets Green sea turtle Lethal: 165 per year Non-lethal: 330 per year Either: 18 per year* Kemp's ridley sea turtle Lethal: 49 per year Non-lethal: 98 per year Either: 12 per year* Leatherback sea turtle Lethal: n/a Non-lethal: n/a Either: 8 per year* Loggerhead sea turtle Lethal: n/a Non-lethal: n/a Either: 24 per year* Any species Lethal: n/a Non-lethal: n/a Either: 8 per year* * Observed take, rest are estimated take based on observed take. N/A if not enough observed take occurred to provide an estimate.	2013-2023

5.1.5 Operations of Vessels Carrying Out Federal Actions

Potential sources of adverse effects to sea turtles, sturgeon, and salmon from federal vessel operations in the action area include operations of the U.S. Navy, U.S. Coast Guard (USCG), Bureau of Ocean Energy Management (BOEM), Maritime Administration (MARAD), Environmental Protection Agency (EPA), NOAA and USACE vessels. NMFS has previously conducted formal consultations with the Navy and USCG on their vessel-based operations. NMFS has also conducted section 7 consultations with BOEM and MARAD on vessel traffic related to energy projects and has implemented conservation measures. Through the section 7 process, where applicable, NMFS has and will continue to establish conservation measures for federal vessel operations to avoid or minimize adverse effects to listed species.

5.1.6 Military Operations

NMFS has completed consultations on individual Navy and USCG activities (see https://www.fisheries.noaa.gov/national/endangered-species-conservation/biological-opinions). In the U.S. Atlantic, the operation of USCG boats and cutters are estimated to take no more than one individual sea turtle, of any species, per year (NMFS 1995, 1998b).

In 2018, NMFS issued an Opinion on the U.S. Navy Atlantic Fleet's military readiness training and testing activities and the promulgation of regulations for incidental take of marine mammals (NMFS 2018c). The action area includes the Gulf of Mexico and the western Atlantic. NMFS concluded that the action is not likely to jeopardize the continued existence of NWA DPS loggerhead, leatherback, Kemp's ridley, or North Atlantic DPS green sea turtles and Atlantic sturgeon (Gulf of Maine, New York, Chesapeake Bay, Carolina, and South Atlantic DPSs). For this Opinion, NMFS anticipated the following takes from harm due to exposure to impulsive and non-impulsive acoustic stressors annually: 97 NWA DPS loggerhead, 24 leatherback, five Kemp's ridley, and six North Atlantic DPS green sea turtles. In addition, two lethal takes of loggerhead sea turtles were anticipated. Other sea turtle takes from these stressors are expected to be in the form of harassment. Takes from vessel strikes were anticipated to include the lethal take annually of 75 loggerhead, five leatherback 20 Kemp's ridley, and 55 green sea turtles. Eleven loggerhead, three leatherback, five Kemp's ridley, and four green sea turtles were anticipated have non-lethal injuries. For vessel strikes, the Opinion also anticipates the take of no more than six Atlantic sturgeon (up to one from the Gulf of Maine DPS, one from the New York Bight DPS, six from the Chesapeake Bay DPS, six from the Carolina DPS, and one from the South Atlantic DPS) combined from all DPSs over a five-year period. The ITS did not specify the amount or extent of take of ESA-listed fish, but rather used a surrogate expressed as a distance to reach effects in the water column with injury and sub-injury from acoustic stresses. In addition to takes due to acoustic stressors and vessel strikes, take was estimated to occur as a result of small and large ship shock trials. Forty one (41) NWA DPS loggerhead, 17 leatherback, four Kemp's ridley, and two North Atlantic DPS green sea turtles are anticipated to be harmed over the course of the action. In addition, two lethal takes of loggerheads were estimated.

5.1.7 Offshore Oil and Gas

BOEM oversees leasing of Outer Continental Shelf (OCS) energy and mineral resources; this includes administering the leasing program for OCS oil and gas resources. Currently, BOEM is working under the 2017-2022 National OCS Program, but has initiated a process to develop a program for 2019-2024. No lease sales are scheduled for the Atlantic OCS under the current plan. Under the proposed plan, BOEM has divided the Atlantic OCS into four planning areas: North Atlantic, Mid Atlantic, South Atlantic, and Straits of Florida Planning Areas. The action area overlaps with two of the four Planning Areas (North and Mid Atlantic). The draft proposed program for leasing, published in 2018, calls for leasing in the North Atlantic Planning Area in 2021, 2023 and 2025, and in the Mid Atlantic Planning Area in 2020, 2022 and 2024. At this time, the proposed program has not been approved or finalized.

Geophysical and/or geotechnical surveys to identify hydrocarbon resources would occur if leasing is being pursued in the action area. NMFS recently prepared an Opinion that considered the effects of these activities on ESA-listed species in the action area. It estimated the incidental take of NWA DPS loggerhead, leatherback, Kemp's ridley, and North Atlantic DPS green sea turtles. This take was in the form of harassment through behavioral responses and temporary hearing threshold shifts. The Opinion did not anticipate the death of any individual sea turtles exposed to seismic survey activities. The action was also determined to not likely adversely affect any DPS of Atlantic sturgeon (NMFS 2018d). The activities included in the Opinion were scheduled to be completed by November 30, 2019.

5.1.8 Offshore Renewable Energy

BOEM is responsible for overseeing offshore renewable energy development in federal waters pursuant to the 2009 final regulations for the OCS Renewable Energy Program, which was authorized by the Energy Policy Act of 2005 (EPAct). These regulations provide a framework for issuing leases, easements, and rights-of-way for OCS activities that support production and transmission of energy from sources other than oil and natural gas (i.e., offshore wind and hydrokinetic projects).

Under the renewable energy regulations (30 CFR § 585), the issuance of leases and subsequent approval of wind energy development on the OCS is a staged decision making process and occurs over several years with each step having varying impacts to marine and/or terrestrial resources. The process follows these general steps: lease issuance, site assessment plan approval, and construction and operation plan (COP) review/approval including permitting with cooperating agencies. NMFS has carried out programmatic consultations with BOEM to address the effects of issuance of leases and site assessment activities associated with offshore wind energy. These consultations consider effects from of a suite of activities on listed sea turtles, Atlantic sturgeon, and other species. The expected effects of the actions considered result from temporary exposure to acoustic sources (e.g., geophysical survey equipment) that may result in behavioral disturbance of individuals. No take in the form of injury or mortality is anticipated.

As of June 2023, BOEM has issued nearly 40 leases for commercial offshore wind site development along the U.S. Atlantic coast (see https://www.boem.gov/Lease-and-Grant-Information/; accessed June 7, 2023). A variety of site assessment activities have been completed or are ongoing within the lease blocks, including the use of meteorological buoys or towers at some sites. The effects of these activities on ESA-listed species were considered in the programmatic consultation above. No injury or mortality of any ESA-listed species have been reported to date during construction activities, although a few interactions and mortalities of sea turtles and Atlantic sturgeon have been recorded during associated fisheries surveys (NMFS unpublished data).

In order for an offshore wind facility on the OCS to be built, BOEM must approve a COP; proposed approval of the COP is the federal action that triggers review under NEPA and ESA section 7 consultation. Generically, effects to be considered include (but are not limited to) noise (pile driving, vessels, surveys), vessel strikes, habitat disturbance/loss, avoidance/displacement from the area, and electromagnetic fields.

In 2014, NMFS conducted a formal consultation on the effects of Deepwater Wind Block Island, LLC's and Deepwater Wind Block Transmission, LLC's proposals to construct and operate the Block Island Wind Farm. No injury of mortality of sea turtles was anticipated. Behavioral disturbance (i.e., harassment) of loggerhead, leatherback, Kemp's ridley, and green sea turtles was anticipated due to exposure to disturbing levels of noise during pile driving. Temporary, short-term behavioral effects due to exposure to underwater noise was also anticipated for Atlantic sturgeon, but NMFS was unable to estimate the number of animals affected.

In 2020, NMFS concluded a formal consultation on the construction, operation, maintenance, and decommissioning of the Vineyard Wind Offshore Energy Project (NMFS 2020f). Vineyard Wind's proposed activity would occur in the northern portion of the 675 square kilometer (166,886 acre) Vineyard Wind Lease Area, also referred to as the wind development area. Under the maximum impact scenario, pile driving during construction is expected to result in harassment of three NWA DPS loggerhead, seven leatherback, one Kemp's ridley, and one North Atlantic DPS green sea turtles. Serious injury or mortality of 17 NWA DPS loggerhead, 18 leatherback, two Kemp's ridley, and two North Atlantic DPS green sea turtles is also anticipated due to vessel strikes. The Opinion also includes estimated levels of take under other scenarios in which the project installs fewer turbines of larger capacity, if such turbines are available, and fewer electrical service platforms (NMFS 2020f).

In April 2023, NMFS also concluded formal consultation on the construction, operation, maintenance, and decommissioning of the Ocean Wind 1 Offshore Energy Project (Lease OCS-A 0498) offshore of New Jersey. Under the maximum impact scenario, pile driving during construction is expected to result in the harassment of 184 NWA DPS loggerhead, seven leatherback, 16 Kemp's ridley, and one North Atlantic DPS green sea turtles. Serious injury or mortality of nine NWA DPS loggerhead, one leatherback, one Kemp's ridley, and one North Atlantic DPS green sea turtle is also anticipated due to vessel strikes. The Opinion also exempts incidental takes of sea turtles and Atlantic sturgeon during associated fisheries resource surveys, although no serious injuries or mortalities of either species are anticipated (NMFS 2023).

5.2 Non-Federally Regulated Fisheries

Several fisheries for species not managed by a federal FMP occur in state waters of the action area, as well as fishing by dually permitted vessels (i.e., those possessing both a state and federal permit) when operating under their state permit (NMFS 2021c). In addition, unmanaged fisheries (e.g., hagfish) may occur in federal waters. The amount of gear contributed to the environment by all of these fisheries together is currently unknown. In most cases, there is limited observer coverage of these fisheries, and the extent of interactions with ESA-listed species is difficult to estimate. Sea turtles and Atlantic sturgeon may be vulnerable to capture, injury, and mortality in a number of these fisheries. Captures of loggerhead, leatherback, Kemp's ridley, and green sea turtles (SEFSC 2001, 2009; Murray 2006, 2008, 2009a, 2009b, 2013, 2015b, 2018, 2020; Warden 2011a, 2011b; Murray and Orphanides 2013) and Atlantic sturgeon (ASSRT 2007; ASMFC 2017) in these fisheries have been reported through state reporting requirements, research studies, VTRs, NEFSC observer programs, and anecdotal reports.

Sea turtles may interact with fishing gear in state waters. Interactions have been documented with loggerhead, leatherback, Kemp's ridley, and green sea turtles. Gear types used in these fisheries include hook-and-line, gillnet, trawl, pound net and weir, pot/trap, seines, and channel nets. The magnitude and extent of interaction in many of these fisheries is largely unknown. Through the Annual Determination, NMFS identifies U.S. fisheries that are required to take observers upon request. The goals of this coverage is to learn more about interactions in that fishery, evaluate existing measures to prohibit take, and to determine if additional measures may be needed. It is not intended to be a comprehensive list of fisheries with interactions or suspected interactions, but rather those fisheries that NMFS intends to observe over a five-year period (see Table 19 for current listing).

Table 19. Fisheries currently listed under the Annual Determination in the action area and vicinity.

Fishery	Years Eligible to Carry Observers
Southeastern U.S. Atlantic, Gulf of Mexico shrimp trawl	2020-2025
Long Island inshore gillnet	2020-2025
Chesapeake Bay inshore gillnet	2020-2025
Mid-Atlantic gillnet	2023-2027

The available bycatch data for FMP fisheries indicate that sink gillnets and bottom otter trawl gear pose the greatest risk to Atlantic sturgeon, although they are also caught by hook and line gear, fyke nets, pound nets, drift gillnets, and crab pots (ASMFC 2017). It is likely that this vulnerability to these types of gear is similar to federal fisheries, although there is little data available to support this. Information on the number of Atlantic sturgeon captured or killed in non-federal fisheries, which primarily occur in state waters, is extremely limited. An Atlantic sturgeon "reward program" provided commercial fishermen monetary rewards for reporting captures of Atlantic sturgeon in Maryland's Chesapeake Bay from 1996 to 2012 (Mangold et al. 2007). The data from this program show that Atlantic sturgeon have been caught in a wide variety of gear types, including hook and line, pound nets, gillnets, crab pots, eel pots, hoop nets, trawls, and fyke nets. Pound nets (58.9%) and gillnets (40.7%) accounted for the vast majority of captures. Of the more than 2,000 Atlantic sturgeon reported in the reward program over a 16-year period from 1996-2012, biologists counted ten individuals that died because of their capture. No information on post-release mortality is available (Mangold et al. 2007).

Efforts are currently underway to obtain more information on the number of Atlantic sturgeon and sea turtles captured and killed in state-water fisheries. Atlantic sturgeon are also vulnerable to capture in state-water fisheries occurring in rivers, such as shad fisheries; however, these riverine areas are outside of the action area considered in this Opinion. Where available, specific information on protected species interactions in non-federal fisheries is provided below.

Atlantic croaker fishery

Along the U.S. Atlantic coast, Atlantic croaker are most abundant from the Chesapeake Bay to northern Florida. The Atlantic croaker fishery is managed by the ASMFC. The fishery is prosecuted with bottom trawl and gillnet gear. In 2018, the majority (97%) of commercial landings (in pounds) in came from Virginia (53%) and North Carolina (44%); the majority of recreational landings (in number of fish) were from Virginia (68%) and Florida (13%) (Atlantic

Croaker Plan Review Team 2019). Sea turtle interactions have been documented in this fishery. In previous bycatch estimates where loggerhead bycatch was prorated by managed species landed, croaker was one of the fisheries with a higher number of takes for trawl (Murray 2015b) and gillnet gear (Murray 2018). Atlantic sturgeon interactions have also been observed in the Atlantic croaker fishery, but a quantitative assessment of the number of Atlantic sturgeon captured in the croaker fishery is not available. A mortality rate of Atlantic sturgeon in commercial trawls has been estimated at 5%. An earlier review of bycatch rates and landings for the weakfish fishery reported that the weakfish-Atlantic croaker fishery had an Atlantic sturgeon bycatch rate of 0.02% from 1989-2000. Bycatch rates were the ratio of sturgeon catch weight to the catch weight of all species landed (Stein et al. 2004b; ASSRT 2007). The ASSRT notes that the estimates can be heavily biased and the error rate large as observer coverage was not equal between fisheries or months of sampling and error (ASSRT 2007). In addition, fisheries have changed significantly since these estimates and, therefore, they are likely not applicable to contemporary fisheries.

Weakfish fishery

Weakfish are found Nova Scotia to southeastern Florida, but are more common from New York to North Carolina. The weakfish fishery occurs in both state and federal waters. Most commercial landings occur in the fall and winter months (Weakfish Plan Review Team 2019). The dominant commercial gear is gillnets with about 55% of commercial landings. There has been a shift in the dominant source of landings from trawls in the 1950s to 1980s to gillnets from the 1990s to present (Weakfish Plan Review Team 2019). Other gears include pound nets, haul seines, and beach seines (ASMFC 2016). North Carolina (34%), New York (23%), and Virginia (22%) had the largest share of the harvest in 2018 (Weakfish Plan Review Team 2019). North Carolina dominates commercial harvest, followed by Virginia and New Jersey. Together, these states have consistently accounted for 70-90% of the coast-wide commercial harvest since 1950 (ASMFC 2016; Weakfish Plan Review Team 2019). The recreational fishery catches weakfish using live or cut bait, jigging, trolling, and chumming, and the majority of fish are caught in state waters. The recreational fishery primarily occurs in state waters between New York and North Carolina (Weakfish Plan Review Team 2019).

Sea turtle bycatch in the weakfish fishery has occurred. NMFS originally assessed the impacts of the fishery on sea turtles in an Opinion issued in 1997 (NMFS 1997). While recent gillnet bycatch estimates for 2007-2011 (Murray 2013) and 2012-2016 (Murray 2018) prorated the bycatch by species landed, they did not include an estimate of loggerhead bycatch estimate in the weakfish gillnet fishery. In an estimate of bycatch from 2002-2006, one loggerhead sea turtle was estimated to have been captured in the weakfish fishery based on a proration by species landed (Murray 2009a). These estimates encompassed both state and federal waters.

A quantitative assessment of the number of Atlantic sturgeon captured in the weakfish fishery is not available. A mortality rate of Atlantic sturgeon in commercial trawls has been estimated at 5%. Weakfish has also been identified as the top landed species on observed trips where sturgeon were incidentally captured (NEFSC observer/sea sampling database, unpublished data). In addition, as described above, the weakfish-striped bass fishery was identified as having higher bycatch rates using data from 1989-2000 (ASSRT 2007); however, there are a number of caveats associated with this data.

Whelk/conch fishery
A whelk/conch fishery occurs in several parts of the action area, including waters off Maine, Massachusetts, Connecticut, New York, New Jersey, Delaware, Maryland, and Virginia. While pot gear is the predominant gear used, whelk/conch are also harvested by hand and dredge. The fishery is limited entry in Massachusetts, New York, New Jersey and Virginia. Species targeted include waved, Stimpson, channeled, and knobbed whelk. Unlike lobster, there is no uniform, coast-wide management of the whelk fishery. Each state manages the fishery individually. Requirements often include licenses, gear marking, pot limits, and buoy line requirements.

Whelk fisheries overlap in time and space with sea turtles. Loggerhead, leatherback, and green sea turtles are known to become entangled in lines associated with pot/trap gear used in several fisheries including lobster, finfish, whelk, and crab species (GAR STDN, unpublished data). Unlike lobster pots, whelk pots in this area are not fully enclosed. This design of whelk pots has been suggested as a potential source of entrapment for loggerhead sea turtles that may be enticed to enter the trap to get the bait or whelks caught in the trap (Mansfield et al. 2001). Whelk fisheries in Massachusetts, New York, Delaware, Maryland, and Virginia were confirmed or probable fisheries involved in 22 sea turtle entanglements from 2009-2018. Seventeen entanglement events involved a leatherback sea turtle and five involved a loggerhead sea turtle. An additional 18 leatherbacks were entangled in either multiple gears (e.g., conch and lobster) or in gear where the fisherman held multiple permits, including conch, and the exact gear could not be identified. Green sea turtles have been documented in whelk/conch gear in previous years (GAR STDN, unpublished data). Atlantic sturgeon interactions with trap/pot gear have never been observed or documented and; therefore, this gear type is not expected to be a source of injury or mortality to these species.

Crab fisheries
Crab fisheries use a variety of gears including hand, pot/trap, trawl, and dredge. These fisheries occur in federal and state waters and target species such as blue, Jonah, rock and horseshoe crab. While the blue crab fishery occurs throughout the Mid-Atlantic south to the Gulf of Mexico, Maryland, Virginia, and North Carolina harvesters prosecute the majority of the effort. The Chesapeake Bay Program's Blue Crab Management Strategy indicates that there are multiple commercial and recreational gear types, various season lengths and regulations in three management jurisdictions. Fishing practices and the resulting harvest vary because of the complex ways crabs migrate and disperse throughout Chesapeake Bay.

The Jonah and rock crab fisheries may be prosecuted in conjunction with the lobster fishery. In this case, lobster traps are likely to be used. Depending on state regulation, other style traps may be available for use. Jonah crabs are harvested from deeper waters than rock crabs, and presently, are more highly valued. The commercial Jonah crab fishery is centered around Massachusetts and Rhode Island, though landings occur throughout New England and Mid-Atlantic states. The majority of horseshoe crab harvest comes from the Delaware Bay region, followed by the New York, New England, and the Southeast regions. Trawls, hand harvests, and dredges make up the bulk of commercial horseshoe crab landings.

Sea turtles can become entangled in the vertical lines of pot/trap gear when they overlap with these fisheries. From 2009-2018, records (confirmed and probable) show five leatherbacks and seven loggerhead sea turtles interacted with the vertical lines of crab gear in New Jersey and Virginia (GAR STDN, unpublished data). While these are where takes have been reported, interactions could occur wherever crab gear and sea turtles overlap. Interactions are primarily associated with entanglement in vertical lines, although sea turtles can also become entangled in groundline or surface systems. In 2007, a leatherback sea turtle was entangled in the lines connecting whelk pots (GAR STDN, unpublished data). In 2012, a leatherback was entangled in the surface system of a mooring buoy (GAR STDN, unpublished data), indicating that interactions with surface systems are possible.

Horseshoe crab has also been identified as the top species landed on trips that have incidentally taken sea turtles (NEFSC observer/sea sampling database, unpublished data). These takes were documented in trawl gear. Based on a proration of landings, two loggerheads on average annually were estimated to have been taken in the horseshoe crab trawl fishery from 2009-2013 (Murray 2015b).

The crab fisheries may have other detrimental impacts on sea turtles beyond entanglement in the fishing gear itself. Loggerheads are known to prey on crab species, including horseshoe and blue crabs. In a study of the diet of loggerhead sea turtles in Virginia waters from 1983 to 2002, Seney and Musick (2007) found a shift in the diet of loggerheads in the area from horseshoe and blue crabs to fish, particularly menhaden and Atlantic croaker. The authors suggested that this shift in loggerhead diet may be due to a decline in the crab species (Seney and Musick 2007). The physiological impacts of this shift are uncertain, although, Mansfield (2006) suggested it as a possible explanation for the declines in loggerhead abundance. Maier et al. (2005) detected seasonal declines in loggerhead abundance coincident with seasonal declines of horseshoe and blue crabs were detected in the same area. While there is no evidence of a decline in horseshoe crab abundance in the Southeast during the period 1995-2003, declines were evident in some parts of the Mid-Atlantic (ASMFC 2004; Eyler et al. 2007). Given the variety of loggerheads prey items (Dodd 1988; Burke et al. 1993; Bjorndal 1997; Morreale and Standora 1998) and the differences in regional abundance of horseshoe crabs and other prey items (ASMFC 2004; Eyler et al. 2007), a direct correlation between loggerhead sea turtle abundance and horseshoe crab and blue crab availability cannot be made at this time. Nevertheless, the decline in loggerhead abundance in Virginia waters (Mansfield 2006) and possibly Long Island waters (Morreale and Standora 2005), coincident with noted declines in the abundance of horseshoe crab and other crab species, raised concerns that crab fisheries may be impacting the forage base for loggerheads in portions of their range.

Atlantic sturgeon are known to be caught in state water horseshoe crab fisheries using trawl gear (Stein et al. 2004b). With the exception of New Jersey state waters, the horseshoe crab fishery operates in all state waters that occur in the action area. Along the U.S. East Coast, hand, bottom trawl, and dredge fisheries account for the majority (86% in the 2017 fishery) of commercial horseshoe crab landings in the bait fishery. Other methods used to land horseshoe crab are gillnets, fixed nets, rakes, hoes, and tongs (ASMFC 2019a; Horseshoe Crab Plan Review Team 2019). For most states, the bait fishery is open year round. However, the fishery operates at different times due to movement of the horseshoe crab. New Jersey has prohibited commercial harvest of horseshoe crabs in state waters (N.J.S.A. 23:2B-20-21) since 2006 (Horseshoe Crab Plan Review Team 2019). State waters of Delaware are closed to horseshoe crab harvest and landing from January 1 through June 7 each year (7 Del Admin. C § 3200). Other states also regulate various seasonal and area closures and other state horseshoe crab fisheries are regulated with various seasonal/area closures (Horseshoe Crab Plan Review Team 2019). The majority of horseshoe crab landings from the bait fishery from 2014-2018 came from Maryland, Delaware, New York, Virginia, and Massachusetts (Horseshoe Crab Plan Review Team 2019). There is also a smaller fishery for biomedical uses.

An evaluation of bycatch of Atlantic sturgeon using the NEFSC observer/sea sampling database (1989-2000) found that the bycatch rate for horseshoe crabs was low, at 0.05% (Stein et al. 2004b). An Atlantic sturgeon "reward program," where commercial fishermen were provided monetary rewards for reporting captures of Atlantic sturgeon in the Maryland waters of Chesapeake Bay operated from 1996 to 2012.[8] From 1996-2006, the data showed that one of 1,395 wild Atlantic sturgeon was found caught in a crab pot (Mangold et al. 2007).

Fish Trap, Seine, and Channel Net Fisheries
Incidental captures of sea turtles in fish traps have been reported from several states along the U.S. Atlantic coast (GAR STDN, unpublished data). From 2009-2018, records (confirmed and probable) documented 22 leatherback, two Kemp's ridley, six loggerheads, and one unknown sea turtle in pound nets/weirs from Maine through Virginia. Of the 31 interactions, seven animals were documented free swimming (GAR STDN, unpublished data). In this gear, sea turtles may become entangled in the gear or be free swimming in the pound/weir.

The Virginia pound net fishery is contiguous to the action area at the mouth of Chesapeake Bay. Sea turtle interactions with the Virginia pound net fishery have been documented, and interactions reported to the Greater Atlantic Region Sea Turtle Disentanglement Network (GAR STDN) are included above. NMFS has taken regulatory action to address sea turtle bycatch in the Virginia pound net fishery. The most recent Opinion on this fishery anticipated the take of up to 805 (one lethal) loggerhead, 161 Kemp's ridley (one lethal), 16 green (one lethal), and 11 Atlantic sturgeon (none lethal) in the pound and heart portions of the gear. The leaders may also capture sea turtles and Atlantic sturgeon. NMFS anticipated that up to one loggerhead (lethal), one Kemp's ridley (lethal), one green (lethal), eight leatherback (four lethal), and two Atlantic sturgeon (one lethal) could occur annually (NMFS 2018e).

Long haul seines, beach seines, purse seines, and channel nets are also known to incidentally capture sea turtles in sounds and other inshore waters along the U.S. Atlantic coast, although no lethal interactions have been reported (SEFSC 2001). No information on interactions between Atlantic sturgeon and fish traps, long haul seines, or channel nets is currently available; however, depending on where this gear is set and the mesh size, the potential exists for Atlantic sturgeon to be entangled or captured in net gear.

American lobster trap fishery
An American lobster trap fishery occurs in state waters of New England and the Mid-Atlantic and is managed under the Commission's ISFMP. Like the federal waters component of the fishery, the state waters fishery uses trap/pot gear to land lobster. Trap/pot gear is known to

[8] The program was terminated in February 2012, with the listing of Atlantic sturgeon under the ESA.

entangle sea turtles. Often for these entanglements, the gear cannot be documented to a specific fishery.

Leatherback, loggerhead, green, and Kemp's ridley sea turtles are known to interact with trap/pot gear. As described above, interactions are primarily associated with entanglement in vertical lines. Records of stranded or entangled sea turtles indicate that fishing gear can wrap around the neck, flipper, or body of the sea turtle and severely restrict swimming or feeding (GAR STDN, unpublished data; NMFS STSSN, unpublished data). As a result, these interactions often result in the injury or mortality to sea turtles.

As described in the GARFO batched fisheries Opinion (NMFS 2021c), there were 81 leatherback entanglements from 2009-2018 in state and unknown waters confirmed to the lobster fishery. Two of the cases were confirmed to recreational pot gear. All entanglements involved the vertical line of the gear. These verified/confirmed entanglements occurred in waters off Maine, Massachusetts, and Connecticut from May through October. The majority were documented in waters off Massachusetts (GAR STDN, unpublished data).

Atlantic sturgeon interactions with trap/pot gear have never been observed (NEFSC observer/sea sampling database, unpublished data) or documented; therefore, this gear type is not expected to be a source of injury or mortality to this species.

American shad fishery
An American shad fishery occurs in state waters of New England and the Mid-Atlantic and is managed under the Commission's ISFMP. Amendment 3 to the ISFMP requires states and jurisdictions to develop sustainable FMPs, which are reviewed and approved by the Commission's Technical Committee, in order to maintain recreational and commercial shad fisheries (ASMFC 2010). Eight entities in the action area have developed these FMPs. The fishery occurs in rivers and coastal ocean waters. In 2005, the directed at-sea fishery was closed and subsequent landings from the ocean are only from the bycatch fishery. Given this, the fishery is not expected to interact with sea turtles.

In the past, approximately 40-500 Atlantic sturgeon were reportedly captured in the spring shad fishery in Delaware. In recent years, this fishery has turned more to striped bass. Most of the Atlantic sturgeon were captured in the Delaware Bay, with only 2% caught in the Delaware River. The fishery uses five-inch mesh gillnets that are left to soak overnight; based on the available information, there is little bycatch mortality (NMFS 2011). Recreational hook and line shad fisheries are known to capture Atlantic sturgeon, particularly in southern Maine.

Striped Bass Fishery
Since 1981, the ASMFC has managed striped bass, from Maine to North Carolina through an ISFMP. The striped bass fishery occurs only in state waters. With the exception of a defined area around Block Island, Rhode Island for possession, federal waters have been closed to the harvest and possession of striped bass since 1990. All states are required to have recreational and commercial size limits, recreational creel limits, and commercial quotas. The commercial striped bass fishery is closed in Maine, New Hampshire, and Connecticut, but open in Massachusetts

(hook and line only), Rhode Island, New Jersey (hook and line only), Delaware, Maryland, and Virginia. Recreational striped bass fishing occurs all along the U.S. East Coast.

The striped bass fishery uses gears known to interact with sea turtles, including trap, pound nets, gillnets, trawl, and hook-and-line (ASMFC 2020). When prorated by species landed, striped bass was one of the trawl and gillnet fisheries in which sea turtles were estimated (Murray 2015b; Murray 2018). Several states have reported incidental catch of Atlantic sturgeon during striped bass fishing activities (NMFS 2011). In southern Maine and New Hampshire, the recreational striped bass fishery is known to catch Atlantic sturgeon, although numbers are not available. There are also numerous reports of Atlantic sturgeon bycatch in recreational striped bass fishery along the south shore of Long Island, particularly around Fire Island and Far Rockaway. Unreported mortality is likely occurring.

Data from the Atlantic Coast Sturgeon Tagging Database showed that from 2000-2004, the striped bass fishery accounted for 43% of Atlantic sturgeon recaptures (ASSRT 2007). The striped bass-weakfish fishery also had one of the highest bycatch rates of 30 directed fisheries according to NMFS Observer Program data from 1989-2000 (ASSRT 2007).

State gillnet fisheries
State gillnet fisheries occur in many portions of the action area. However, limited information is available on interactions between these fisheries and protected species. Large and small mesh gillnet fisheries occur in state waters. For example, the black drum shark gillnet fisheries in Virginia state waters fisheries uses large mesh (10- to 14-inch) gillnets. Meshes smaller than 10 inches are used in the croaker and dogfish fisheries. Entanglements of sea turtles in large mesh gillnet sets targeting and/or landing black drum have been recorded (NEFSC observer/sea sampling database, unpublished data). Similarly, sea turtles are vulnerable to capture in small mesh gillnet fisheries occurring in state waters. Observer coverage in state gillnet fisheries has been limited. For example, 31 trips were observed in the Long Island Sound gillnet fishery from 2014 through 2018. There has also been limited coverage on coastal gillnet fisheries in the mid-Atlantic on vessels with federal permits and, to a lesser extent, vessels with state only permit. Through this limited coverage, interactions have been recorded with Kemp’s ridley, loggerhead, green, and leatherback sea turtles in gillnets operating in state waters (NEFSC observer/sea sampling database, unpublished data). As gillnet gear is known to pose an interaction risk to listed species of sea turtles and Atlantic sturgeon, these fisheries have the potential to interact with these species when the fisheries overlap with them.

High levels of sea turtle strandings in North Carolina in 1999 were determined to likely result from incidental capture in the large mesh gillnet fishery in Pamlico Sound. Since 2000, NMFS has issued five ESA section 10(a)(1)(B) incidental take permits (65 FR 65840, November 2, 2000; 66 FR 51023, October 5, 2001; 67 FR 67150, November 4, 2002; 70 FR 52984, September 6, 2005; 78 FR 57132, September 17, 2013) to the North Carolina Division of Marine Fisheries (NC DMF) authorizing the incidental take of sea turtles in certain components of the gillnet fishery. The most recent permit (78 FR 57132, September 17, 2013) authorizes the take through August 2023. Required measures under the permit include restricted soak times, restricted net lengths, attendance requirements, time-area closures, and adaptive management (78 FR 57132, September 17, 2013). NC DMF also has a permit for the incidental take of Atlantic sturgeon

DPSs associated with the inshore gillnet fishery. The conservation plan requires specific monitoring for Atlantic sturgeon. If allowable thresholds are approached, NC DMF will place additional restrictions (e.g., closures, attendance requirements) on the fishery. In addition, the observer coverage will identify and adaptively respond to "hotspots" (79 FR 43716, July 28, 2014). The level of take specified in these permits is detailed in section 5.1.4.

The 2017 Benchmark Assessment (ASMFC 2017) used data from NEFOP, the North Carolina gillnet fisheries, and the South Carolina American shad gillnet fishery to assess Atlantic sturgeon bycatch. For the North Carolina gillnet fisheries predicted bycatch for 2004-2005 ranged from 1,286 Atlantic sturgeon in 2011 to 13,668 in 2008. The Atlantic sturgeon caught in this fishery were primarily juveniles. The percent observed sturgeon that died ranged from 0-20% with an overall mean of 6%. Estimates of dead discards ranged from 0-424 fish (ASMFC 2017).

In 2017, 167 Atlantic sturgeon were reported as bycatch from state water fisheries (0-3 miles offshore, including rivers and estuaries). This included 51 fish in the North Carolina gillnet fishery. Connecticut (15), Maryland (1), and Virginia (11) also reported bycatch in 2017 (ASMFC 2019).

State Trawl Fisheries

Trawl fisheries also occur in state waters in the action area. Virginia (VA Code Ann. §28.2-315), New Hampshire (NH Rev Stat §21149), and Delaware (7 Del C §927) prohibit trawling in state waters. Other states such as Maryland prohibit its use in certain areas.

A Northern shrimp fishery has occurred in waters off Maine, New Hampshire, and Massachusetts, and is managed under the ASMFC's ISFMP. Due to recruitment failure and a collapsed stock, fishing moratoria were instituted by the ASMFC for the 2014-2018 fishing seasons. In November 2018, the ASMFC's Northern Shrimp Section extended the moratorium on commercial fishing through 2021. The majority of northern shrimp are caught with otter trawls, which must be equipped with Nordmore grates (ASMFC NSTC 2011). When the fishery is open, it is a winter fishery with the season occurring between December 1 and May 31 (ASMFC 2017).

Bottom otter trawls in the Northern shrimp fishery are known to interact with Atlantic sturgeon, but exact numbers are not available (NMFS 2011). A majority (84%) of Atlantic sturgeon bycatch in otter trawls occurs at depths <20 meters, with 90% occurring at depths of <30 meters (ASMFC 2007). During the NEFSC's spring and fall inshore northern shrimp trawl surveys, northern shrimp are most commonly found in tows with depths of >64 meters (ASMFC NSTC 2011), which is well below the depths at which most Atlantic sturgeon bycatch occurs. Given that the Northern shrimp trawl fishery is a winter fishery, it is not expected to overlap with sea turtles in the action area.

Other trawl fisheries occur in state waters, but information is limited. In these fisheries, the gear may operate along or off the bottom. From 2009-2018, observers documented the take of Kemp's ridley, loggerhead, green, and leatherback sea turtles in state waters (NEFSC observer/sea sampling database, unpublished data). The top landed species on trips that captured turtles included scup, summer flounder, longfin squid, horseshoe crab, and butterfish. Atlantic sturgeon have also been observed captured on state trawl fisheries from 2009-2018. Top landed species on these trips included, among others, summer flounder, little skate, scup, butterfish, longfin squid, spiny dogfish, smooth dogfish, and bluefish. Information available on interactions between ESA-listed species and these fisheries is incomplete.

State recreational fisheries
Observations of state hook and line recreational fisheries have shown that loggerhead, leatherback, Kemp's ridley, and green sea turtles can interact with recreational fishing gear. When swimming near rod and reel fishing gear, sea turtles can be "foul-hooked" on the flipper or entangled in the fishing line. Sea turtles are also known to bite the bait and become hooked in the mouth or esophagus, or swallow the hook. Most of the reports of interactions come from fishing piers, but there are also reports of offshore captures (NMFS and U.S. FWS 2008). A summary of known impacts of hook-and-line captures on loggerhead and Kemp's ridley sea turtles can be found in the TEWG (1998, 2000, 2009) reports.

Stranding data also provide evidence of interactions between recreational hook-and-line gear and sea turtles. While data from stranded animals contain certain biases and cannot be used to quantify the magnitude of a particular threat, it does provide some information on interactions with recreational gear. From Maine through Virginia, there were 186 cases reported from 2016-2018 in the STSSN database in which recreational fishing gear was present (NMFS STSSN, unpublished data). This included 36 loggerhead, 122 Kemp's ridley, two green, one leatherback, and 25 unknown turtles. NMFS conducts outreach on what to do if you hook or entangle a sea turtle while fishing. In addition, Virginia Aquarium's Stranding Response Program has developed a pier partner program that provides signage for the pier and training to the pier operator on what to do if a sea turtle is hooked. Since the program began in 2014, there have been 253 reports received with 172 animals admitted. In 2018, the Aquarium received a record number of hooked turtle reports. Of the 66 reported cases, they admitted 45 sea turtles for exam. Almost 87% of these were Kemp's ridleys. Sea turtle captures on recreational hook and line gear are not uncommon, but the overall level of take and post-release mortality are unknown.

Shortnose and Atlantic sturgeon have also been observed captured in state recreational fisheries, yet the total number of interactions that occur annually is unknown. There have been no post-release survival studies for this species. However, we anticipate that sturgeon will likely be released alive, due to the overall hardiness of the species. NMFS also engages in educational outreach efforts on disentanglement, release, and handling and resuscitation of sturgeon.

5.3 Other Activities

5.3.1 Maritime Industry

Private and commercial vessels, including fishing vessels, operating in the action area of this consultation also have the potential to interact with ESA-listed species. The effects of fishing vessels, recreational vessels, or other types of commercial vessels on listed species may involve disturbance or injury/mortality due to collisions or entanglement in anchor lines. Commercial traffic and recreational pursuits can also adversely affect ESA-listed species through propeller and boat strikes. Vessel interactions have been documented with sea turtles and sturgeon. The extent of the problem is difficult to assess because the interactions occur at sea and are often only detected when the animal strands. It is also often not known if the animal was struck pre- or post-mortem. It is important to note that although minor vessel collisions may not kill an animal directly, they may weaken or otherwise affect an animal, which may make it more vulnerable to other threats.

5.3.2 Pollution

Anthropogenic sources of marine pollution, while difficult to attribute to a specific federal, state, local, or private action, may affect ESA-listed species in the action area. Sources of pollutants in the action area include atmospheric loading of pollutants (e.g., PCBs); storm water runoff from coastal towns, cities, and villages; runoff into rivers emptying into bays; groundwater discharges; sewage treatment plant effluents; and oil spills. Oil spills may affect ESA-listed species either directly or through the food chain.

Degraded water quality from point and non-point sources can impact protected species. Run-off can introduce pesticides, herbicides, and other contaminants into the system on which these species depend. Contaminants could degrade habitat if pollution and other factors reduce the food available to marine animals. In 2017, NMFS completed an Opinion on the EPA's registration of certain pesticides (NMFS 2017d). Effects ranged from killing species directly to reductions in prey, and impaired growth. Species likely to be affected include, among others, sea turtles and Atlantic sturgeon (all five DPSs). In specifying the ITS, NMFS identified surrogates for anadromous fish and sea turtles (NMFS 2017d).

Oil spills, resulting from anthropogenic activities (e.g., commercial vessel traffic/shipping), directly and indirectly affect all components of the marine ecosystem. Larger oil spills may result from severe accidents, although these events would be rare. The pathological effects of oil spills on sea turtles specifically have been documented in several laboratory studies (Vargo et al. 1986). There have been a number of documented smaller oil spills in the northeastern U.S.

As many ESA-listed species ranges extend beyond that of the action area, oil spills that occur outside the action area, but within the range of the species, also have the potential to affect ESA-listed species that occur within the action area. For instance, on April 20, 2010, the Deepwater Horizon oil spill occurred off the coast of Louisiana in the Gulf of Mexico. The effects of this spill on ESA-listed species are discussed in the *Status of the Species* section.

Marine debris (e.g., discarded fishing line, boat lines, and plastics) can directly or indirectly affect listed species. Discarded line (fishing or boat) can entangle sea turtles, sturgeon, or salmon causing injury or mortality. Sea turtles may ingest plastic and other marine debris, which they could mistake for food. For instance, jellyfish are a preferred prey for leatherbacks, and plastic bags, which may look like jellyfish to the turtles, are often found in the turtles' stomach contents (NRC 1990; Mrosovsky et al. 2009; Schuyler et al. 2014; Nelms et al. 2015). While marine debris is known to affect these species, the effects have not been quantified and impacts at the population level are not well understood.

5.3.3 Coastal development

Beachfront development, lighting, and beach erosion control are ongoing activities along the coastlines of the U.S. and within the action area. In the U.S. Mid-Atlantic and Southeast, these activities potentially reduce or degrade sea turtle nesting habitats or interfere with hatchling movement to sea. Human activities along nesting beaches at night may also discourage sea turtles from nesting sites. The extent to which these activities reduce sea turtle nesting and hatchling production is unknown. However, more and more coastal counties are adopting stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting. Coastal development may also impact sturgeon and salmon if it disturbs or degrades foraging habitats or otherwise affects the ability of sturgeon to use coastal habitats.

5.4 Reducing Threats to ESA-listed Species

Numerous efforts are ongoing to reduce threats to listed sea turtles, sturgeon, and salmon. Below, we detail efforts that are ongoing within the action area. The majority of these activities are related to regulations that have been implemented to reduce the potential for incidental mortality of sea turtles from commercial fisheries. These include sea turtle release gear requirements for Atlantic HMS; TED requirements for Southeast shrimp trawl fishery and the southern part of the summer flounder trawl fishery; mesh size restrictions in the North Carolina gillnet fishery and Virginia's gillnet and pound net fisheries; modified leader requirements in the Virginia Chesapeake Bay pound net fishery; area closures in the North Carolina gillnet fishery; and gear modifications in the Atlantic sea scallop dredge fishery. In addition to regulations, outreach programs have been established and data on sea turtle interactions and strandings are collected. The summaries below discuss all of these measures in more detail.

5.4.1 Education and Outreach Activities

Education and outreach activities are some of the primary tools to effectively reduce the threats to all protected species. For example, NMFS has been active in public outreach to educate fishermen about sea turtle handling and resuscitation techniques, and educate recreational fishermen and boaters on how to avoid interactions with sea turtles and Atlantic sturgeon. NMFS is engaged in a number of education and outreach activities aimed specifically at increasing mariner awareness of the threat of ship strikes to protected species. NMFS also offers educational programs to students. One such program is "SCUTES" (Student Collaborating to Undertake Tracking Efforts for Sturgeon), which offers educational programs and activities about the movements, behaviors, and threats to Atlantic sturgeon. While the effects of these efforts at reducing impacts to protected species cannot be quantified, they are anticipated to reduce impacts through education and promoting stewardship. Outreach occurs through websites, NMFS presence at industry meetings, outreach events and trade shows, publications in industry trade journals and news outlets, and dockside interactions between NOAA staff and industry. NMFS intends to continue these outreach efforts in an attempt to reduce interactions and the likelihood of injury to protected species and to potentially improve the condition of the ESA-listed species or its designated critical habitat in the action area.

5.4.2 Stranding and Salvage Programs

The Sea Turtle Stranding and Salvage Network (STSSN) does not directly reduce the threats to sea turtles. However, the extensive network of STSSN participants along the U.S. Atlantic and Gulf of Mexico coasts not only collects data on dead sea turtles, but also rescues and rehabilitates live stranded turtles, reducing mortality of injured or sick animals. NMFS manages the activities of the STSSN. Data collected by the STSSN are used to monitor stranding levels, to identify areas where unusual or elevated mortality is occurring, and to identify sources of mortality. The data are also used to monitor incidence of disease, study toxicology and contaminants, and conduct genetic studies to determine population structure. All of the states that participate in the STSSN tag live turtles when encountered (either via the stranding network, through incidental takes, or permitted in-water studies). Tagging studies help improve our understanding of sea turtle movements, longevity, and reproductive patterns, all of which contribute to our ability to reach recovery goals for sea turtle species.

NMFS was designated the lead agency to coordinate the Marine Mammal Health and Stranding Response Program (MMHSRP), which was formalized by the 1992 Amendments to the MMPA. The program consists of state volunteer stranding networks, biomonitoring, Analytical Quality Assurance for marine mammal tissue samples, a Working Group on Marine Mammal Unusual Mortality Events (UME) and a National Marine Mammal Tissue Bank. Additionally, a serum bank and long-term storage of histopathology tissue are being developed. The MMHSRP's permit (permit #18786) includes the incidental take of unidentified sea turtles (10), leatherback sea turtles (two), and Atlantic sturgeon (three).

A salvage program operating under an ESA section 10(a)(a)(A) permit is in place for Atlantic sturgeon. Atlantic sturgeon carcasses can provide pertinent life history data and information on new or evolving threats to Atlantic sturgeon. Their use in scientific research studies can reduce the need to collect live Atlantic sturgeon. The NMFS Sturgeon Salvage Program is a network of individuals qualified to retrieve and/or use Atlantic and shortnose sturgeon carcasses and parts for scientific research and education. All carcasses and parts are retrieved opportunistically and participation in the network is voluntary.

5.4.3 Disentanglement Networks

In 2002, in response to the high number of leatherback sea turtles found entangled in pot gear along the U.S. Northeast Atlantic coast, NMFS Northeast Region (now GARFO) established the NMFS Greater Atlantic Region Sea Turtle Disentanglement Network (GAR STDN). The GAR STDN is a component of the larger STSSN program, and operates in all states in the region. The GAR STDN responds to entangled sea turtles, disentangling and releasing live animals, thereby reducing injury and mortality. In addition, the GAR STDN collects data on sea turtle entanglement events, providing valuable information for management purposes. NMFS GARFO oversees the GAR STDN program and manages the GAR STDN database.

Any agent or employee of NMFS, the U.S. FWS, the USCG, any other federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his/her official duties, is allowed to take endangered sea turtles encountered in the marine environment if such taking is necessary to: (1) aid a sick, injured, or entangled endangered sea turtle; (2) dispose of a dead endangered sea turtle; or (3) salvage a dead endangered sea turtle for scientific or educational purposes (70 FR 42508, July 25, 2005). NMFS affords the same protection to sea turtles listed as threatened under the ESA (50 CFR 223.206(b)).

5.4.4 Regulatory Measures for Sea Turtles

Large-Mesh Gillnet Requirements in the Mid-Atlantic
Since 2002, NMFS has regulated the use of large mesh gillnets in federal waters off North Carolina and Virginia (67 FR 13098, March 21, 2002) to reduce the impact of these fisheries on ESA-listed sea turtles. These restrictions were revised in 2006 (73 FR 24776, April 26, 2006). Currently, gillnets with stretched mesh size of seven inches (17.8 centimeters) or larger are prohibited in the U.S. EEZ during the following times and in the following areas:

(1) north of the North Carolina/South Carolina border to Oregon Inlet, North Carolina at all times,
(2) north of Oregon Inlet, North Carolina to Currituck Beach Light, North Carolina from March 16 through January 14,
(3) north of Currituck Beach Light, North Carolina to Wachapreague Inlet, Virginia from April 1 through January 14, and
(4) north of Wachapreague Inlet, Virginia to Chincoteague, Virginia from April 16 through January 14.

NMFS has also issued regulations to address the interaction of sea turtles in gillnet gear fished in Pamlico Sound, North Carolina. Waters of Pamlico Sound are closed to fishing with gillnets with a stretched mesh size larger than 4 ¼ inches (10.8 centimeters) from September 1 through December 15 each year to protect sea turtles. The closed area includes all inshore waters of Pamlico Sound, and all contiguous tidal waters, south of 35° 46.3’ N, north of 35° 00’ N, and east of 76° 30’ W (50 CFR 223.206). As described above, NMFS has also issued incidental take permits for Atlantic sturgeon and sea turtles in Pamlico Sound gillnet fisheries. The permit includes mandatory measures to reduce take, and impacts from take, in this fishery.

TED Requirements in Trawl Fisheries
Turtle Excluder Devices (TEDs) are required in the summer flounder and southeast shrimp fisheries. TEDs allow sea turtles to escape the trawl net, reducing injury and mortality resulting from capture in the net. Approved TEDs are required in the shrimp trawl fishery operating in the Atlantic and Gulf Areas (50 CFR 222.102) unless the trawler is fishing under one of the exemptions (e.g., bait shrimper, pusher-head trawl) and all requirements of the exemption are met (50 CFR 223.206). On February 21, 2003, NMFS issued a final rule to amend the TED regulations to enhance their effectiveness in the Atlantic and Gulf Areas of the southeastern U.S. by requiring an escape opening designed to exclude leatherbacks as well as large loggerhead and green sea turtles (68 FR 8456). NMFS published a final rule, effective April 1, 2021, that requires TEDs to exclude small sea turtles on skimmer trawls vessels 40 feet or greater in length (84 FR 70048, December 20, 2019).

TEDs are also required for summer flounder trawlers in the summer flounder fishery-sea turtle protection area. This area is bounded on the north by a line extending along 37°05' N (Cape Charles, Virginia) and on the south by a line extending out from the North Carolina-South Carolina border. Vessels north of Oregon Inlet, North Carolina are exempt from the TED requirement from January 15 through March 15 each year (50 CFR 223.206). The TED requirements for the summer flounder trawl fishery do not require the use of the larger escape opening.

Pound net requirements in Virginia

NMFS has issued several regulations to help protect sea turtles from entanglement in, and impingement on Virginia pound net gear (66 FR 33489, June 22 2001; 67 FR 41196; June 17, 2002; 68 FR 41942, July 16, 2003; 69 FR 24997, May 5, 2004; 71 FR 36024; June 23, 2006; 73 FR 68348, November 18, 2008; 80 FR 6925, February 9, 2015). All offshore pound leaders in Pound Net Regulated Area I (Figure 15) must meet the definition of a modified pound net leader from May 6 through July 15. The modified leader has been found to be effective in reducing sea turtle interactions as compared to the unmodified leader. Under the ESA regulations, nearshore pound net leaders in Pound Net Regulated Area I and all pound net leaders in Pound Net Regulated Area II must have mesh size less than 12 inches (30.5 centimeters) stretched mesh and may not employ stringers (50 CFR 223.206) from May 6 through July 15 each year. A pound net leader is exempt from these measures only if it meets the definition of a modified pound net leader. The 2015 regulation (80 FR 6925) modified the definitions of offshore and inshore pound net leaders under the ESA. In addition, there are compliance training, monitoring and reporting requirements in this fishery (50 CFR 223.206).

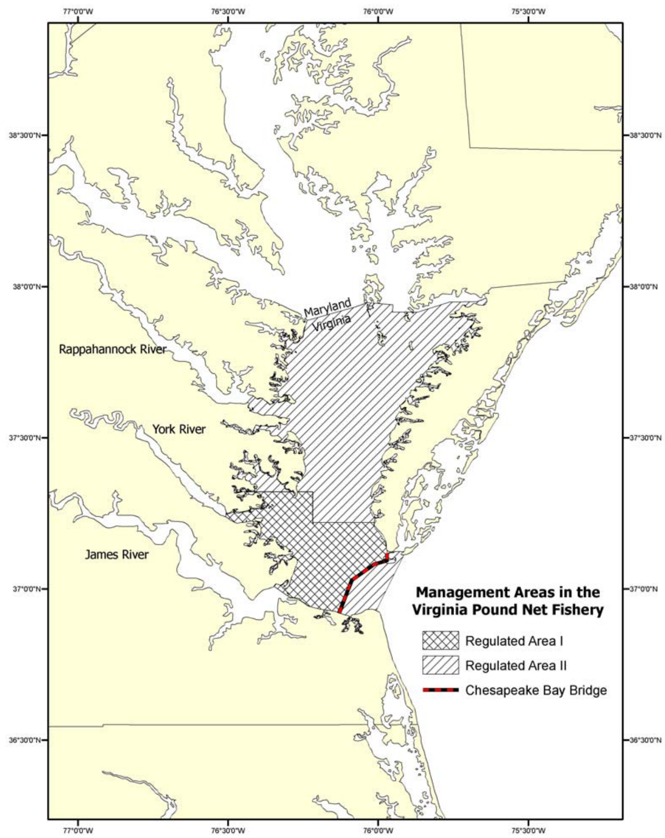


Figure 15. Virginia Pound Net Regulated Areas.

Under the Bottlenose Dolphin Take Reduction Plan, fishermen with offshore pound nets must use a modified pound net leader year-round within the Bottlenose Dolphin Pound Net Regulated Area (Figure 16). Pound nets fished in offshore and inshore areas must be fished with all three continuous sections (i.e., pound, heart, and leader) in the Bottlenose Dolphin Pound Net Regulated Area or Regulated Areas I and II under the ESA sea turtle conservation requirements. An exception is that one or more sections may be missing for up to 10 days for setting, removing, and/or repairing the gear.

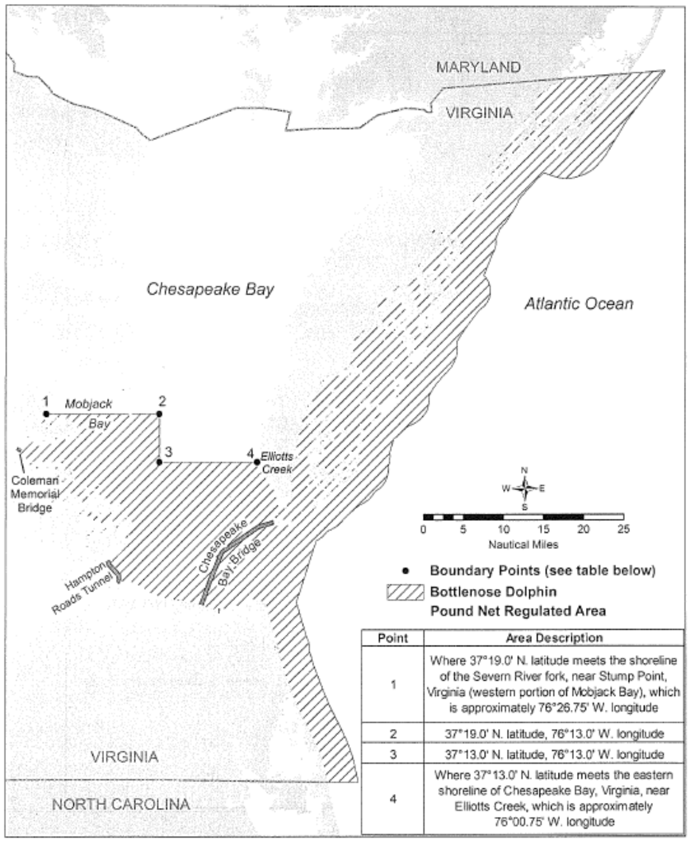


Figure 16. Bottlenose Dolphin Pound Net Regulated Areas.

Longline requirements in the HMS fishery

In 2020, NMFS SERO completed two biological opinions on the FMP for the Atlantic HMS fisheries for swordfish, tunas, and sharks (NMFS 2020a, 2020b). These opinions concluded that the actions are not likely to jeopardize the continued existence of any hard-shell or leatherback sea turtle. Sea turtle conservation requirements in the HMS fishery are related to the fishing gear, bait, and disentanglement gear and training (50 CFR 648.21). NMFS requires the use of specific gears and release equipment in the pelagic longline component of the HMS fishery in order to minimize lethal impacts to sea turtles. Sea turtle handling and release protocols for the HMS fishery are described in detail in SEFSC (2008). Sea turtle handling and release placards are required to be posted in the wheelhouse of certain commercial fishing vessels. NMFS has also initiated an extensive outreach and education program for commercial fishermen that engage in these fisheries in order to minimize the impacts of this fishery on sea turtles. As part of the program, NMFS has distributed sea turtle identification and resuscitation guidelines to HMS fishermen who may incidentally hook, entangle, or capture sea turtles during their fishing activities and has also conducted hands-on workshops on safe handling, release, and identification of sea turtles.

Modified Dredge Requirements in the Atlantic Sea Scallop Fishery

In response to the observed capture of sea turtles in scallop dredge gear, including serious injuries and mortality as a result of capture, NMFS required federally-permitted scallop vessels fishing with dredge gear to modify their gear by adding an arrangement of horizontal and vertical chains (hereafter referred to as a “chain mat”) between the sweep and the cutting bar. This modification was required when fishing in Mid-Atlantic waters south of 41°09’ N from the shoreline to the outer boundary of the U.S. EEZ during the period of May 1-November 30 each year (70 FR 30660, May 27, 2005). The requirement was subsequently modified by emergency rule on November 15, 2006 (71 FR 66466) and by final rules published on April 8, 2008 (73 FR 18984) and May 5, 2009 (74 FR 20667). In 2015, NMFS aligned the requirements with the TDD requirements as described below. Since 2006, the chain mat modifications have reduced the severity of most sea turtle interactions with scallop dredge gear (Murray 2011, 2015a, 2021). However, these modifications are not expected to reduce the overall number of sea turtle interactions with scallop dredge gear.

Beginning May 1, 2013, all limited access scallop vessels, as well as Limited Access General Category vessels with a dredge width of 10.5 feet or greater, were required to use a TDD in the Mid-Atlantic (west of 71° W) from May 1 through October 31 each year (77 FR 20728, April 6, 2012). The purpose of the TDD requirement is to deflect sea turtles over the dredge frame and bag rather than under the cutting bar, so as to reduce sea turtle injuries due to contact with the dredge frame on the ocean bottom (including being crushed under the dredge frame). When combined with the effects of chain mats, which decrease captures in the dredge bag, the TDD should provide greater sea turtle benefits by reducing serious injury and mortality due to interactions with the dredge frame, compared to a standard New Bedford dredge.

In 2015, NMFS aligned the TDD and chain mat requirements (80 FR 22119, April 21, 2015). Currently, chain mats are required on any vessel with a sea scallop dredge and required to have a federal Atlantic sea scallop fishery permit, regardless of dredge size or vessel permit category, entering waters west of 71° W from May 1 through November 30. Similarly, any limited access scallop vessel and limited access general category vessel with a dredge width of 10.5 feet or greater is required to use a TDD west of 71° W from May 1 through November 30.

Handling and Resuscitation Requirements
NMFS has developed and published sea turtle handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities (66 FR 67495, December 31, 2001). Persons participating in fishing activities or scientific research are required to handle and resuscitate (as necessary) sea turtles as prescribed in the final rule. These measures help to prevent mortality of hard-shelled turtles caught in fishing or scientific research gear. NMFS has conducted outreach to fishermen participating in fisheries in the Greater Atlantic Region, providing wheelhouse cards detailing the requirements.

5.4.5 Regulatory Measures for Shortnose and Atlantic Sturgeon

Sturgeon Recovery Planning
Several conservation actions aimed at reducing threats to shortnose and Atlantic sturgeon are currently ongoing. The most recent recovery plan for shortnose sturgeon was written by NMFS back in 1998. In the near future, NMFS will be convening a recovery team and drafting a recovery plan which will outline recovery goals and criteria and steps necessary to recover all Atlantic sturgeon DPSs. Numerous research activities are underway for both sturgeon species, involving NMFS and other Federal, State, and academic partners, to obtain more information on

the distribution and abundance of sturgeon throughout their range, including in the action area. Efforts are also underway to better understand threats faced by sturgeon and ways to minimize these threats, including bycatch and water quality. Fishing gear research is underway to design fishing gear that minimizes interactions with Atlantic sturgeon while maximizing retention of targeted fish species. Several states are in the process of preparing ESA section 10 Habitat Conservation Plans aimed at minimizing the effects of state fisheries on Atlantic sturgeon.

Research Activity Guidelines
Research activities aid in the conservation of listed species by furthering our understanding of the species' life history and biological requirements. We recognize, however, that many scientific research activities involve capture and may pose some level of risk to individuals or to the species. Therefore, it is necessary for research activities to be carried out in a manner that minimizes the adverse impacts of the activities on individuals and the species while obtaining crucial information that will benefit the species. Guidelines developed by sturgeon researchers in cooperation with NMFS staff (Moser et al. 2000; Damon-Randall et al. 2010; Kahn and Mohead 2010) provide standardized research protocols that minimize the risk to sturgeon species from capture, handling, and sampling. These guidelines must be followed by any entity receiving a federal permit to do research on shortnose or Atlantic sturgeon.

Protections for the GOM DPS of Atlantic Sturgeon
The prohibitions listed under section 9(a)(1) of the ESA automatically apply when a species is listed as endangered but not when listed as threatened. When a species is listed as threatened, section 4(d) of the ESA requires the Secretary of Commerce (Secretary) to issue regulations, as deemed necessary and advisable, to provide for the conservation of the species. The Secretary may, with respect to any threatened species, issue regulations that prohibit any act covered under section 9(a)(1). Whether section 9(a)(1) prohibitions are necessary and advisable for a threatened species is largely dependent on the biological status of the species and the potential impacts of various activities on the species. On June 10, 2011, we proposed protective measures for the GOM DPS of Atlantic sturgeon (76 FR 34023). On November 19, 2013 we published a preliminary final rule that applied all prohibitions of section 9(a)(1) to the GOM DPS beginning on December 19, 2013 (78 FR 69310).

5.4.6 Regulatory Measures for Atlantic Salmon

NMFS has worked with the Maine Department of Marine Resources, U.S. FWS, the Penobscot Indian Nation, and other partners to pursue a range of management and research activities to mitigate and reduce the most severe threats to Atlantic salmon and to improve understanding of salmon abundance and population health. Recovery actions and activities recently implemented include: (1) conducting reviews of Species Protection Plans for Federal Energy Regulatory Commission (FERC) licensed hydroelectric projects in the Gulf of Maine DPS; (2) developing fish passage guidelines; (3) developing a quantitative model to assess the impacts of proposed dam-related work; (4) completing a survey of non-power generating dams and their effect on Atlantic salmon habitat that resulted in multiple dam removals; (5) developing a General Conservation Plan with operating conditions for non-power generating dam owners who request incidental take permits; and (6) consulting with Federal partners (e.g., USACE, FERC, Federal

Highway Administration) to assure that their proposed and ongoing actions (e.g., dredging, hydropower, and transportation activities) minimize harm to Atlantic salmon.

International Coordination and Collaboration to Protect Atlantic Salmon
NMFS participates in the North Atlantic Salmon Conservation Organization (NASCO), the international governing body that jointly manages Atlantic salmon. Participation in NASCO has led to the development of multi-year regulatory measures for high-seas Atlantic salmon fisheries, international guidelines for salmon stocking and mitigation of threats from aquaculture practices, and country specific Action Plans that outline the implementation of all the NASCO guidelines.

International Atlantic Salmon Research
NMFS works with international partners to conduct annual sampling of the Atlantic salmon fishery in West Greenland. From this sampling, biological information related to the Greenlandic local-use catch is used to confirm catch, support international Atlantic salmon stock assessments, and determine salmon continent-of-origin while providing a platform for research evaluating the ecological health of Atlantic salmon at Greenland.

Restoring Ecosystem Function for Atlantic Salmon
NMFS, the Maine Department of Marine Resources, U.S. FWS, and other partners have taken a number of steps to restore ecosystem function as part of the Atlantic Salmon Recovery Plan. Among these are dam removals, including the recent removals of the Great Works and Veazie Dams on the Penobscot River. Removal of these two dams allows Atlantic salmon and other diadromous unimpeded access to sections of the Penobscot River that they have not had in 200 years. Several small projects such as bypasses, fishways, culvert replacements, and barrier (including dams) removal helped restore physical and biological features necessary to further salmon recovery in the Gulf of Maine DPS. In addition, active stocking and fisheries management is supporting recovery of other diadromous species.

Atlantic Salmon Annual Assessment and Monitoring
NMFS supports several annual assessment and monitoring efforts to gain greater understanding of Atlantic salmon movement patterns and community. This information will help inform future management decisions. Among these efforts are: (1) a satellite-tagging project of adult Atlantic salmon off the coast of West Greenland to track ocean movements; (2) a fish community study in the Penobscot River estuary; and (3) telemetry studies measuring Atlantic salmon smolt survival from the Penobscot River to the Gulf of Maine and monitoring fish at Halifax, Nova Scotia.

5.5 Magnuson-Stevens Fishery Conservation and Management Act

In addition to the measures described in section 5.4, there are numerous regulations mandated by the Magnuson-Stevens Fishery Conservation and Management Act that benefit ESA-listed species. Many fisheries are subject to different time and area closures. These area closures can be seasonal, year-round, and/or gear based. Closure areas benefit ESA-listed species due to elimination of active gear in areas where sea turtles, sturgeon, and salmon are present. However, if closures shift effort to areas with a comparable or higher density of sea turtles, sturgeon, or salmon, and/or the shift in effort results in increases in gear soak or tow time and/or quantity of fishing gear set/towed in the affected area, then risk of interaction could actually increase.

Fishing effort reduction measures (*i.e*., landing/possession limits or trap allocations) may also benefit ESA-listed species by limiting the amount of time that gear is present in the species environment. Additionally, gear restrictions and modifications required for fishing regulations also decrease the risk of entanglement with endangered species. National Standard 9 of the MSA specifies conservation and management measures shall, to the extent practicable, (a) minimize bycatch and (b) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch. This includes bycatch of sea turtles and ESA-listed fish. For a complete listing of fishery regulations in the action area visit: https://www.fisheries.noaa.gov/content/greater-atlantic-region-regulations.

5.6 Status of the Species within the Action Area

5.6.1 Sea Turtles

The fisheries and ecosystem research activities considered in this Opinion and habitat used by sea turtles overlap in the action area. Adult and/or juvenile loggerhead, leatherback, Kemp's ridley, and green sea turtles may be migrating or foraging in the areas where the fisheries and ecosystem research activities will occur. As described in the *Status of the Species*, the occurrence of loggerhead, Kemp's ridley, green, and leatherback sea turtles along the U.S. Atlantic coast is primarily temperature dependent. In general, sea turtles move up the U.S. Atlantic coast from southern wintering areas to foraging grounds as water temperatures warm in the spring. The trend is reversed in the fall as water temperatures cool. By December, sea turtles have passed Cape Hatteras, returning to more southern waters for the winter (Shoop and Kenney 1992; Morreale and Standora 1998, 2005; Braun-McNeill and Epperly 2002; James et al. 2005; Mansfield et al. 2009; TEWG 2009, NEFSC 2011; Ceriani et al. 2012; Griffin et al. 2013; Winton et al. 2018).

Within the action area, sea turtles are found as far north as Georges Bank and the Gulf of Maine seasonally. They occur throughout the bays and estuaries of most Mid-Atlantic states and in several Northeast areas as well (e.g., Cape Cod Bay, Massachusetts), from shallow waters along the shoreline and near river mouths to deeper waters of the Atlantic Ocean. They are present in Greater Atlantic waters from May to November each year, with the highest number of individuals present from June to October. Sea turtles arrive in waters off Virginia in late April/early May and in the Gulf of Maine in June (Braun-McNeill and Epperly 2002; Morreale and Standora 2005; Ceriani et al. 2012; Griffin et al. 2013; Palka et al. 2017; Winton et al. 2018). Leatherback sea turtles have a similar seasonal distribution but have a more extensive range compared to the hard-shelled species (Shoop and Kenney 1992; Mitchell et al. 2002; James et al. 2005a, 2005b; Dodge et al. 2014; Archibald and James 2016).

Sea turtles have been documented in the action area by fisheries observers, research vessel staff, opportunistic platforms, and through aerial and vessel surveys and satellite tracking programs (James et al. 2005a, 2005b, 2005c, 2006a, 2006b; Archibald and James 2016; Kraus et al. 2016; Barco et al. 2018; Patel et al. 2018; Winton et al. 2018; NMFS 2019c). The Atlantic Marine Assessment Program for Protected Species (AMAPPS) is a comprehensive program to assess abundance, distribution, and ecology of marine mammals, sea turtles, and seabirds throughout the U.S. Atlantic. From 2010-2018, aerial and shipboard surveys (approximately 191,000 kilometers of trackline) from Nova Scotia, Canada, through Florida detected more than 8,000 sea turtles including loggerhead, leatherback, Kemp's ridley, and green sea turtles (Palka et al. 2017). These sightings occurred throughout most of the action area (see AMAPPS sightings at http://seamap.env.duke.edu/). From 2010-2018, the NEFSC and Coonamessett Farm Foundation deployed 180 satellite tags on loggerhead sea turtles. Data from these satellite tags were used to assess the relative density of sea turtles (Palka et al. 2017; Winton et al. 2018). Researchers continue to tag both loggerhead and leatherback sea turtles though this program (NEFSC 2022). Other AMAPPS studies explore species distribution relative to prey and physical oceanography.

In the summer of 2010, as part of the AMAPPS project, the NEFSC and SEFSC estimated the abundance of juvenile and adult loggerhead sea turtles in the portion of the northwestern Atlantic continental shelf between Cape Canaveral, Florida and the mouth of the Gulf of St. Lawrence, Canada (NEFSC 2011). The abundance estimates were based on data collected from an aerial line-transect sighting survey as well as satellite tagged loggerheads. The preliminary regional abundance estimate was about 588,000 individuals (approximate inter-quartile range of 382,000-817,000) based on only the positively identified loggerhead sightings, and about 801,000 individuals (approximate inter-quartile range of 521,000-1,111,000) when based on the positively identified loggerheads and a portion of the unidentified sea turtle sightings (NEFSC 2011).

Barco et al. (2018) estimated loggerhead sea turtle abundance and density in the southern portion of the Mid-Atlantic Bight and Chesapeake Bay using data from 2011-2012. As Chesapeake Bay falls outside the action area, the focus here is on the results for the ocean waters off Virginia and Maryland. During aerial surveys, loggerhead sea turtles were the most common sea turtle species detected, followed by greens and leatherbacks, with few Kemp's ridleys documented. Density varied both spatially and temporally. Loggerhead abundance and density estimates in the ocean were higher in the spring (May-June) than the summer (July-August) or fall (September-October) (Barco et al. 2018).

The AMAPPS data, along with other sources, have been used in recent modelling studies. Winton et al. (2018) modelled the spatial distribution of satellite-tagged loggerhead sea turtles in the Northwest Atlantic. The Mid-Atlantic Bight was identified as an important summer foraging area and the results suggest that the area may support a large proportion of the population, over 50% of the predicted relative density of loggerheads north of Cape Hatteras from June to October (Winton et al. 2018; NMFS 2019c). Using satellite telemetry observations from 271 large juvenile and adult sea turtles collected from 2004 to 2016, the models predicted that overall densities were greatest in the shelf waters of the U.S. Atlantic coast from Florida to North Carolina (Figure 17, left side). Tagged loggerheads primarily occupied the continental shelf from Long Island, New York to Florida, with some moving offshore. Monthly variation in the Mid-Atlantic Bight (Figure 17, right side) indicated migration north to the foraging grounds from March to May and migration south from November to December. In late spring and summer, predicted densities were highest in the shelf waters from Maryland to New Jersey. In the cooler months, the predicted densities in the Mid-Atlantic Bight were higher offshore (Winton et al. 2018). South of Cape Hatteras, there was less seasonal variability and predicted densities were high in all months. Many of the individuals tagged in this area remained in the general vicinity of the tagging location. The authors did caution that the model was driven, at least in part, by the weighting scheme chosen, is reflective only of the tagged population, and has biases associated with the non-random tag deployment. Most loggerheads tagged in the Mid-Atlantic Bight were tagged in offshore shelf waters north of Chesapeake Bay in the spring. Thus, loggerheads in the nearshore areas of the Mid-Atlantic Bight may have been under-represented while those in more northern areas may be as well given the initial tagging locations (Winton et al. 2018). Despite these caveats, this data is the best available scientific and commercial data on loggerhead density in the action area.

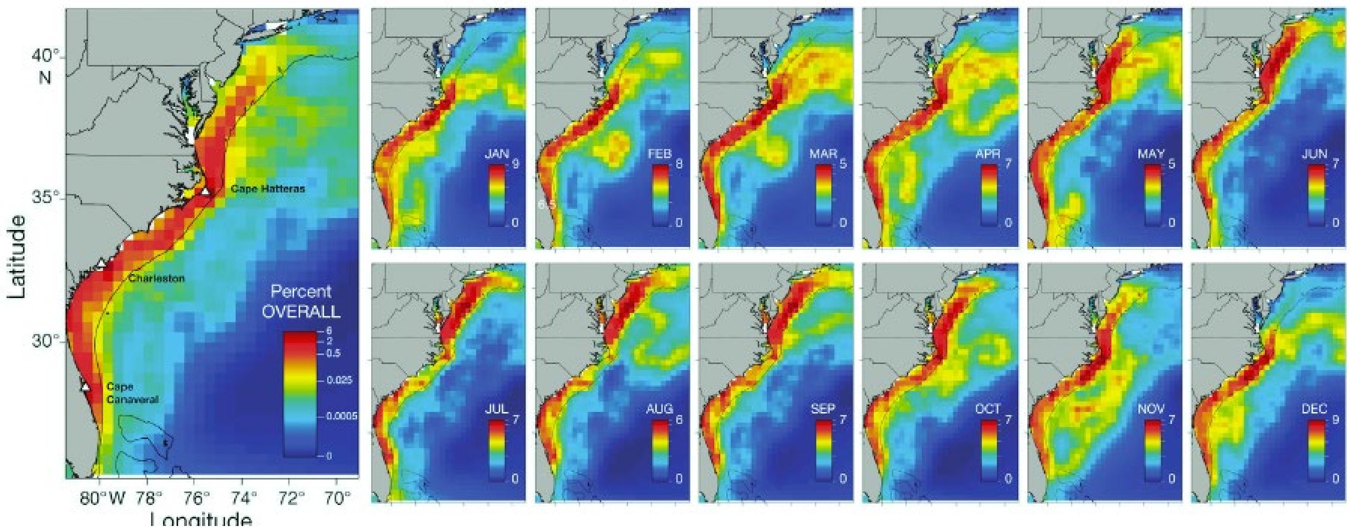


Figure 17. Overall and monthly log density of tagged loggerhead sea turtles predicted from a space-time geostatistical mixed effects model. The proportion of the predicted density in each cell is indicated by the key. Source: Winton et al. 2018.

One of the main factors influencing sea turtle presence in Mid-Atlantic waters and north is seasonal temperature patterns (Ruben and Morreale 1999). The distribution of sea turtles is limited geographically and temporally by water temperatures (Epperly et al. 1995, James et al. 2006b, Braun-McNeill et al. 2008, Mansfield et al. 2009), with warmer waters in the late spring, summer, and early fall being the most suitable. Water temperatures too low or too high may affect feeding rates and physiological functioning (Milton and Lutz 2003); metabolic rates may be suppressed when a sea turtle is exposed for a prolonged period to temperatures below 8-10°C (Morreale et al. 1992; George 1997; Milton and Lutz 2003). That said, loggerhead sea turtles have been found in waters as low as 7.1°-8°C (Braun-McNeill et al. 2008; Weeks et al. 2010; Smolowitz et al. 2015). However, in assessing critical habitat for loggerhead sea turtles, the review team considered the water-temperature habitat range for loggerheads to be above 10°C (NMFS 2013c). Sea turtles are most likely to occur in the action area when water temperatures are above this temperature, although depending on seasonal weather patterns and prey availability, they could be also present in months when water temperatures are cooler (as evidenced by fall and winter cold stunning records as well as year round stranding records).

To better understand loggerhead behavior on the Mid-Atlantic foraging grounds, Patel et al. (2016) used a remotely operated vehicle (ROV) to document the feeding habitats (and prey availability), buoyancy control, and water column use of 73 loggerheads recorded from 2008-2014. When the mouth and face were in view, loggerheads spent 13% of the time feeding on non-gelatinous prey and 2% feeding on gelatinous prey. Feeding on gelatinous prey occurred near the surface to depths of 16 meters. Non-gelatinous prey were consumed on the bottom. Turtles spent approximately 7% of their time on the surface (associated with breathing), 42% in the near surface region, 44% in the water column, 0.4% near bottom, and 6% on bottom. When diving to depth, turtles displayed negative buoyancy, making staying at the bottom easier (Patel et al. 2016).

Patel et al. (2018) evaluated temperature-depth data from 162 satellite tags deployed on loggerhead sea turtles from 2009 to 2017 when the water column is highly stratified (June 1-October 4). Turtles arrived in the Mid-Atlantic Bight in late May as the Cold Pool formed and departed in early October when the Cold Pool started to dissipate. The Cold Pool is an oceanographic feature that forms annually in late May. During the highly stratified season, tagged turtles were documented throughout the water column from June through September. Fewer bottom dives occurred north of Hudson Canyon early (June) and late (September) in the foraging season (Patel et al. 2018).

Satellite tagging studies have also been used to understand leatherback sea turtle behavior and movement in the action area (Eckert et al. 2006; Dodge et al. 2014, 2015; James et al. 2005a, 2005b, 2005c, 2006a, 2006b). These studies show that leatherback sea turtles move throughout most of the North Atlantic from the equator to high latitudes. Key foraging destinations include, among others, the eastern coast of U.S. (Eckert et al. 2006). Telemetry studies provide information on the use of the water column by leatherback sea turtles. Based on telemetry data for leatherbacks (n=15) off Cape Cod, Massachusetts, leatherback turtles spent over 60% of their time in the top 10 meters of the water column and over 70% in the top 15 meters (Dodge et al. 2014). Leatherbacks on the foraging grounds moved with slow, sinuous area-restricted search behaviors. Shorter, shallower dives were taken in productive, shallow waters with strong sea surface temperature gradients. They were highly aggregated in shelf and slope waters in the summer, early fall, and late spring. During the late fall, winter, and early spring, they were more widely dispersed in more southern waters and neritic habitats (Dodge et al. 2014). Leatherbacks (n=24) tagged in Canadian waters primarily used the upper 30 meters of the water column and had shallow dives (Wallace et al. 2015).

Dodge et al. (2018) used an autonomous underwater vehicle (AUV) to remotely monitor fine-scale movements and behaviors of nine leatherbacks off Cape Cod, Massachusetts. The "TurtleCam" collected video of tagged leatherback sea turtles and simultaneously sampled the habitat (e.g., chlorophyll, temperature, salinity). Representative data from one turtle was reported in Dodge et al. (2018). During the 5.5 hours of tracking, the turtle dove continuously from the surface to the seafloor (0-20 meters). Over a two-hour period, the turtle spent 68% of its time diving, 16% swimming just above the seafloor, 15% at the surface and 17% just below the surface. The animal frequently surfaced (>100 times in ~2 hours). The turtle used the entire water column, feeding on jellyfish from the seafloor to the surface. The turtle silhouetted prey 36% of the time, diving to near/at bottom and looking up to locate prey. The authors note that silhouetting prey may increase entanglement in fixed gear if a buoy of float is mistaken for jellyfish (Dodge et al. 2018).

5.6.2 Shortnose Sturgeon

Historically, shortnose sturgeon are thought to have inhabited nearly all major rivers and estuaries along nearly the entire east coast of North America. The range extended from the Saint John River in New Brunswick, Canada to the Indian River in Florida. Today, only 19 populations remain ranging from the St. Johns River, Florida (possibly extirpated from this system) to the Minas Basin in Nova Scotia, Canada (NMFS 1998a; Dadswell et al. 2016). The present range of shortnose sturgeon is disjunct, with northern populations separated from southern populations by a distance of about 400 kilometers. Population sizes vary across the species' range. From available estimates, the smallest populations in the action area occur in the Merrimack and Penobscot rivers (~ several hundred to several thousand adults depending on population estimates used; M. Kieffer, U.S. Geological Survey, pers. comm.; Dionne 2010), while the largest populations are found in the nearby Saint John River in Canada (~18,000; Dadswell 1979) and Hudson River (~61,000; Bain et al. 1998). As indicated in Kynard (1997), adult abundance is less than the minimum estimated viable population abundance of 1,000 adults for five of 11 surveyed northern populations and all natural southern populations. Kynard (1997) indicates that all aspects of the species' life history indicate that shortnose sturgeon should be abundant in most rivers. As such, the expected abundance of adults in northern and north-central populations should be thousands to tens of thousands of adults. The only river systems likely supporting populations of these sizes are the Saint John, Hudson, and possibly the Delaware and the Kennebec, making the continued success of shortnose sturgeon in these rivers critical to the species as a whole. While no reliable estimate of the size of either the total species or the shortnose sturgeon population in the Northeastern U.S. exists, it is clearly below the size that could be supported if the threats to shortnose sturgeon were removed.

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 (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) where they could overlap in occurrence with the proposed actions (SSSRT 2010). 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). Shortnose sturgeon feed on a variety of benthic and epibenthic invertebrates including mollusks, crustaceans (amphipods, chironomids, isopods), and oligochaete worms (Vladykov and Greeley 1963; Dadswell 1979 in NMFS 1998a). They have similar lengths at maturity (45-55 centimeters fork length) throughout their range, but, because sturgeon in southern rivers grow faster than those in northern rivers, southern sturgeon mature at younger ages (Dadswell et al. 1984). Shortnose sturgeon are long-lived (30-40 years) and, particularly in the northern extent of their range, mature at late ages. In the north, males reach maturity at 5 to 10 years, while females mature between 7 and 13 years. Based on limited data, females spawn every three to five years while males spawn approximately every two years. The spawning period is estimated to last from a few days to several weeks. Spawning begins from late winter/early spring (southern rivers) to mid to late spring (northern rivers)[9] when the freshwater temperatures increase to 8º-

[9] For purposes of this consultation, Northern rivers are considered to include tributaries of the Chesapeake Bay northward to the Minas Basin in Canada. Southern rivers are those south of the Chesapeake Bay down to Florida.

9ºC. Several published reports have presented the problems facing long-lived species that delay sexual maturity (Crouse et al. 1987; Crowder et al. 1994; Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes.

5.6.3 Atlantic Sturgeon

The marine and estuarine range of all five Atlantic sturgeon DPSs overlaps and extends from Canada through Cape Canaveral, Florida. Based on the best available scientific and commercial data, Atlantic sturgeon originating from any of five DPSs could occur in the waters of the action area (Damon-Randall et al. 2013; Wirgin et al. 2015b). Eggs, early life stages, and juveniles (as used here referring to Atlantic sturgeon offspring that have not emigrated from the natal river) are not present in the action area. Sub-adult and adult Atlantic sturgeon occur in waters off the Northeast and Mid-Atlantic year round. Atlantic sturgeon are known to use the action area for migration and foraging. Foraging behaviors typically occur in areas where suitable forage and appropriate habitat conditions are present. These areas include tidally influenced flats and mud, sand, and mixed cobble substrates (Stein et al. 2004a). Within the marine range of Atlantic sturgeon, several marine aggregation areas have been identified adjacent to estuaries and/or coastal features formed by bay mouths and inlets along the U.S. eastern seaboard. Depths in these areas are generally no greater than 25 meters (Stein et al. 2004a, 2004b; Laney et al. 2007; Dunton et al. 2010; Erickson et al. 2011). Given the depth range, it is expected that these identified aggregations are primarily in state waters. Most of the NEFSC's fisheries and ecosystem research activities overlap with Atlantic sturgeon in marine and coastal waters, suggesting that if suitable forage and/or habitat features are present, adults and sub-adults from any of the five listed DPSs may be foraging or undertaking migrations in the areas where research activities will occur.

5.6.4 Atlantic Salmon

Atlantic salmon also use the action area as a migratory route and for foraging. Upon completion of the physiological transition to salt water, the post-smolt Atlantic salmon grows rapidly and has been documented to move in small schools loosely aggregated close to the surface (Dutil and Coutui 1988). After entering into the nearshore waters of Canada, the U.S. post-smolts become part of a mixture of stocks of Atlantic salmon from various North American streams. Their diet includes invertebrates, amphipods, euphausiids, and fish (Hislop and Youngson 1984; Jutila and Toivonen 1985; Fraser 1987; Hislop and Shelton 1993). Results from a 2001-2005 post-smolt trawl survey in Penobscot Bay and the nearshore waters of the Gulf of Maine indicate that Atlantic salmon post-smolts are prevalent in the upper water column (Sheehan et al. 2005).

Most of the GOM DPS-origin salmon spend two winters in the ocean before returning to streams for spawning. Aggregations of Atlantic salmon may still occur after the first winter at sea, but most evidence indicates that they travel individually (Reddin 1985). At this stage, Atlantic salmon primarily eat fish, feeding upon capelin, herring, and sand lance (Hansen and Pethon 1985; Reddin 1985; Hislop and Shelton 1993). Gulf of Maine DPS Atlantic salmon are likely to overlap with the proposed actions in the Gulf of Maine (including the Penobscot River estuary), on the Western Scotian Shelf, and potentially in the waters of southwest Greenland.

5.7 The Impact of the Environmental Baseline on ESA-Listed Species

Collectively, the stressors described above have had, and likely continue to have, lasting impacts on the ESA-listed species considered in this consultation. Some of these stressors (e.g., vessel strike, entanglement) result in mortality or serious injury to individual animals, whereas others (e.g., a fishery that impacts prey availability) result in more indirect or non-lethal impacts. Assessing the aggregate impacts of these stressors on species is difficult, especially since many of the species in this Opinion are wide ranging and subject to stressors in locations throughout the action area and outside the action area.

We consider the best indicator of the aggregate impact of the *Environmental Baseline* on ESA-listed resources to be the status and trends of those species. As noted in the *Status of the Species*, some of the species considered in this consultation are experiencing increases in population abundance, some are declining, and for others, their status remains unknown. In considering these trends, we must also consider that some are based on a proxy for the overall population. For example, sea turtle trends are primarily based on nesting data that assesses a subset of the population. The trends must be considered in this context. Taken together, this indicates that the *Environmental Baseline* is impacting species in different ways. The species experiencing increasing population abundances are doing so despite the potential negative impacts of the *Environmental Baseline*. Therefore, while the *Environmental Baseline* may slow their recovery, recovery is not being prevented. For the species that may be declining in abundance, it is possible that the suite of conditions described in the *Environmental Baseline* is preventing their recovery. At small population sizes, species may experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects[10], 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 is discussed in the *Status of Species* section of this Opinion.

6.0 CLIMATE CHANGE

The discussion below presents background information on global climate change, as well as information on past and predicted future effects of global climate change throughout the range of the listed species considered here. Additionally, we present the available information on predicted effects of climate change in the action area and how those predicted environmental changes may affect listed species. Climate change is relevant to the *Status of the Species*, *Environmental Baseline*, and *Cumulative Effects* sections of this Opinion. Therefore, rather than include partial discussions in several sections of this Opinion, we are synthesizing this information into one discussion. Consideration of the effects of the proposed action in light of predicted changes in environmental conditions due to anticipated climate change are included in the *Effects of the Action* below (section 7.0).

[10] Demographic stochasticity is caused by random independent events of individual mortality and reproduction, which cause random fluctuations in population growth rate. It is most strong in small populations. Inbreeding depression is the reduced biological fitness of a population from breeding of related individuals, inbreeding. Allee effects are broadly characterized as a decline in individual fitness in populations with a small size or density.

6.1 Background Information on Global Climate Change

In its Sixth Assessment Report (AR6) from 2021, the Intergovernmental Panel on Climate Change (IPCC) found that human activities are estimated to have caused approximately a 1.07°C (likely range 0.8°C to 1.3°C) global surface temperature increase over pre-industrial (1850-1900) levels. For the first time in an IPCC report, assessed future changes in global surface temperature, ocean warming, and sea level were constructed by combining multi-model projections with observational constraints based on past simulated warming, as well as the AR6 assessment of climate sensitivity. Even under a very low greenhouse gas (GHG) emissions scenario, the IPCC predicts that the 1.5°C global warming level is more likely than not going to be exceeded in the near term (2021-2040) (IPCC 2021). Since the 1860s, the Northeast U.S. shelf sea surface temperature (SST) has exhibited an overall warming trend, with the past decade measuring well above the long-term average (and the trend line). Changes in the Gulf Stream, increases in the number of warm core ring formations, and anomalous onshore intrusions of warm salty water are affecting the coastal ocean dynamics with important implications for commercial fisheries and protected species. Annual surface and bottom temperatures in the Gulf of Maine and Georges Bank have trended warmer since the early 1980s. The 2020 seasonal surface temperatures have trended warmer in summer and fall and just slightly warmer than average in the winter and spring throughout New England. The 2020 summer SST was the highest on record in Georges Bank with a heatwave of 4.3°C above the heatwave threshold. Annual surface and bottom temperatures in the Mid-Atlantic Bight have also trended warmer since the early 1980s, and seasonal temperatures have similarly trended warmer (NEFSC 2021a, 2021b).

Model projections of global mean sea level rise (relative to 1995-2014) suggest that the likely global mean sea level rise by 2100 is 0.28-0.55 meters (0.92-1.80 feet) under the very low GHG emissions scenario, 0.32-0.62 meters (1.05-2.03 feet) under the low GHG emissions scenario, 0.44-0.76 meters (1.4-2.5 feet) under the intermediate GHG emissions scenario, and 0.63-1.01 meters (2.07-3.3 feet) under the very high GHG emissions scenario (IPCC 2021). It is virtually certain that global mean sea level will continue to rise over the 21st century. The magnitude and rate of rise depends on future emission pathways (IPCC 2021). Temperature increases will very likely be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Climate warming has also resulted in increased river discharge and glacial and sea-ice melting (Greene et al. 2008).

Ocean temperature in the U.S. Northeast Shelf and surrounding Northwest Atlantic waters have warmed faster than the global average over the last decade (Pershing et al. 2015). New projections for these waters suggest that this region will warm two to three times faster than the global average; given this, existing projections from the IPCC may be too conservative (Saba et al. 2015).

The past few decades have also witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene et al. 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and increased the export of freshwater to the North Atlantic. Large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (IPCC 2007; Greene et al. 2008). There is evidence that the NADW has already freshened significantly (IPCC 2007). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the entire world (Greene et al. 2008). Changes in salinity and temperature may be the result of changes in the Earth's atmosphere caused by anthropogenic forces (IPCC 2021). Specifically, recent research on the North Atlantic Oscillation (NAO), which impacts climate variability throughout the Northern Hemisphere, has found potential changes in NAO characteristics under future climate change until 2100 (Hanna and Cropper 2017).

Global warming of 1.5°C is projected to shift the ranges of many marine species to higher latitudes and drive the loss of coastal resources. The risk of irreversible loss of many marine and coastal ecosystems increases with global warming, especially at 2°C or higher (high confidence) (IPCC 2018). There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as changes in ice cover, salinity, oxygen levels, and circulation. Changes to the marine ecosystem due to climate change may result in changes in the distribution and abundance of the prey for protected species.

While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change on smaller geographic scales, such as the action area. The effects of future change will vary greatly among coastal regions for the U.S. For example, sea level rise is projected to be worse in low-lying coastal areas where land is sinking (e.g., the Gulf of Mexico) than in areas with higher, rising coastlines (e.g., Alaska) (Jay et al. 2018). Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. As climate warms, water temperatures in streams and rivers are likely to increase; this will likely result wide-ranging effects to aquatic ecosystems. Changes in temperature will be most evident during low flow periods when the water column in waterways are more likely to warm beyond the physiological tolerance of resident species (NAST 2000). Low flow can impede fish entry into waterways and combined with high temperatures can reduce survival and recruitment in anadromous fish (Jonsson and Jonsson 2009).

Expected consequences of climate change for river systems are wide ranging. Rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate (Hulme 2005). Rivers could experience a decrease in the amount of dissolved oxygen in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch et al. 2000). Increased water volume in a warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants currently degrade water quality (Murdoch et al. 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources along the U.S. Atlantic coast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. Within 50 years, river basins that are impacted by dams or by extensive development will experience greater changes in discharge and water stress than unimpacted, free-flowing rivers (Palmer et al. 2008). Given this, a global analysis of the potential effects of climate change on river basins indicates that large river basins impacted by dams will need a higher level of reactive or proactive management interventions in response to climate change than basins with free-flowing rivers (Palmer et al. 2008). Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to respond and/or adapt to change. Given the above, under a continually changing environment, maintaining healthy riverine ecosystems will likely require adaptive management strategies (Hulme 2005).

Recent changes in climate conditions are well documented and are predicted to continue (IPCC 2021), increasing the likelihood for effects to marine and anadromous protected species and their habitats. In marine systems, climate change impacts extend beyond changes in temperature and precipitation to include changes in pH, ocean currents, loss of sea ice, and sea level rise. The increased frequency and intensity of floods, droughts, summer low-flows, and stressful water temperatures already occurring in freshwater rivers and streams used by anadromous species are expected to continue or worsen in many locations. Estuaries may experience changes in habitat quality/quantity and productivity because of changes in freshwater flows, nutrient cycling, sediment delivery, sea level rise, and storm surge.

6.2 Species Specific Information on Climate Change Effects

6.2.1 Sea Turtles

Sea turtle species have persisted for millions of years. They are ectotherms, meaning that their body temperatures depends on ambient temperatures. Throughout this time, they have experienced wide variations in global climate conditions and are thought to have previously adapted to these changes through changes in nesting phenology and behavior (Poloczanska et al. 2009). Given this, climate change at normal rates (thousands of years) is not thought to have historically been a problem for sea turtle species. However, at the current rate of global climate change, future effects to sea turtles are probable. Climate change has been identified as a threat to all species of sea turtles found in the action area (Conant et al. 2009; NMFS et al. 2011; Seminoff et al. 2015: NMFS and U.S. FWS 2020). However, trying to assess the likely effects of climate change on sea turtles is extremely difficult given the uncertainty of regional climate change projections and the scope and scale of sea turtle habitat, biology, and behavioral change. In the Northwest Atlantic, specifically, loggerhead, green, and leatherback sea turtles are predicted to be among the more resilient species to climate change, while Kemp’s ridley sea turtles are among the least resilient (Fuentes et al. 2013). Leatherbacks may be more resilient to climate change in the Northwest Atlantic because of their wide geographic distribution, low nest-site fidelity, and gigantothermy (Dutton et al. 1999; Robinson et al. 2009; Fuentes et al. 2013). Gigantothermy refers to the leatherback’s ability to use its large body size, peripheral tissues as insulation, and circulatory changes in thermoregulation (Paladino et al. 1990). Leatherbacks achieve and maintain substantial differentials between body and ambient temperatures through adaptations for heat production, including adjustments of the metabolic rate, and retention (Wallace et al. 2008). However, modeling results show that global warming poses a “slight risk” to females nesting in French Guiana and Suriname relative to those in Gabon/Congo and West Papua, Indonesia (Dudley et al. 2016). More recently, Lettrich et al. (2020) and Lettrich et al. (in prep) have determined that in the Northwest Atlantic, the vulnerability of Kemp's ridley and leatherback sea turtles to climate change is very high, the vulnerability of green sea turtles is high, and the vulnerability of loggerhead sea turtles is moderate.

Sea turtles are most likely to be affected by climate change due to:

(1) changing air/land temperatures and rainfall at nesting beaches that could affect reproductive output including hatching success, hatchling emergence rate, and hatchling sex ratios;
(2) sea level rise, which could result in a reduction or shift in available nesting beach habitat, an increased risk of erosion and nest inundation, and reduced nest success;
(3) changes in the abundance and distribution of forage species, which could result in changes in the foraging behavior and distribution of sea turtle species as well as changes in sea turtle fitness and growth;
(4) changes in water temperature, which could possibly lead to a shift in their range, changes in phenology (timing of nesting seasons, timing of migrations) and different threat exposure; and
(5) increased frequency and severity of storm events, which could impact nests and nesting habitat, thus reducing nesting and hatching success.

Current approaches have limited power to predict the magnitude of future climate change, associated impacts, whether and to what extent some impacts will offset others, or the adaptive capacity of this species. From 1901 through 2020, sea surface temperatures rose at an average rate of 0.14°F per decade and continue to rise (NOAA 2021). However, in the foreseeable future, it is unknown if continued increases in temperature are enough of a change to contribute to shifts in the range, distribution and recruitment of sea turtles or their prey. Theoretically, we expect that as waters in the action area warm, more sea turtles could be present for longer periods. A recent study by Patel et al. (2021) in which nearly 200 loggerheads were tagged and tracked in the Mid-Atlantic Bight indicated that the habitat envelope for these turtles consisted of SSTs ranging from 11.0° to 29.7°C. The core range consisted of SSTs between 15.0° and 28.0°C, with the highest probability of presence occurred in regions with SST between 17.7° and 25.3°C. Their model was then forced by a high-resolution global climate model under a doubling of atmospheric CO_2 to project loggerhead probability of presence over the next 80 years. Results suggest that loggerhead thermal habitat and seasonal duration will likely increase in northern regions of the Northwest Atlantic shelf.

As the climate continues to warm, feminization of sea turtle populations is a concern for many sea turtle species, which undergo temperature-dependent sex determination. Rapidly increasing global temperatures may result in warmer incubation temperatures and higher female-biased sex ratios (*e.g.*, Glen and Mrosovsky 2004, Hawkes et al. 2009). Increases in precipitation might cool beaches (Houghton et al. 2007); thereby, mitigating some impacts relative to increasing sand temperature. Though the predicted level of warming over the period of the action is small (i.e., <1°C), feminization occurs over a small temperature range (1°-4°C) (Wibbels 2003) and several populations in the action area already are female biased (Gledhill, 2007; Witt et al. 2010; Patino-Martinez et al. 2012; Laloë et al. 2016). The existing female bias among juvenile loggerhead sea turtles is estimated at approximately three to two females per males (Witt et al. 2010). Feminization is a particular concern in tropical nesting areas where over 95% female biased nests are already suspected for green sea turtles, and leatherbacks are expected to cross this threshold within a decade (Patino-Martinez et al. 2012; Laloë et al. 2014, 2016). It is possible for populations to persist, and potentially increase with increased egg production, with strong female biases (Godfrey et al. 1999; Broderick et al. 2000; Hays et al. 2003; Coyne and Landry 2007), but population productivity could decline if access to males becomes scarce (Coyne 2000). Low numbers of males could also result in the loss of genetic diversity within a population. Behavioral changes could help mitigate the impacts of climate change, including shifting of the breeding season and location to avoid warmer temperatures. For example, the start of the nesting season for loggerheads has already shifted as the climate has warmed (Weishampel et al. 2004). Nesting selectivity could also help mitigate the impacts of climate on sex ratios as well (Kamel and Mrosovsky 2004).

At St. Eustatius in the Caribbean, there is an increasing female biased sex ratio of green sea turtle hatchlings (Laloë et al. 2016). While this is partly attributable to imperfect egg hatchery practices, global climate change is also implicated as a likely cause as warmer sand temperatures at nesting beaches can result in the production of more female embryos. At this time, we do not know how much of this bias is also due to hatchery practices as opposed to temperature. Global warming may exacerbate this female skew. An increase in female bias is predicted in St. Eustatius, with only 2.4% male hatchlings expected to be produced by 2030 (Laloë et al. 2016). The study also evaluated leatherback sea turtles on St. Eustatius. The authors found that the model results project the entire feminization of green and leatherback sea turtles due to increased air temperature within the next century (Laloë et al. 2016). The extent to which sea turtles may be able to cope with this change, by selecting cooler areas of the beach or shifting their nesting distribution to other beaches with smaller increases in sand temperature, is currently unknown.

Several leatherback nesting areas are already predominantly female, a trend that is expected to continue with some areas expecting at least 95% female nests by 2028 (Gledhill 2007; Patino-Martinez et al. 2012; Laloë et al. 2016). Hatchling success has declined in St. Croix (Garner et al. 2017), though there is some evidence that the overall trend is not climate or precipitation related (Rafferty et al. 2017). Excess precipitation is known to negatively impact hatchling success in wet areas, but can have a positive effect in dry climates (Santidrián Tomillo et al. 2015). In Grenada, increased rainfall (another effect of climate change) was found to have a cooling influence on leatherback nests, so that more male producing temperatures (less than 29.75°C) were found within the clutches (Houghton et al. 2007). There is also evidence for very wet conditions inundating nests or increasing fungal and mold growth, reducing hatching success (Patino-Martinez et al. 2014). Very dry conditions may also affect embryonic development and decrease hatchling output. Leatherbacks have a tendency towards individual nest placement preferences, with some clutches deposited in the cooler tide zone of beaches and have relatively weak nesting site fidelity; this may mitigate the effects of long-term changes in climate on sex ratios (Kamel and Mrosovsky 2004; Fuentes et al. 2013).

If nesting can shift over time or space towards regions with cooler sand temperatures, these effects may be partially offset. A shift towards earlier onset of loggerhead nesting was associated with an average warming of 0.8°C in Florida (Weishampel et al. 2004). Early nesting could also help mitigate some effects of warming, but has also been linked to shorter nesting seasons in this population (Pike et al. 2006), which could have negative effects on hatchling output. Nesting beach characteristics, such as the amount of precipitation and degree of shading, can effectively cool nest temperatures (Lolavar and Wyneken 2015). However, current evidence suggests that the degree of cooling resulting from precipitation and/or shading effects is relatively small and therefore, even under these conditions, the production of predominantly female nests is still possible (Lolavar and Wyneken 2015). However, the impact of precipitation, as well as humidity and air temperature, on loggerhead nests is site specific and data suggest temperate sites may see improvements in hatchling success with predicted increases in precipitation and temperature (Montero et al. 2018, 2019). Conversely, tropical areas already produce 30% less output than temperate regions and reproductive output is expected to decline in these regions (Pike 2014).

Warming sea temperatures are likely to result in a shift in the seasonal distribution of sea turtles in the action area. In the northern part of the action area, sea turtles may be present earlier in the year if northward migrations from their southern overwintering grounds begin earlier in the spring. Likewise, if water temperatures are warmer in the fall, sea turtles could remain in the more northern areas later in the year. Potential effects of climate change include range expansion and changes in migration routes as increasing ocean temperatures shift range-limiting isotherms north (Robinson et al. 2009). McMahon and Hays (2006) reported that warming caused a generally northerly migration of the 15°C SST isotherm from 1983 to 2006. In response to this, leatherbacks expanded their range in the Atlantic north by 330 kilometers (McMahon and Hays 2006). An increase in cold stunning of Kemp's ridley sea turtles in New England has also been linked to climate change and could pose an additional threat to population resilience (Griffin et al. 2019).

In addition, although nesting occurs in the Mid-Atlantic (i.e., North Carolina and into Virginia), recent observations have caused some speculation that the nesting range of some sea turtle species may shift northward as the climate warms and that nest crowding may increase as sea level rises and available nesting habitat shrinks (Reece et al. 2013). Recent instances include a Kemp's ridley nest in New York in July 2018 (96 hatchlings), a loggerhead nest in Delaware in July 2018 (48 hatchlings), and a loggerhead nest in Maryland in September 2017 (7 live hatchlings). The ability to shift nesting in time and space towards cooler areas could reduce some of the temperature-induced impacts of climate change (e.g., female biased sex ratio). Fuentes et al. (2020) modelled the geographic distribution of climatically suitable nesting habitat for sea turtles in the U.S. Atlantic under future climate scenarios, identified potential range shifts by 2050, determined sea-level rise impacts, and explored changes in exposure to coastal development as a result of range shifts. Overall, the researchers found that, with the exception of the northern nesting boundaries for loggerhead sea turtles, the nesting ranges were not predicted to change. Fuentes et al. (2020) noted that range shifts may be hindered by expanding development. They also found that loggerhead sea turtles would experience a decrease (10%) in suitable nesting habitat followed by declines in nesting habitat for green turtles. No significant changes was predicted in the distribution of climatically suitable nesting area for leatherbacks by 2050. Sea level rise is projected to inundate current habitats; however, new beaches will also be formed and suitable habitats could be gained, with leatherback sea turtles potentially experience the biggest gain in suitable habitat (Fuentes et al. 2020).

Despite site-specific vulnerabilities of the Northwest Atlantic Ocean loggerhead DPS, this DPS may be more resilient to changing climate than other management units (Fuentes et al. 2013). Van Houtan and Halley (2011) recently developed climate based models to investigate loggerhead nesting (considering juvenile recruitment and breeding remigration) in the Northwest Atlantic and North Pacific. These models found that climatic conditions and oceanographic influences explain loggerhead nesting variability. Specifically, climate variability alone explained an average 60% (range 18-88%) of the observed nesting changes in the Northwest Atlantic and North Pacific over the past several decades. In terms of future nesting projections, modeled climate data predict a positive trend for Florida nesting (the Northwest Atlantic Ocean DPS), with increases through 2040 as a result of the Atlantic Multidecadal Oscillation (Van Houtan and Halley 2011). In a separate model, Arendt et al (2013) suggested that nesting variability represents a response to both climate variability and historical anthropogenic impacts. The nest count increases since 2008 may reflect a potential recovery response (Arendt et al. 2013).

Climate change may also increase hurricane activity, leading to an increase in debris in nearshore and offshore environments. This, in turn, could increase the occurrence of entanglements, ingestion of pollutants, or drowning. In addition, increased hurricane activity may damage nesting beaches or inundate nests with seawater. Increasing temperatures are expected to result in increased polar melting and changes in precipitation that may lead to rising sea levels (Titus and Narayanan 1995).

Hurricanes and tropical storms occur frequently in the southeastern U.S. They impact nesting beaches by increasing erosion and sand loss and depositing large amounts of debris on the beach. A lower level of leatherback nesting attempts occurred on sites more likely to be impacted by hurricanes (Dewald and Pike 2014). These storm events may ultimately affect the amount of suitable nesting beach habitat, potentially resulting in reduced productivity (TEWG 2007). These storms may also result in egg loss through nest destruction or inundation. Climate change may be increasing the intensity of hurricanes (IPCC 2014).

These environmental/climatic changes could result in increased erosion rates along nesting beaches, increased inundation of nesting sites, a decrease in available nesting habitat, and an increase in nest crowding (Daniels et al. 1993; Fish et al. 2005; Baker et al. 2006; Reece et al. 2013). Changes in environmental and oceanographic conditions (e.g., increases in the frequency of storms, changes in prevailing currents), as a result of climate change, could accelerate the loss of sea turtle nesting habitat, and thus, loss of eggs (Antonelis et al. 2006; Baker et al. 2006; Conant et al. 2009; Ehrhart et al. 2014).

Tidal inundation and excess precipitation can contribute to reduce hatchling output, particularly in wetter climates (Pike 2014; Pike et al. 2015; Santidrián Tomillo et al. 2015). This is especially problematic in areas with storm events and in highly developed areas where the beach has nowhere to migrate. Females may deposit eggs seaward of erosion control structures, potentially subjecting nests to repeated tidal inundation. A recent study by the U.S. Geological Survey found that sea levels in a 620-mile “hot spot” along the East Coast are rising three to four times faster than the global average (Sallenger et al. 2012). In the next 100 years, the study predicted that sea levels will rise an additional 20-27 centimeters along the Atlantic coast “hot spot” (Sallenger et al. 2012). The disproportionate sea level rise is due to the slowing of Atlantic currents caused by fresh water from the melting of the Greenland Ice Sheet. Sharp rises in sea levels from North Carolina to Massachusetts could threaten wetland and beach habitats, and negatively affect sea turtle nesting along the North Carolina and Virginia coasts. If warming temperatures moved favorable nesting sites northward, it is possible that rises in sea level could constrain the availability of nesting sites on existing beaches (Reece et al. 2013). There is limited evidence of a potential northward range shift of nesting loggerheads in Florida, and it is predicted that this shift, along with sea level rise, could result in more crowded nesting beaches (Reece et al. 2013).

In the case of Kemp's ridleys, most of their critical nesting beaches are undeveloped and may still be available for nesting despite shifting landward. Unlike much of the Texas coast, the Padre Island National Seashore (PAIS) shoreline in Texas, where increasing numbers of Kemp's ridley are nesting, is accreting. Given the increase in nesting at the PAIS, as well as increasing and slightly cooler sand temperatures than at other primary nesting sites, PAIS could become an increasingly important source of males for a species, which already has one of the most restricted nesting ranges of all sea turtles. Nesting activity of Kemp's ridleys in Florida has also increased over the past decade, suggesting the population may have some behavioral flexibility to adapt to a changing climate (Pike 2013). Still, current models predict long-term reductions in sea turtle fertility as a result of climate change; however, these effects may not be seen for 30 to 50 years because of the longevity of sea turtles (Davenport 1997; Hulin and Guillon 2007; Hawkes et al. 2007).

Changes in water temperature may also alter the forage base and thus, foraging behavior of sea turtles (Conant et al. 2009). Likewise, if changes in water temperature affected the prey base for loggerhead, leatherback, Kemp's ridley, or green sea turtles, there may be changes in the abundance and distribution of these species in the action area. Depending on whether there was an increase or decrease in the forage base and/or a seasonal shift in water temperature, there could be an increase or decrease in the number of sea turtles in the action area. Seagrass habitats may suffer from decreased productivity and/or increased stress due to sea level rise, as well as changes in salinity, light levels, and temperature (Short and Neckles 1999; Duarte 2002; Saunders et al. 2013). If seagrasses in the action area decline, it is reasonable to expect that the number of foraging hard-shelled sea turtles, namely greens, would also decline as well. Rising water temperatures, and associated changes in marine physical oceanographic systems (e.g., salinity, oxygen levels, and circulation), may also impact the distribution/abundance of leatherback prey (i.e., jellyfish) and in turn, impact the distribution and foraging behavior of leatherbacks (Brodeur et al. 1999; Purcell 2005; Attrill et al. 2007; Richardson et al. 2009; NMFS 2013c). Loggerhead sea turtles are thought to be generalists (NMFS and U.S. FWS 2008), and, therefore, may be more resilient to changes in prey availability. As noted above, because we do not know the adaptive capacity of these individuals, or what level of temperature change would cause a shift in distribution, it is not possible to predict changes to the foraging behavior of sea turtles over the foreseeable future. If sea turtle distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact to sea turtles due to the availability of food. Similarly, if sea turtles shifted to areas where different forage was available, and sea turtles were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. However, should climatic changes cause sea turtles to shift to an area or time where insufficient forage is available, impacts to these species would be greater.

Kemp's ridley sea turtles are also the most commonly documented species during cold stun events in the Greater Atlantic Region. With prolonged exposure to low water temperatures, sea turtles become hypothermic and can experience debilitating lethargic conditions. These events occur in the fall at higher latitudes when sea turtles do not migrate south before water temperatures decline. Griffin et al. (2019) suggest that warming sea surface temperatures in the Gulf of Maine are associated with increased strandings of Kemp's ridleys in Massachusetts. The warmer temperatures may be allowing Kemp's ridley distribution to expand and may act as an ecological bridge between the Gulf Stream and nearshore waters (Griffin et al. 2019).

6.2.2 Shortnose and Atlantic Sturgeon

Shortnose and Atlantic sturgeon have persisted for millions of years and have experienced wide variations in global climate conditions, to which they have successfully adapted. Climate change at historical rates (thousands of years) is not thought to have been a problem for sturgeon species. However, at the current rate of global climate change, future effects to sturgeon are possible. Rising sea level may result in the salt wedge moving upstream in affected rivers. Shortnose and Atlantic sturgeon spawning occurs in freshwater reaches of rivers because early life stages have little to no tolerance for salinity. Similarly, juvenile sturgeon have limited tolerance to salinity and remain in waters with little to no salinity. If the salt wedge moves further upstream, sturgeon spawning and rearing habitat could be restricted. In river systems with dams or natural falls that are impassable by sturgeon, the extent that spawning or rearing may be shifted upstream to compensate for the shift in the movement of the salt wedge would be limited. While there is an indication that an increase in sea level rise would result in a shift in the location of the salt wedge, at this time there are no predictions on the timing or extent of any 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 uncertain over the long term (which includes the foreseeable future) that shifts in the location of the salt wedge would reduce freshwater spawning or rearing habitat. Although if habitat was restricted or somehow eliminated, productivity or survivability would likely decrease.

The increased rainfall predicted by some models in some areas may increase runoff and scour spawning areas and flooding events could cause temporary water quality issues. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems with dissolved oxygen (DO) and temperature. While this occurs primarily in rivers in the southeast U.S. and the Chesapeake Bay, it may start to occur more commonly in the northern rivers. Shortnose and Atlantic sturgeon are tolerant to water temperatures up to approximately 28°C (82.4°F); these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise and temperatures above 28°C are experienced in larger areas, sturgeon may be excluded from some habitats.

Increased droughts (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spring may also expose eggs and larvae in rearing habitats. If a river becomes too shallow or flows become intermittent, all sturgeon life stages, including adults, may become susceptible to stranding or habitat restriction. Low flow and drought conditions are also expected to cause additional water quality issues. Any of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey. Additionally, cues for spawning migration and spawning could occur earlier in the season causing a mismatch in prey that are currently available to developing sturgeon in rearing habitat.

Shortnose and Atlantic sturgeon in the action area are most likely to experience the effects of global climate change in warming water temperatures, which could change their range and migratory patterns. Warming temperatures predicted to occur over the next 100 years would likely result in a northward shift/extension of their range (i.e., into the St. Lawrence River, Canada) while truncating the southern distribution, thus affecting the recruitment and distribution of sturgeon range-wide. In the foreseeable future, gradual increases in sea surface temperature are expected, but it is unlikely that this expanded range will be observed in the near-term future. If any shift does occur, it is likely to be minimal and thus, it seems unlikely that any increases in temperature will cause a significant effect to shortnose and Atlantic sturgeon or a significant modification to the number of sturgeon likely to be present in the action area over the life of the proposed actions. However, even a small increase in temperate can affect DO concentrations. A one degree change in temperature in Chesapeake Bay could make parts of Chesapeake Bay inaccessible to sturgeon due to decreased levels of DO (Batiuk et al. 2009).

Although the action area does not include spawning grounds for shortnose and Atlantic sturgeon, sturgeon are migrating through the action area to reach their natal rivers to spawn. Elevated temperatures could modify cues for spawning migration, resulting in an earlier spawning season, and thus, altering the time of year sturgeon may or may not be present within the action area. This may cause an increase or decrease in the number of sturgeon present in the action area. However, because spawning is not triggered solely by water temperature, but also by day length (which would not be affected by climate change) and river flow (which could be affected by climate change), it is not possible to predict how any change in water temperature alone will affect the seasonal movements of sturgeon through the action area.

In addition, changes in water temperature may also alter the forage base and thus, foraging behavior of sturgeon. Any forage species that are temperature-dependent may also shift in distribution as water temperatures warm and cause a shift in the distribution of sturgeon. However, because we do not know the adaptive capacity of these species or how much of a change in temperature would be necessary to cause a shift in distribution, it is not possible to predict how these changes may affect foraging sturgeon. If sturgeon distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact on the availability of food. Similarly, if sturgeon shifted to areas where different forage was available and sturgeon were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. The greatest potential for effect to forage resources would be if sturgeon shifted to an area or time where insufficient forage was available; however, the likelihood of this happening seems low because sturgeon feed on a wide variety of species and in a wide variety of habitats.

Hare et al. (2016) assessed the vulnerability to climate change of a number of species that occur along the U.S. Atlantic coast. The authors define vulnerability as "the extent to which abundance or productivity of a species in the region could be impacted by climate change and decadal variability." Atlantic sturgeon were given a vulnerability rank of very high (99% certainty from bootstrap analysis) and a climate exposure rank of very high. Three exposure factors contributed to this score: sea surface temperature, ocean acidification, and air temperature. The authors concluded that Atlantic sturgeon are relatively invulnerable to distribution shifts. Climate factors such as sea level rise, reduced dissolved oxygen, and increased temperatures have the potential to decrease productivity, but the magnitude and interaction of effects is difficult to assess (Hare et al. 2016). Increasing hypoxia, in combination with increasing temperature, affects juvenile Atlantic sturgeon metabolism and survival (Secor and Gunderson 1998). A multivariable bioenergetics and survival model predicted that within the Chesapeake Bay, a 1°C increase in Bay-wide temperature reduced suitable habitat for juvenile Atlantic sturgeon by 65% (Niklitschek and Secor 2005). These studies highlight the importance of the availability of water with suitable temperature, salinity and dissolved oxygen; climate conditions that reduce the amount of available habitat with these conditions would reduce the productivity of Atlantic sturgeon.

Changes in water availability may also affect the productivity of populations of Atlantic sturgeon. In rivers with dams or other barriers that limit access to upstream freshwater reaches, spawning and rearing habitat may be restricted by increased saltwater intrusion; however, no estimates of the impacts of such change are currently available.

6.2.3 Atlantic Salmon

Hare et al. (2016) gave Atlantic salmon a vulnerability rank of very high (100% certainty from bootstrap analysis) as well as a climate exposure rank of very high and a distributional vulnerability rank of moderate (87% certainty from bootstrap analysis). Due to the effects of warming on freshwater and marine habitats, and the potential to affect the phenology of Atlantic salmon migration, the effect of climate change on Atlantic salmon in the Northeast U.S. Shelf Ecosystem is very likely to be negative (>95% certainty in expert scores) (Hare et al. 2016). Ocean acidification could also affect olfaction, which Atlantic salmon use for natal homing.

As described in Hare et al. (2016), several studies have examined the effects of climate on the abundance and distribution of Atlantic salmon. A review of the likely effects of climate change found that the thermal niche of Atlantic salmon will likely shift northward causing decreased production and possibly extinction at the southern end of the species range (Jonsson and Jonsson 2009). The GOM DPS is the southernmost population of Atlantic salmon in the Northwest Atlantic Ocean. Declines in post-smolt survival were associated with ocean warming (Friedland et al. 2014). The authors hypothesized that in the Northwest Atlantic, the decline in survival was due to early ocean migration by post-smolts (Friedland et al. 2014). Results of a recent study suggest that poor trophic conditions, likely due to climate-driven environmental factors, and warmer ocean temperatures are constraining the productivity and recovery of Atlantic salmon in the Northwest Atlantic (Mills et al. 2013). Available evidence suggests that climate change and long-term climate variability will reduce the productivity of the GOM DPS of Atlantic salmon within the action area, namely in the Gulf of Maine where water temperatures have been warming faster than 99% of the world’s oceans in the past 15 years (Pershing et al. 2015).

7.0 EFFECTS OF THE ACTIONS

In this *Effects of the Actions* section, we present the results of our assessment of the probable effects of the federal actions that are the subject of this consultation on threatened and endangered species and designated critical habitat. Effects of the action are defined 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 would not occur but for the proposed action, and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.17).

The analysis in this section forms the foundation for our jeopardy analysis in section 9.0. The quantitative and qualitative analyses in this section are based upon the best available commercial and scientific data on species biology and the effects of the action. Data are limited, so we are often forced to make assumptions to overcome the limits in our knowledge. Sometimes, the best available information may include a range of values for a particular aspect under consideration or different analytical approaches may be applied to the same data set.

In this section of the Opinion, we assess the direct and indirect effects of the proposed actions on ESA-listed sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon. The purpose of the assessment is to determine if it is reasonable to conclude that the proposed actions are likely to have direct or indirect effects on those species that appreciably reduce their likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution.

As discussed in the *Description of the Proposed Actions*, the proposed actions are fisheries and ecosystem research activities conducted and funded by the NEFSC, as well as fisheries observer handling and sampling of sea turtles, sturgeon, and salmon. This consultation considers long-term survey programs as well as short-term cooperative research projects to be carried out over five-year period from 2021-2026. Sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon may be affected by the proposed actions in a number of ways. This includes via: (1) direct capture, hooking, or entanglement in fishing gear used during NEFSC research; (2) post-interaction handling and sampling by fisheries observers; (3) interactions with research and fishing vessels; (4) effects to prey and habitat; and (5) effects (i.e., harassment) from active acoustics sources. The following effects analysis will be organized along these topics.

To calculate adverse impacts to ESA-listed species (i.e., incidental takes), the 2016 final PEA, 2020 final BA, and 2023 supplemental BA reviewed data and information on past and anticipated interactions of sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon with the gears and equipment used by the NEFSC and its research partners as well as through post-fishing interaction handling and sampling by observers. The authors of the PEA and BAs are subject matter experts who developed a discussion of the effects on these species based on their best professional judgment, relying on the collective knowledge of other specialists in their respective fields and the body of accepted literature (NEFSC 2016, 2020a, 2021a).

7.1 Approach to the Assessment

We begin our analysis of the effects of the actions by first reviewing what activities (e.g., gear types and techniques, vessel transits) associated with the proposed actions (i.e., the proposed action stressors) are likely to adversely affect sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon in the action area. We next review the range of responses to an individual's exposure to that stressor and the factors affecting the likelihood, frequency, and severity of exposure. Afterwards, our focus shifts to evaluating and quantifying exposure. We estimate the number of individuals of each species likely to be exposed and the likely fate of those animals.

The *Integration and Synthesis* section of this Opinion follows the *Effects of the Action* section and integrates information we presented in the *Status of the Species* and *Environmental Baseline* with the results of our exposure and response analyses to estimate the probable risks the proposed actions pose to endangered and threatened species. Because we previously concluded that the proposed actions are not likely to adversely affect several listed species and areas designated as critical habitat for listed species (section 4.1), these listed species and critical habitat are not considered in the analyses that follow.

To identify, describe, and assess the effects to listed species considered in this Opinion, we reviewed information on: (1) interactions and captures of sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon in past NEFSC fisheries and ecosystem research projects and observer program monitored commercial fishing trips, (2) the life history of sea turtles, sturgeon, and salmon, and (3) the effects of fishing gear, equipment, active acoustic sources, and vessel interactions on sea turtles, sturgeon, and salmon in similar fisheries and ecosystem research activities in the U.S. Atlantic. These sources of information include status reviews, stock assessments, biological reports, recovery plans, impact assessments, annual reports from the NEFSC, and numerous other references from the published literature.

Potential Stressors

We consider all stressors from the proposed actions that may adversely affect endangered or threatened species, their ecological interactions, or their designated critical habitat. At any point in time, a single research or fishing vessel may be the source of one or more of these potential stressors, and listed individuals may be exposed to one or more of these stressors.

Potential stressors from the proposed actions include NEFSC research fishing gear interactions, observer program handling and sampling, vessel strikes, exposure to active acoustic sources, as well as impacts to prey and habitat, although we have determined that effects from and to the latter four are insignificant and/or discountable. Research and fishing gear related effects on threatened and endangered species stem primarily from interactions that result in the strike or capture of an individual animal, some of which could result in injury or death. Our species-specific analyses in sections 7.2, 7.3, 7.4, and 7.5 will focus on and assess adverse effects from physical contact with and any resulting capture in research or fishing gear as well as from post-interaction handling and sampling during observed commercial fishing trips by the NEFOP, IFS, and ASM programs. We assume the potential effects of each gear type are proportional to the number of interactions between the gear and each species. Other potential effects of the proposed actions on listed species are via vessel interactions (which may result in injury or death if the vessel strike is severe), habitat degradation, a reduction of prey/foraging base, or harassment from active acoustic sources (each of which are discussed in sections 7.6, 7.7, 7.8, and 7.9).

7.2 Fishing Gear and Observer Handling/Sampling Effects to Sea Turtles

The primary factors affecting sea turtle interactions with the activities assessed in this Opinion are: (1) overlap in time and space, (2) susceptibility to fisheries and ecosystem sampling methodologies, (3) the behavior of sea turtles in the presence of gear, equipment, and vessels, and (4) oceanographic features. As described in the *Status of the Species*, the occurrence of loggerhead, Kemp's ridley, green, and leatherback sea turtles in Northwest Atlantic waters is primarily temperature dependent. In general, sea turtles move up the U.S. Atlantic coast from southern wintering areas as water temperatures warm in the spring (Braun-McNeill and Epperly 2002, Braun-McNeill et al. 2008, James et al. 2005a, James et al. 2005b, James et al. 2005c, Keinath et al. 1987, Morreale and Standora 1998, Morreale and Standora 2005, Musick and Limpus 1997, Shoop and Kenney 1992). Recreational anglers have reported sightings of sea turtles in inshore waters (bays, inlets, rivers, or sounds) as far north as New York as early as March-April, but in relatively low numbers (Braun-McNeill and Epperly 2002). The trend is reversed in the fall as water temperatures cool. Near Cape Hatteras during late fall and early winter, the narrowness of the continental shelf and influence of the Gulf Stream helps to concentrate sea turtles, making them more susceptible to fishery interactions (Epperly 1995). Greater numbers of loggerheads, Kemp's ridleys, and greens are found in inshore, nearshore, and offshore waters of the southern Mid-Atlantic (Virginia and North Carolina) from May-November (Mansfield et al. 2009) and in inshore, nearshore, and offshore waters of the northern Mid-Atlantic (New York and New Jersey) from June-October (Braun-McNeill and Epperly 2002, Keinath and Musick 1993, Morreale and Standora 1994). Hard-shelled sea turtles are more commonly found in waters south of Cape Cod and Georges Bank, but may also occur in waters farther north (Morreale and Standora 1994). Leatherbacks have a similar seasonal distribution, but have a more extensive range into the Gulf of Maine compared to the hard-shelled sea turtle species (James et al. 2005a, James et al. 2005b, Mitchell et al. 2002, Shoop and Kenney 1992).

Extensive survey effort of the continental shelf from Cape Hatteras to Nova Scotia, Canada in the 1980s revealed that loggerheads were observed at the surface from the beach to bottom depths up to 14,700 feet (4,481 meters) (CETAP 1982). However, they were generally found in waters where bottom depths ranged from 72-161 feet (median 120 feet) (22-49 meters (median 36.6 meters)) (Shoop and Kenney 1992). Leatherbacks were sighted at the surface in waters with bottom depths ranging from 3.3-13,620 feet (1-4,151 meters) (Shoop and Kenney 1992). However, 84.4% of leatherback sightings occurred in waters where the bottom depth was less than 590 feet (180 meters); whereas 84.5% of loggerhead sightings occurred in waters where the bottom depth was less than 262 feet (80 meters) (Shoop and Kenney 1992). Neither species was commonly found in waters over Georges Bank, regardless of season (Shoop and Kenney 1992). The CeTAP study did not include Kemp's ridley and green sea turtle sightings, given the difficulty of sighting and identifying these sea turtle species (CETAP 1982).

More recently as part of an AMAPPS survey, the NEFSC and SEFSC conducted two shipboard and two aerial line transect surveys covering U.S. Atlantic waters from Florida to Maine, from the coastline to the U.S. EEZ and slightly beyond from June 27 to September 28, 2016 (NMFS

2016d). The aerial abundance surveys targeted sea turtles in Atlantic continental shelf waters from the shore to about the 328-foot (100 meter) or 656-foot (200 meter) depth contour, depending on the location. The shipboard abundance surveys targeted sea turtles in waters at the shelf break, starting from the offshore edge of the plane's survey area to waters farther offshore to the U.S. EEZ and slightly beyond. The surveys completed about 18,338 nautical miles (33,963 kilometers) of track lines: 5,796 nautical miles (10,735 kilometers) from ships and 12,542 nautical miles (23,228 kilometers) from planes. The most frequently detected sea turtles were loggerheads, with about 1,000 individuals that ranged from 26-41°N, mostly in waters on the continental shelf. Studies conducted in 2016 also investigated methods to estimate spatial and temporal distributions of tagged loggerhead sea turtle densities (NMFS 2016d).

Researchers also conducted aerial surveys in coastal ocean waters of Maryland and Virginia from spring through fall in 2011 and 2012 (Barco et al. 2018). Ocean abundance estimates of loggerheads were highest in the spring months of May-June and lower in the fall months of September-October. Ocean abundance estimates for loggerheads during the summer months of July-August were in between the spring and fall ranges, while no surveys were flown in the winter months from November-March (Barco et al. 2018).

Given the seasonal occurrence patterns and depth preferences of sea turtles off the U.S. Atlantic coast from Florida to New England, the distribution of sea turtles is likely to overlap with most of the fisheries and ecosystem studies to be conducted by the NEFSC. This is confirmed by the past captures of sea turtles during the NEFSC Bottom Trawl Surveys (BTS), NEAMAP trawl surveys, Apex Predators, and COASTSPAN surveys as well as in numerous commercial fisheries using similar gear types (trawls, gillnets, hook and line) as evidenced by NEFOP incidental take data. Historical takes of sea turtles during the NEFSC's fisheries and ecosystem research from 2004-2020 are summarized in the December 2020 BA and Table 20 below. We also added the incidental takes of sea turtles documented during NEFSC research activities in 2021 and 2022, which are available from our Protected Species Incidental Take (PSIT) database.

Incidental captures of all four species have been documented across both the NE and SE LMEs, although loggerheads and Kemp's ridleys are by far the most common, followed by greens and then leatherbacks. Sea turtles have only been captured in the following five long-term NEFSC-affiliated survey programs: (1) COASTSPAN gillnet and longline surveys, (2) Spring and Fall NEFSC BTS, (3) Spring and Fall NEAMAP trawl surveys, (4) Apex Predators longline surveys, and (5) Massachusetts Division of Marine Fisheries (MADMF) Spring and Fall bottom trawl surveys. The greatest number of sea turtle interactions since 2004 has occurred during the NEAMAP trawl surveys, followed by the NEFSC BTS and COASTSPAN surveys, with interactions during the remaining two survey programs being much more infrequent.

Table 20. Incidental takes of sea turtles in NEFSC fisheries and ecosystem research surveys, 2004-2022.[a]

Year	Kemp's Ridley	Leatherback	Loggerhead	Green
2004	0	0	2	0
2005	2	0	2	0
2006	1	0	2	0
2007	1	2 [b]	4	0
2008	2	0	10	0
2009	4 [c]	1	1	1
2010[c]	5	0	3	2
2011	6	0	5	0
2012	8	0	7	2
2013	1	0	0	0
2014	1	0	1	0
2015	1	0	0	0
2016	2	0	4	0
2017	8	0	6	1
2018	4	0	10	3
2019	6	0	10	2
2020[d]	0	0	5	5
2021	0	0	9	0
2022	3	0	9	3
Total	55	3	90	19

Source: NMFS PSIT database and NEFSC (2018, 2019, 2020b).

[a] All sea turtles were released alive and uninjured, except as noted.

[b] One leatherback sea turtle was killed during the Apex Predators surveys.

[c] One Kemp's ridley sea turtle was released alive but injured during the COASTSPAN surveys.

[d] Due to COVID-19, some annual surveys were canceled in 2020 including the Fall BTS, Northern Shrimp, and Ecosystem Monitoring Surveys. However, the Spring BTS and Spring and Fall NEAMAP surveys were conducted.

Table 21 provides quantitative average annual estimates of sea turtle captures and mortalities under the proposed actions, including the five major recurring surveys noted above as well as other short-term cooperative research projects, based on gear types used and deployment details such as tow times and soak durations. This table was created for and included in the NEFSC's July 2016 final PEA.

Table 21. Estimated average annual future takes of sea turtles in the 2016 final PEA using historical takes from 2004-2013.

Gear type	Trawl		Longline		Gillnet		Totals	
Species	Captures per year	SI&M per year	Captures per year	SI&M per year	Captures per year	SI&M per year	Captures per year	SI&M per year
Loggerhead	(14.7) 15 turtles	(0.19) 1 turtle	(1.6) 2 turtles	(0.16) 1 turtle	0	0	17 turtles	2 turtles
Kemp's ridley	(13.1) 14 turtles	(0.2) 1 turtle	(1.9) 2 turtles	(0.19) 1 turtle	(2.8) 3 turtles	(0.41) 1 turtle	19 turtles	3 turtles
Green	(0.1) 1 turtle	0	0	0	(0.4) 1 turtle	0	2 turtles	0
Leatherback	(0.1) 1 turtle	0	(0.6) 1 turtle	(0.06) 1 turtle	0	0	2 turtles	1 turtle
Totals	31 turtles	2 turtles	5 turtles	3 turtles	4 turtles	1 turtle	40 turtles	6 turtles

*Numbers of estimated captures/hookings/entanglements and serious injuries/mortalities (SI&M) totaled from Table 4.3-5 of the final PEA (in parentheses), rounded up to the next highest whole number of sea turtles. Those interactions resulting in SI&M are a subset of the total number of estimated captures each year (e.g., 2 of the 17 captures for loggerheads, 3 of the 19 for Kemp's ridleys, etc.). It should be noted that the term SI&M for sea turtles is now known as post-interaction mortality for most fishing gear interactions (NMFS 2017e; Upite et al. 2019).

The number of sea turtle incidental takes in NEFSC fisheries and ecosystem research activities from 2004 to 2022 was well below the level anticipated and exempted in the 2016 and 2021 Opinions. Although no leatherback sea turtles have been captured during NEFSC surveys over the last decade, they have been historically captured (three since 2004) and one was killed during an Apex Predators survey in 2007. In addition, during the COASTSPAN surveys in 2009 and 2010, one Kemp's ridley sea turtle was captured and released alive. In 2009, a hook was removed from the turtle's mouth and it swam away. In 2010, a hook imbedded in the turtle's body was cut off and the turtle swam away. Since 2010, no sea turtles have been injured or killed during NEFSC surveys.

Table 21 provides the number of estimated captures and serious injuries/mortalities (now known as post-interaction mortality) for all NEFSC-affiliated trawl, hook and line, and gillnet projects that are likely to interact with sea turtles, rounded up to next highest whole number of turtles. Mortalities have been associated with short-term cooperative trawl research projects due to greater effort and longer tow times, the Apex Predators and COASTSPAN longline surveys due to deep hookings in the gear or lengthy sets, and in the COASTSPAN gillnet surveys and NEFOP gillnet training cruises due to their relatively long (12 to 24 hour) soak times. Based on this analysis, up to 17 loggerhead, 19 Kemp's ridley, two leatherback, and two green sea turtles per year could be captured incidentally during NEFSC-affiliated research using bottom trawl, hook and line, and gillnet gears. That equates to up to 85 loggerhead, 95 Kemp's ridley, ten leatherback and ten green sea turtle interactions every five years, of which ten loggerhead, 15 Kemp's ridley, five leatherback, and one green sea turtle interactions are anticipated to be lethal.

The lack of historical takes from fisheries and ecosystem research using dredge and pot/trap gear and the substantial differences between those research surveys and the commercial fisheries makes it difficult to provide quantitative estimates of potential future takes of sea turtles in those two additional gear types. Given the continued use of fishing gear with documented adverse interactions with sea turtles, there is a risk of future interactions during NEFSC fisheries and ecosystem research activities, and captures in dredge and pot/trap gear and unobserved collisions of sea turtles with the gear or lines on the sea floor may occur. However, based on the lack of observed research takes over many years, the short tow times of dredge gear (15 minutes for most tows), and the relatively small number of research tows (less than 450 scallop tows and 150 surf clam/quahog tows per year compared to tens of thousands of commercial dredge tows) and pot/trap deployments (only occasional scup, black sea bass, and ropeless pot/trap projects are proposed), the risk of future adverse interactions with sea turtles is small, and interactions would be extremely rare.

Since we currently have no information to indicate that the incidental take levels for sea turtles during NEFSC fisheries and ecosystem research have been significantly different over the past five years as compared to years prior, we are assuming that the quantitative take and mortality estimates for sea turtles provided within the 2016 final PEA still represent the best available information. The only difference is that we now expect up to one of the ten green sea turtle interactions every five years to be a lethal take, due to recent captures in COASTSPAN survey gillnet gear, where sets are likely to be longer than for bottom trawl and hook and line surveys.

The NEFSC has been coordinating the collection of fisheries observer data since 1989. To assess the number of sea turtles that may be handled and sampled by the NEFSC observer programs, we looked to observer data from the recent ten-year period of 2010-2019 to be representative of what we anticipate through 2026 (Table 22). We have included the numbers from 2020 and 2021 for information purposes below. However, given the restrictions on the observer programs due to COVID-19 during these years, we do not believe that they are representative of future levels of effort.

Table 22: Average and maximum number of ESA-listed species handled and sampled by the NEFSC's observer programs from 2010-2021.

Species	Average sampled 2010-2019	Maximum sampled 2010-2019	Average sampled 2020-2021	Maximum sampled 2020-2021
Loggerhead sea turtle (*Caretta caretta*), Northwest Atlantic DPS	17	31	1.5	3
Kemp's ridley sea turtle (*Lepidochelys kempii*)	4	10	0.5	1
Green sea turtle (*Chelonia mydas*), North Atlantic DPS	2	2	0	0

Leatherback sea turtle (*Dermochelys coriacea*)	2	2	0	0

We believe that these past data, during years when the observer programs were fully operational, represent the best available data for estimating future takes. We considered using the average number of animals per year to estimate the takes; however, because of recent funding allocated through the sea turtle observer requirements under the Annual Determination (ESA observer requirement) the NEFSC observer programs will be observing fisheries in state waters specifically for sea turtle bycatch. It is unclear whether Annual Determination funding will continue in future years, but the intent is to pursue funding for fisheries (currently several gillnet fisheries) listed on the Determination. In past years, both gillnet and trawl fisheries in state waters have been listed on the Annual Determination. These trips may occur in areas where there is a higher presence of ESA-listed species. Given that this is a new program, we do not have historical data to assess the potential level of take. Therefore, we determined that we should use the maximum number of animals handled and sampled in the ten past years prior to COVID-19 to calculate the number of animals to be handled and sampled under the proposed actions. We have taken the maximum number of animals during the 2010-2019 period and multiplied it by the number of years the proposed actions will occur (i.e., through 2026; therefore, four years) to estimate the total number of animals anticipated to be taken (see Table 23).

Table 23: Estimate of sea turtles to be handled and sampled by the observer programs through 2026.

Species	Estimate of animals sampled through 2026
Loggerhead sea turtle (*Caretta caretta*), Northwest Atlantic DPS	124
Kemp's ridley sea turtle (*Lepidochelys kempii*)	40
Green sea turtle (*Chelonia mydas*), North Atlantic DPS	8
Leatherback sea turtle (*Dermochelys coriacea*)	8

Effects to sea turtles from handling and sampling are similar for loggerhead, Kemp’s ridley, green, and leatherback sea turtles and are, therefore, described here at the taxa level. As indicated above, the observer program portion of the proposed actions does not include the initial incidental capture in the commercial fisheries, but rather the handling and sampling activities that the observer conducts once the animal has been transferred to them. The techniques used by the observers are standard in sea turtle research and have been implemented by the NEFSC observer programs for over three decades. Potential impacts from handling, photographing, and measuring the animal include only minor stress reactions. We expect these stress reactions to be temporary and of short duration, and that stress levels will to return to normal when the animal is returned to the water. When more invasive procedures (e.g., biopsy, tagging) are conducted, only minor stress, discomfort, and pain are expected. The methods used are standard worldwide and are not known to result in decreased reproduction or prolonged health effects. In past sampling, reactions in sea turtles have ranged from none to mild reactions including pulling flippers away or minor bleeding at the sampling site. No serious injuries or mortalities have been documented as a result of sea turtle handling or sampling conducted by observers.

While transfer of live animals to rehabilitation facilities may result in a longer period of stress for the animal, this is only done in consultation with the STSSN and in cases where the animal is injured when brought on board. These injuries are not a result of the observer handling and sampling. The STSSN will be contacted by the observer program, and they will advise the observer on when transport is appropriate given the details of the interaction and the condition of the animal. While this may result in slight increases in stress levels experienced by the animal due to the longer time it is on the vessel, the animal will be subsequently treated by veterinarians at the rehabilitation facility to reduce any long-term impacts resulting from the initial capture.

7.3 Fishing Gear and Observer Handling/Sampling Effects to Shortnose Sturgeon

To date, there have been no documented shortnose sturgeon captures in NEFSC-conducted or funded bottom or mid-water trawl, gillnet, dredge, hook and line, or pot/trap surveys, or similar commercial fisheries. However, future catch of this species in NEFSC fisheries and ecosystem research is possible, and would most likely occur during surface trawl, fyke net, or seine surveys in coastal areas routinely studied by the NEFSC such as the Penobscot River estuary in Maine. The Penobscot Estuarine Fish Community and Ecosystem Survey occurs annually for 12 days at sea in the Penobscot River Estuary throughout the year and involves 200 total trawls at the surface. The Maine Estuaries Diadromous Survey also occurs in the Penobscot River with 100 fyke net sets per year over 100 days. Surface trawl, fyke net, and beach seine surveys with the potential to capture shortnose sturgeon have been conducted by the NEFSC in the past and have resulted in incidental take during state fisheries surveys funded by the U.S. FWS (NMFS 2018b).

Both our 2012 Opinion on the NEFSC‘s Penobscot River estuary studies and our 2016 and 2021 NEFSC programmatic Opinions anticipated the take of up to ten shortnose sturgeon over a five-year period, with one take leading to serious injury or mortality. Since the design of these surveys has remained unchanged over the past decade, we are not anticipating any additional take as a result of those activities. Since there have yet to be any shortnose sturgeon captures documented in any gear type used during the past ten years of these surveys, we continue to anticipate that no more than ten incidental captures of shortnose sturgeon will occur as a result of the NEFSC’s fisheries and ecosystem research activities over the next five years.

While all shortnose sturgeon captured in the sampling gear during the NEFSC's fisheries and ecosystem research are largely assumed to be released alive and uninjured, a small portion may experience lethal injuries or death. Given the above information, and assuming the worst case (that captures in trawls, fyke nets, or seines have comparable mortality rates to captures in directed research trawls or commercial gillnets; 4% or less), it is reasonable to expect up to one mortality over the course of the proposed actions. However, by following proper handling protocols and carefully releasing the captured fish, the majority of effects that could lead to lethal mortalities can be avoided. Therefore, we expect no more than one individual would experience serious injuries or mortality as a result of interactions with NEFSC sampling gear over the five-year duration of the proposed actions.

While shortnose sturgeon have not been taken in commercial fisheries in the past ten years, observers have documented twelve interactions since the inception of the program. None have occurred since 2005, which equates to an annual average of 0.4 animals per year since the program's inception in 1989. As described in the 2021 "batched fisheries" Opinion on ten GARFO fisheries, there is skepticism as to whether these identifications are correct (NMFS 2021c). Under the Annual Determination, we may be observing fisheries in times and areas not previously covered. Given the possibility that these earlier takes were shortnose sturgeon and that we will be observing fisheries under the Annual Determination for the first time, we are including the species here so that samples can be collected in the very rare instance a shortnose sturgeon is captured. Given that the take of a shortnose sturgeon in an observed commercial fishery is likely to be extremely rare, we are only anticipating one (1) handling and sampling take for this species through 2026.

Effects to ESA-listed fish are similar across species and include stress and behavior responses as well as minor injury from collecting genetic samples. The sampling techniques (e.g., scale collection, fin clips) used by observers are standard worldwide in finfish research. Kahn and Mohead (2010) strongly recommend standard handling procedures be performed on all sturgeon captured including measuring, weighing, and tissue sampling. These procedures are followed by observers. The procedures developed are designed to minimize impacts and represent best practices.

As described above, the proposed actions do not include the initial incidental capture by commercial fishing activities but rather the handling and sampling activities that an observer conducts once the animal has been transferred to them. Kahn and Mohead (2010) estimate that routine procedures (i.e., measuring, weighing, and tissue sampling) will take less than 15 minutes. Routine handling/holding can result in increased stress levels in shortnose sturgeon. Generally, sturgeon are hardy and are generally tolerant of handling but can be sensitive to this stressor (Kahn and Mohead 2010). In addition to stress resulting from handling, stress to the animal and minor injury may occur due to fin clip and scale collection (a minor injury is one that would heal in a matter of hours or days and result in no long term, adverse effects to the animal). There is no evidence that the collection of the genetic samples results in the serious injury or mortality of any species of sturgeon (Kahn and Mohead 2010). In addition, Wydoski and Emery (1983) found that tissue samples, clipped with sterile surgical scissors from the sections of soft pelvic (the fin sampled by observers) or anal fins of captured sturgeon, does not impair a sturgeon's ability to swim and is not thought to have any long-term adverse impact. Practices are in line with the current protocols for NEFSC surveys. While interactions are unlikely based on past data recorded in the observer programs, these measures are in place in order to capture vital data should an interaction occur. Additionally, scales are collected using the blunt side of a clean knife. The use of gently running saltwater extends the time the animal is able to be kept out of water safely and sampling should be concluded in less than 15 minutes. If using a live well set up, time onboard could be extended past the 15 minutes depending on recovery times. If the animal appears to be overly stressed or conditions do not allow for the safe handling, the animal will be released. In all cases, live animals are returned to the water as soon as possible. Given the short handling time, limited sampling, and that these procedures are minimally invasive, we expect that any effects to shortnose sturgeon to be temporary, minor, and of short duration. No serious injuries or mortalities have been documented as a result of sampling ESA-listed fish conducted by observers, and we do not anticipate any.

7.4 Fishing Gear and Observer Handling/Sampling Effects to Atlantic Sturgeon

Sub-adult and adult Atlantic sturgeon may be present in the action area year-round. In the marine environment, Atlantic sturgeon are most often captured in depths less than 50 meters. Some information suggests that captures in otter trawl gear are most likely to occur in waters with depths less than 30 meters and in depths less than 40 meters and mesh sizes greater than 10 inches for sink gillnet gear (ASMFC TC 2007).

Atlantic sturgeon have been caught on a slightly increasing basis during the standard NEFSC bottom trawl surveys, the ME-NH inshore trawl surveys, and the spring and fall NEAMAP bottom trawl surveys over the past ten years since the ESA listing (see Table 24 below). All of these fish have been released alive and in apparent good condition. Short-term cooperative research projects have also recorded occasional catches of Atlantic sturgeon, but the disposition of the fish (mortality, injury, or released alive) may not be recorded. The analysis of potential future takes uses catch rates from these surveys (fish caught per trawl) and the number of annual bottom trawls in the different surveys to estimate future takes. Because of the great diversity of potential locations, timing, and protocols for future short-term cooperative research projects, factors that could affect catch rates, data from the standardized NEAMAP surveys was used to approximate catch rates for these types of research projects.

Given the past capture of Atlantic sturgeon in the NEFSC, NEAMAP, and ME-NH bottom trawl surveys, during cooperative research projects, as well as in commercial trawl and gillnet gear, it is reasonable to anticipate that Atlantic sturgeon will be present throughout the action area during the proposed actions. As described above, we expect that Atlantic sturgeon in the action area will originate from the New York Bight (71.4%), Chesapeake Bay (10.7%), Gulf of Maine (8.7%), South Atlantic (5.6%), Carolina (2.6%), and non-listed Canada (1.0%) DPSs in the descending percentages identified in parentheses (Kazyak et al. 2020a, 2021).

The capture of Atlantic sturgeon in otter trawls used for commercial fisheries is well documented (see for example, Stein et al. 2004b and ASMFC TC 2007). Atlantic sturgeon are also captured incidentally in trawls used for scientific studies. The NEFSC and VIMS have recorded all Atlantic sturgeon interactions since the NEFSC and NEAMAP bottom trawl survey programs began, which allows us to predict future interactions as demonstrated in Tables 24 and 25.

Table 24. Incidental takes of Atlantic sturgeon in NEFSC fisheries and ecosystem research surveys, 2008-2021.

Year	Number Killed	Released Alive Injured	Released Alive Uninjured	Total Taken	Survey
2008	0	0	2	22	2 - ME/NH trawl 20 – NEAMAP
2009	0	0	3	29	3 - ME/NH trawl 26 – NEAMAP
2010	0	0	2	33	2 - ME/NH trawl 31 – NEAMAP
2011	0	0	2	25	2 - ME/NH trawl 23 - NEAMAP
2012	0	0	33	33	5 – BTS spring 6 – ME/NH trawl 22 – NEAMAP
2013	0	0	17	17	1 – BTS spring 2 – ME/NH 14 – NEAMAP
2014	0	0	2	40	2 - ME/NH trawl 38 – NEAMAP
2015	0	0	6	21	2 – BTS spring 4 – ME/NH trawl 15 – NEAMAP
2016	0	0	3	34	3 - BTS spring 31- NEAMAP
2017	0	0	25	25	4 – BTS spring 20 – NEAMAP 1 – NEFOP gillnet training
2018	0	0	62	62	1 – BTS spring 7 – ME/NH trawl 54 – NEAMAP 1 – NEFOP gillnet training
2019	0	0	35	35	2 – BTS spring 31 – NEAMAP 1 – NEFOP trawl training 1 – Twin Trawl Sweep Comparison
2020	0	0	22	22	9 – BTS spring 1 – ME/NH trawl 12 – NEAMAP
2021	0	0	101	101	3 – BTS spring 4 – ME/NH trawl 94 – NEAMAP
Total	0	0	499	499	

Source: NMFS PSIT database and NEFSC (2018, 2019, 2020b).

Table 25, which was created for and included in the NEFSC's July 2016 final PEA, provides estimates of Atlantic sturgeon bycatch for each set of research activities and the overall total for NEFSC-conducted and funded fisheries and ecosystem research. Based on this analysis, up to 119 Atlantic sturgeon per year (and up to 595 over a five-year period) could be incidentally captured during NEFSC-affiliated research. The DPS breakdown for these interactions is expected to be as follows: 425 from the NYB, 64 from the CB DPS, 52 from the GOM DPS, 33 from the South Atlantic DPS, 15 from the Carolina DPS, and 6 of non-listed Canadian origin fish. These estimates exceed past recorded takes, but could be reasonably expected to occur in future five-year periods as interactions with Atlantic sturgeon in NEFSC research and commercial fisheries have been on the rise. Most Atlantic sturgeon caught are expected to be released alive and in good condition based on past experience. Given the continued use of fishing gears that have caused mortality of Atlantic sturgeon in commercial fisheries, and since some cooperative research projects may include research protocols similar to commercial fishing conditions, there is a potential for NEFSC-affiliated fisheries research to cause mortality in the future. However, given the substantially shorter tow/set times and other differences between most research and commercial fishing, such incidents would likely be rare.

Table 25. Estimated future takes of Atlantic sturgeon in the 2016 final PEA using historical takes from 1963-2013.

Research Activity	Trawls per year	Capture rate (sturgeon per trawl)	Estimated annual captures	Estimated Atlantic sturgeon takes per year (rounded up)
NEFSC BTS	800	0.00379	3.03	4
ME-NH trawl surveys	200	0.01083	2.17	3
NEAMAP (VIMS) trawl surveys	300	0.07556	22.67	23
Other long-term research	910	0.00379	3.45	4
Short-term cooperative research	1700	0.04967	84.44	85
Total estimated Atlantic sturgeon takes per year in NEFSC-affiliated research projects				119

The short duration of tows/sets and the careful handling of any Atlantic sturgeon once on deck is likely to result in a low potential for mortality. None of the Atlantic sturgeon captured in previous NEFSC-conducted or funded surveys have had any evidence of injury, and there have been no recorded mortalities. In the Hudson and Penobscot Rivers, trawl surveys that incidentally captures shortnose and Atlantic sturgeon have been ongoing for many years. To date, no injuries or mortalities of sturgeon have been recorded. Based on this information, we expect that nearly all Atlantic sturgeon captured during the proposed actions will be alive and released uninjured.

NEFOP data indicates that mortality rates of Atlantic sturgeon caught in trawl gear are approximately 5% (Stein et al. 2004b; ASMFC TC 2007). Thus, we anticipate up to six Atlantic sturgeon mortalities annually (5% of 119 interactions) and up to 30 over the next five years. The

DPS breakdown for these mortalities is expected to be as follows: 21 from the NYB, three from the CB DPS, three from the GOM DPS, two from the SA DPS, and one from the Carolina DPS.

Aside from the NEFSC BTS, NEAMAP, ME-NH inshore trawl, NEFOP Trawl and Gillnet Training Trips, and a recent (2019) twin trawl sweep comparison project, no other long-term or short-term research projects have reported any interactions with Atlantic sturgeon using trawls, gillnets, or any other gear. However, gillnets are used for several long-term research projects, including the COASTSPAN gillnet surveys and the occasional spiny dogfish and monkfish tagging projects. The COASTSPAN surveys use short set times (three hours) and continuously run the net to collect target species (sharks) and release all other species quickly. Based on past experience, the potential for capturing Atlantic sturgeon in the COASTSPAN and spiny dogfish/monkfish tagging surveys is low and the potential for mortality is negligible. Other short- and long-term cooperative research projects using gillnets are likely to be small in scope and captures of Atlantic sturgeon would be extremely rare events.

Several past short-term cooperative research projects have used gillnet gear for research in association with commercial fisheries that have caught Atlantic sturgeon in the past. One past project, "Bycatch Reduction Engineering Program (BREP) monkfish gillnet – sturgeon", was a pilot project to begin examining factors that could affect bycatch of Atlantic sturgeon in a commercial fishery. That project continued after Atlantic sturgeon were listed under the ESA in 2012, but it required a section 10 permit under the ESA; coordination moved to the NEFSC Protected Species Branch and the project was covered under directed research permits issued under the ESA (NMFS 2013a). Such directed research on ESA-listed species is not covered in this Opinion. Any future projects that have a reasonable chance of adverse interactions with ESA-listed species would either be covered under directed research permits or, if the effects were incidental to the intent of the research, would receive additional scrutiny (section 7 consultation) to ensure the research does not harm the stock before it is issued a research permit.

Since we currently have no information to indicate that the incidental take levels for Atlantic sturgeon during NEFSC fisheries and ecosystem research have been significantly different over the past five years as compared to years prior, we are assuming that the quantitative take and mortality estimates for Atlantic sturgeon provided within the 2016 final PEA still represent the best available information. The only difference is that we now expect some interactions and potentially lethal takes of Atlantic sturgeon in gillnet gear, as evidenced by the Atlantic sturgeon captured during the NEFOP gillnet training course in 2018. However, we have determined that that interaction would be subsumed in the overall take estimate from the 2016 final PEA.

To assess the number of Atlantic sturgeon that may be handled and sampled by the NEFSC's observer programs, we looked to observer data from the recent ten-year period of 2010-2019 to be representative of what we anticipate through 2026 (Table 26). We have included the numbers from 2020 and 2021 for informational purposes below. However, given the restrictions on the observer programs due to COVID-19 during these years, we do not believe that they are representative of future levels of effort.

Table 26: Average and maximum number of Atlantic sturgeon handled and sampled by the observer program from 2010-2021.

Species	Average sampled 2010-2019	Maximum sampled 2010-2019	Average sampled 2020-2021	Maximum sampled 2020-2021
Atlantic sturgeonon (*Acipenser oxyrinchus*)	183	310	32	48

As with sea turtles, these past data during years when the observer programs were fully operational represent the best available data for estimating future takes of Atlantic sturgeon. Therefore, we have taken the maximum number of Atlantic sturgeon handled and sampled during the 2010-2019 period (310) and multiplied it by the number of years the proposed actions will occur (i.e., through 2026; therefore, four years) to estimate the total number of animals anticipated to be taken, which equates to 1,240 Atlantic sturgeon.

Based on thie mixed stock analysis by Kazyak et al. (2020a, 2021), we expect Atlantic sturgeon throughout the action area at the following frequencies: Gulf of Maine 8.7%; New York Bight 71.4%; Chesapeake Bay 10.7%; Carolina 2.6%; and South Atlantic 5.6%. Approximately 1.0% of the Atlantic sturgeon throughout the action area are expected to originate from Canadian rivers or management units. These are the same proportions used in the 2021 Opinion. One caveat with genetic assignment testing is that not all populations have been discovered and not all discovered populations were used for this assessment. Assignment testing can only assign an individual to a known or defined category. Even if there is very little similarity with the best match, that is where that sample is assigned. However, this represents the best available information and is used to assign the estimated takes to DPS. Estimates of Atlantic sturgeon to be handled and sampled by the NEFSC's observer programs by DPS are included in Table 27.

Effects to ESA-listed fish are similar across species and include stress and behavior responses as well as minor injury from collecting genetic samples. The sampling techniques (e.g., scale collection, fin clips) used by observers are standard worldwide in finfish research. Kahn and Mohead (2010) strongly recommend standard handling procedures be performed on all sturgeon captured including measuring, weighing, and tissue sampling. These procedures are followed by observers. The procedures developed are designed to minimize impacts and represent best practices.

Table 27. Estimates of Atlantic sturgeon by DPS to be handled and sampled by the NEFSC's observer programs through 2026.

Atlantic sturgeon	Frequency in Action Area	Estimate of animals sampled through 2026
Gulf of Maine DPS	8.7%	107.88 (rounded up to 108)
New York Bight DPS	71.4%	885.36 (rounded down to 885)
Chesapeake Bay DPS	10.7%	132.68 (rounded up to 133)
Carolina DPS	2.6%	32.44 (rounded down to 32)
South Atlantic DPS	5.6%	69.44 (rounded up to 70)
Canada	1%	12.4 (rounded down to 12)
Total		1,240

As described above, the proposed actions do not include the initial incidental capture but rather the handling and sampling activities that an observer conducts once the animal has been transferred to them. Kahn and Mohead (2010) estimate that routine procedures (i.e., measuring, weighing, and tissue sampling) will take less than 15 minutes. Routine handling/holding can result in increased stress levels in Atlantic sturgeon. Generally, sturgeon are hardy and are generally tolerant of handling but can be sensitive to this stressor (Kahn and Mohead 2010). In addition to stress resulting from the handling, stress to the animal and minor injury may occur during fin clip and scale collection (a minor injury is one that would heal in a matter of hours or days and result in no long term, adverse effects to the animal). However, there is no evidence that the collection of the genetic samples results in the serious injury or mortality of any species of sturgeon (Kahn and Mohead 2010). In addition, Wydoski and Emery (1983) found that tissue samples, clipped with sterile surgical scissors from the sections of soft pelvic (the fin sampled by observers) or anal fins of captured sturgeon, does not impair the sturgeon's ability to swim and is not thought to have any long-term adverse impact. Practices are in line with the current protocols for NEFSC surveys. Similar to shortnose sturgeon, scales are also collected using the blunt side of a clean knife. The use of gently running saltwater extends the time the animal is able to be kept out of water safely and sampling should be concluded in less than 15 minutes. If using a live well set up, time onboard could be extended past the 15 minutes depending on recovery times. If the animal appears to be overly stressed or conditions do not allow for the safe handling, the animal will be released. In all cases, live animals are returned to the water as soon as possible. Given the short handling time, limited sampling, and that these procedures are minimally invasive, we expect that any effects to Atlantic sturgeon to be temporary, minor, and of short duration. No serious injuries or mortalities have been documented as a result of sampling ESA-listed fish conducted by observers, and we do not anticipate any.

7.5 Fishing Gear and Observer Handling/Sampling Effects to Atlantic Salmon

Atlantic salmon in the ocean are pelagic and highly surface oriented (Kocik and Sheehan 2006; Renkawitz et al. 2012). The preferred habitat of post-smolt salmon in the open ocean is principally the upper 10 meters of the water column (Baum 1997; ICES SGBYSAL 2005), although there is evidence of forays into deeper water for shorter periods. Adult Atlantic salmon demonstrate a wider depth profile (ICES SGBYSAL 2005), but overall salmon tend to be distributed in the surface layer, and all fishing activities covering this part of the water column are considered to have a potential to intercept salmon. Due to these factors and the limited abundance of Atlantic salmon, they are not typically caught in the research activities in question or in commercial fisheries of the U.S. Atlantic. Fisheries observer data from 1989-2022 show records of Atlantic salmon bycatch in seven of the 32 years, with a total of 15 individuals caught, nearly half of which (seven) occurred in 1992 (NEFOP and ASM databases).

While foraging or migrating in the Gulf of Maine, on the Western Scotian Shelf, or in southwest Greenland, Atlantic salmon may be present throughout the water column and could interact with gear used during the NEFSC's fisheries and ecosystem research. Atlantic salmon interactions with bottom trawl and gillnet gear in particular are likely at times when and in areas where their distribution overlaps with the fishing activities. Atlantic salmon also may encounter hooks from both hook-and-line gear and longline gear while traveling through the water column.

Only two Atlantic salmon have been captured during the NEFSC's annual fisheries and ecosystem surveys; one in the NEFSC bottom trawl survey in 1977 and the second during the spring 2012 bottom trawl survey. Both fish were captured alive along the coastline of Maine. There have been no records of Atlantic salmon captures in short-term cooperative research projects funded by the NEFSC. However, future NEFSC research activities aboard both NOAA vessels and cooperative research fishing vessels could encounter Atlantic salmon. All observed takes of Atlantic salmon during NEFSC research activities to this point have occurred in bottom trawls, while all observed takes during commercial fishing operations in the Northeast U.S. have occurred in bottom trawls or gillnets. It is also possible that bottom longline and hook and line gear, which are occasionally used in the NEFSC's fisheries and ecosystem research, could hook Atlantic salmon while foraging, but there have been no reported interactions.

Atlantic salmon may be present in the action area year-round, however they are rarely captured in the marine environment. None have been reported captured in commercial fisheries in the Greater Atlantic since August 2013. For the 15 captures prior to that, there is no information available on the genetics of those Atlantic salmon, so we do not know how many of them were part of the Gulf of Maine DPS. It is likely that at least some of those salmon, particularly those caught south of Cape Cod, originated from the stocking program in the Connecticut River. The

Atlantic salmon caught off the coast of Maine are more likely to be of the Gulf of Maine DPS. However, as their genetic status is unknown, we will assume for this analysis that all 15 were Gulf of Maine DPS salmon.

Of the observed incidentally caught Atlantic salmon, ten were listed as "discarded," which is assumed to be classified as "live discard" (J. Kocik, pers. comm., February 11, 2013). Five of the 15 (33%) were listed as mortalities. The incidental takes of Atlantic salmon occurred using sink gillnets (11) and bottom otter trawls (4). There does not seem to be a seasonal pattern to the observed captures; they occurred in the months of November (6), June (3), March (2), April (2), May (1), and August (1). The most recent data from 2004-2020 show incidental captures in the multispecies and monkfish fisheries in offshore areas (statistical areas 522 and 525) during the spring, and in the Gulf of Maine (statistical areas 513, 514, and 515) in the spring/summer.

The newly added West Greenland tagging project study area includes a portion of the marine range of Atlantic salmon in the North Atlantic Ocean for salmon originating in both North America and Europe. Future research includes trolling over a 30-day (maximum) period during the months of September and October. The fishing season for Atlantic salmon in Greenland is August to October. The fish grow very quickly during that time, so focusing tagging efforts later in the season means obtaining bigger fish to tag. The intent is to capture and tag a maximum of 100 pre-adult individuals a year, although 30 to 50 fish per year is considered a more likely capture range. Of these 100 fish, the overwhelming majority are not expected to be ESA-listed fish. Recent tagging studies since 2018 resulted in only one salmon tagged from ESA-listed populations, suggesting that impacts from the West Greenland study and total takes of the GOM DPS of Atlantic salmon would be only a minor addition to the anticipated trawl and gillnet survey captures already summarized above. Therefore, it is reasonable that this trolling and tagging research would capture one Gulf of Maine DPS salmon for every 100 salmon that are caught (Dr. Tim Sheehan, NEFSC, personal communication, May 21, 2021). The Atlantic salmon populations that are more prevalent in the West Greenland study area are those from European and Canadian waters (Jeffery et al. 2018; ICES 2019). Although most captured Atlantic salmon from this project are expected to survive, including all of the Gulf of Maine DPS fish captured to this point, there is the potential for mortality of these pre-adult life stages due to hooking or increased susceptibility to adverse effects of post-capture handling and release.

Based on the few incidental bycatch and capture records documented for Gulf of Maine DPS Atlantic salmon in NEFSC fisheries and ecosystem research, including none in U.S. and Canadian waters research since 2012 and the likely one per year in the West Greenland trolling and tagging studies, we anticipate up to six Atlantic salmon interactions will occur over a five-year period as a result of the proposed actions. This includes one anticipated capture in any of the past NEFSC fisheries or ecosystem surveys and five anticipated captures in the newly added West Greenland studies. We anticipate that two interactions every five years will be lethal based on the 33% mortality rate as seen in the fisheries observer data from 1989-2022. The rarity of commercial fisheries interactions over the past ten years (only three since 2011 and none since 2013) also supports this estimate of take.

To assess the number of Gulf of Maine DPS Atlantic salmon that may be handled and sampled by the NEFSC observer programs, we looked to observer data from the recent ten-year period of

2010-2019 to be representative of what we anticipate through 2026 (Table 28). We have included the numbers from 2020 and 2021 for information purposes below. However, given the restrictions on the observer programs due to COVID-19 during these years, we do not believe that they are representative of future levels of effort.

Table 28: Average and maximum number of Gulf of Maine DPS Atlantic salmon handled and sampled by the observer program from 2010-2021.

Species	Average sampled 2010-2019	Maximum sampled 2010-2019	Average sampled 2020-2021	Maximum sampled 2020-2021
Atlantic salmon (*Salmo salar*), Gulf of Maine DPS	0.3	2	0	0

As with the other species, these past data during years when the observer programs were fully operational represent the best available data for estimating future takes. Therefore, we have taken the maximum number of Atlantic salmon handled and sampled during the 2010-2019 period (2) and multiplied it by the number of years the proposed actions will occur (i.e., through 2026; therefore, four years) to estimate the total number of animals anticipated to be taken, which equates to eight (8) Atlantic salmon.

Effects to ESA-listed fish are similar across species and include stress and behavior responses as well as minor injury from collecting genetic samples. The sampling techniques (e.g., scale collection, fin clips) used by observers are standard worldwide in finfish research. Kahn and Mohead (2010) strongly recommend standard handling procedures be performed on all sturgeon captured including measuring, weighing, and tissue sampling. These procedures are followed by observers. NEFSC and GARFO biologists with expertise in Atlantic salmon research and management were worked with in developing the handling and sampling procedures for Atlantic salmon. The procedures developed are designed to minimize impacts and represent best practices. Best practices for handling Atlantic salmon include gently running saltwater over the gills while collecting data or placing the animal in a live well in between sampling activities to allow it to recover. Any sampling equipment coming into contact with the animal should be disinfected prior to use. Animal activity is to be observed between each sampling activity to monitor for signs of stress. Once sampling is complete and the Atlantic salmon has recovered, the animal will be released as close to the water surface as possible to reduce the risk of injury.

As described above, the proposed actions do not include the initial incidental capture but rather the handling and sampling activities that an observer conducts once the animal has been transferred to them. Kahn and Mohead (2010) estimate that routine procedures (i.e., measuring, weighing, and tissue sampling) will take less than 15 minutes. Routine handling/holding can result in increased stress levels in Atlantic salmon. In addition to stress resulting from the handling, stress to the animal and minor injury may occur due to the collection of fin clips and scales (a minor injury is one that would heal in a matter of hours or days and result in no long term, adverse effects to the animal). However, there is no evidence that the collection of the genetic samples results in the serious injury or mortality of any species of salmon. Practices are in line with the current protocols for NEFSC surveys. Fin clips are used to collect genetic samples from Atlantic salmon using a pair of clean tweezers to grasp the caudal fin and cut around the tweezers using a clean pair of scissors or knife to obtain a small tissue sample. Scales are also collected using the blunt side of a clean knife. As mentioned above for both sturgeon species, use of gently running saltwater extends the time the animal is able to be kept out of water safely and sampling should be concluded in less than 15 minutes. If using a live well set up, time onboard could be extended past the 15 minutes depending on recovery times. If the animal appears to be overly stressed or conditions do not allow for the safe handling, the animal will be released. In all cases, live animals are returned to the water as soon as possible. Given the short handling time, limited sampling, and that these procedures are minimally invasive, we expect that any effects to Atlantic salmon to be temporary, minor, and of short duration. No serious injuries or mortalities have been documented as a result of sampling ESA-listed fish conducted by observers, and we do not anticipate any.

7.6 Effects due to Interactions with Fisheries and Ecosystem Research Vessels

Sea turtles are known to be injured and/or killed as a result of being struck by vessels on the water and as a result of capture in or physical contact with fishing gear. Interactions between vessels and sea turtles occur and can take many forms, from the most severe (death or bisection of an animal or penetration to the viscera), to severed limbs or cracks to the carapace which can also lead to mortality directly or indirectly. Sea turtle stranding data for the U.S. Gulf of Mexico and Atlantic coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993, about 9% of living and dead stranded sea turtles had propeller or other boat strike injuries (Lutcavage et al. 1997). According to 2001 STSSN stranding data, at least 33 sea turtles (including loggerhead, green, Kemp's ridley and leatherbacks) that stranded on beaches within the Northeast (Maine through North Carolina) were struck by a boat. This number underestimates the actual number of boat strikes that occur since not every boat-struck turtle will strand, not every stranded turtle will be found, and many stranded turtles are too decomposed to determine whether the turtle was struck by a boat. It should be noted, however, that it is not known whether all boat strikes were the cause of death or whether they occurred post-mortem (SEFSC 2001).

Information is lacking on the type or speed of vessels involved in turtle vessel strikes. However, there does appear to be a correlation between the number of vessel struck turtles and the level of recreational boat traffic (NRC 1990). Although little is known about a sea turtle's reaction to vessel traffic, it is generally assumed that sea turtles are more likely to avoid injury from slower moving vessels since the turtle has more time to maneuver and avoid the vessel. In addition, the risk of ship strike is influenced by the amount of time the animal remains near the surface of the water. With respect to the proposed actions, the effects to sea turtles as a result of vessel activities are discountable. The small number of vessels that will operate on the water as a result of the proposed actions are unlikely to strike sea turtles in the action area given that: (a) the vessels will operate/travel at a slow speed such that sea turtles would have the speed and maneuverability to avoid contact with the vessel and (b) sea turtles spend part of their time at depths out of range of a vessel collision.

As noted in the listing rules and status reviews for these species, and the recovery plan for shortnose sturgeon, vessel strikes have been identified as a threat to shortnose and Atlantic sturgeon in certain regions. While the exact number of sturgeon killed as a result of being struck by boat hulls or propellers is unknown, it is of concern in the Delaware and James Rivers. Brown and Murphy (2010) examined 28 dead Atlantic sturgeon observed in the Delaware River from 2005-2008. Fifty-percent (50%) of the mortalities resulted from apparent vessel strikes and 71% of those (ten of 14) had injuries consistent with being struck by a large vessel (Brown and Murphy 2010). Eight of the 14 vessel struck sturgeon were adult-sized fish (Brown and Murphy 2010). Given the time of year in which the fish were observed (predominantly May through July; Brown and Murphy 2010), it is likely that many of the adults were migrating through the river to the spawning grounds.

The factors relevant to determining the risk to shortnose and Atlantic sturgeon from vessel strikes are currently unknown, but they may be related to size and speed of the vessels, navigational clearance (i.e., depth of water and draft of the vessel) in the area where the vessel is operating, and the behavior of sturgeon in the area (e.g., foraging, migrating, etc.). The risk of vessel strikes between sturgeon and research/fishing vessels operating in the open ocean or large estuaries is likely to be low given that the vessels are likely to be operating at slow speeds and there are no restrictions forcing shortnose or Atlantic sturgeon into close proximity with the vessel as may be present in some rivers.

Given the large volume of vessel traffic in the action area and the wide variability in traffic on any given day, the increase in traffic (one or two vessels at a time, traveling at relatively slow speeds) associated with the proposed actions is extremely small. Given the small and localized increase in vessel traffic that would result from the NEFSC's fisheries and ecosystem research, and the depth of the water and ability of sturgeon to avoid vessels and maneuver in the open ocean, it is unlikely that there would be any detectable increase in the risk of vessel strike. As such, effects to sturgeon from the increase in vessel traffic are likely to be discountable.

The threats assessment done for Atlantic salmon as part of the 2009 endangered listing of the expanded Gulf of Maine DPS did not list vessel strikes as a high priority threat (74 FR 29344; June 19, 2009). We are not aware of any records of vessels striking Atlantic salmon. Based on the size and swimming capabilities of Atlantic salmon, the small amount of vessel traffic associated with these actions, and the lack of any prior record of a vessel striking Atlantic salmon, the proposed actions are extremely unlikely to result in vessel strikes to Atlantic salmon.

7.7 Effects to Prey

Sea turtles could be negatively affected by the loss of prey as a result of fisheries and ecosystem research gear that removes or incidentally kills such prey during the proposed actions. However, the amount of potential prey that will be disturbed or removed is minimal. The fishing gears used during the proposed actions are expected to catch a variety of organisms including fish and crab species. However, none of the sea turtle prey species captured by any activity proposed in this Opinion are typical prey of leatherback sea turtles or of neritic juvenile or adult green sea turtles (Rebel 1974; Mortimer 1982; Bjorndal 1985, 1997; U.S. FWS and NMFS 1992). Those organisms that are caught in either trawl, gillnet, dredge, pot/trap, or hook and line gear will be sampled according to the survey protocols. Species that meet the sampling criteria will be sampled for scientific purposes and may not be returned to the water, while the other species will be returned to the water alive, dead, or injured to the extent that they will subsequently die. Nearly all of the species that will be retained for further study are fish. Crabs, on the other hand, which are the preferred prey of loggerhead and Kemp's ridley sea turtles, will often not be retained for further study, and thus would still be available as prey for loggerheads and Kemp's ridleys when returned to the water, as both of these species of sea turtles are known to eat a variety of live prey as well as scavenge dead organisms (Lutcavage and Musick 1985; Keinath et al. 1987; Dodd 1988; Burke et al. 1993, 1994; Morreale and Standora 2005). Thus, the proposed actions considered here are expected to have an undetectable, and therefore insignificant effect on the availability of prey for loggerhead and Kemp's ridley sea turtles in the action area given that: (a) the sea turtle food items that are returned to the water could still be preyed upon by loggerheads and Kemp's ridleys, (b) the number of tows, sets, and hauls for the fisheries and ecosystem surveys are limited in size, scope, and duration across an expansive action area, (c) the priority species that will be retained for scientific analysis are almost entirely fish species, which are not preferred prey for loggerheads and Kemp's ridleys (Keinath et al. 1987; Lutcavage and Musick 1985; Burke et al. 1993, 1994; Morreale and Standora 2005), and (d) and there is no evidence that loggerhead or Kemp's ridley sea turtles are prey limited.

Shortnose and Atlantic sturgeon use the action area as a migratory route and for overwintering and foraging. Any effects on habitat due to fishing and ecosystem research gear are most likely to be on sturgeon prey items, as discussed above. Shortnose and Atlantic sturgeon are known to aggregate in certain areas and at certain times of the year, and some of these areas experience high fishing effort. Despite the overlap in aggregations with some areas of high fishing effort, we have no information that indicates negative effects on sturgeon prey items, although foraging, overwintering, and migrations may be temporarily disturbed by the use of bottom fishing gear. Gillnet gear may also impede shortnose and Atlantic sturgeon migrations, but the effects are also expected to be insignificant.

Shortnose and Atlantic sturgeon feed primarily on small benthic invertebrates and occasionally on small fish. Because of the small size or benthic nature of these prey species, it is unlikely that the proposed actions will capture any sturgeon prey items. Thus, the NEFSC's fisheries and ecosystem research will not affect the availability of prey for sturgeon. Any effects to sturgeon prey will be limited to minor disturbances to the river/estuary/ocean bottom from trawl, gillnet, pot/trap, dredge, and other bottom-tending gear in the expansive action area. Because of this, we have determined that any effects to sturgeon prey or foraging sturgeon will be insignificant.

Atlantic salmon also use the action area as a migratory route and for foraging. The effects on habitat due to fishing gears used in the NEFSC's research are likely to affect some Atlantic salmon prey items. Aggregations of Atlantic salmon may occur both at the post-smolt stage and after their first winter at sea, but most evidence indicates that they travel individually as adults (Reddin 1985). Foraging and travel activity may be temporarily disturbed by the use of bottom fishing gears, but the effects are expected to be insignificant. Gillnet gear may also temporarily impede Atlantic salmon travel, but the effects are also expected to be insignificant.

7.8 Effects to Habitat

A panel of experts has previously concluded that the effects of even light weight otter trawl gear would include: (1) the scraping or plowing of the doors on the bottom, sometimes creating furrows along their path, (2) sediment suspension resulting from the turbulence caused by the doors and the ground gear on the bottom, (3) the removal or damage to benthic or demersal species, and (4) the removal or damage to structure forming biota. The panel also concluded that the greatest impacts from otter trawls occur in high and low energy gravel habitats and in hard clay outcroppings, and that sand habitats were the least likely to be impacted (NREFHSC 2002). The areas to be surveyed for the NEFSC's conducted and funded research include very few habitats that are purely gravel or hard clay—so few that the area encompassed by these habitats is insignificant compared to the area encompassed by sand and silt type habitats, which are more resilient to bottom trawling. For benthic feeding sea turtles, shortnose sturgeon, and Atlantic sturgeon, the effects on habitat due to bottom otter trawl gear would be felt as an effect on their benthic prey species. As stated above, the effects on sea turtle and sturgeon benthic prey items from bottom trawl gear are expected to be insignificant.

As gillnet and pot/trap gears are a form of fixed gear (i.e., stationary, not moving), limited effects to bottom habitat are possible as a result of utilizing these forms of fish harvest gear. The gear rests on the bottom and is capable of getting pushed by slow moving currents, or, moved when the gear is in process of being retrieved. Because the gillnet and pot/trap gear hauls proposed in this Opinion will not be conducted during adverse weather conditions (i.e., when ocean currents may be stronger) and will have brief soak durations, adverse effects on habitat are not expected. As stated above, the effects on sea turtle and sturgeon benthic prey items from fixed gear are expected to be insignificant.

In regards to effects on the pelagic habitat of leatherback sea turtles and Atlantic salmon, we do not anticipate any adverse effects from the NEFSC's fisheries and ecosystem research on those areas since the gear will simply be towed or dropped through them. The gears, active acoustic sources, and vessels to be used by the NEFSC and its partners are not expected to significantly affect the prevailing currents, water quality, or other environmental conditions of those habitats.

7.9 Effects from Active Acoustic Sources

Active acoustic devices that will be used during NEFSC fisheries and ecosystem research projects are described back in Table 1. The use of these acoustic devices during research will not affect ESA-listed sea turtles or fish. The hearing ranges for sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon are from 100 to 2,000 Hertz, while the proposed sonars operate in the 18 to 330 kHz range and are thus completely outside the hearing range of sea turtles and ESA-listed fish. Therefore, the active acoustic sources will have no effect on these species.

8.0 CUMULATIVE EFFECTS

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

This section attempts to identify the likely future changes and their impact on ESA-listed species and their critical habitats in the action area. This section is not meant to be a comprehensive socio-economic evaluation, but a brief outlook on future changes in the environment. Projections are based upon recognized organizations producing best available information and reasonable rough-trend estimates of change stemming from these data. However, all changes are based upon projections that are subject to error and alteration by complex economic and social interactions.

During this consultation, we searched for information on future state, tribal, local, or private (non-federal) actions reasonably certain to occur in the action area that would have an effect on species considered in this Opinion. We did not find any information about non-federal actions other than what has already been described in the *Environmental Baseline*. The primary non-federal activities that will continue to occur in the action area are recreational fisheries, fisheries authorized by states, use of the action area by private vessels, discharge of wastewater and associated pollutants, and coastal development authorized by state and local governments. We do not have any information to indicate that effects of these activities over the life of the proposed actions will have different effects than those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change.

We did not find any information about non-federal actions other than what has already been described in the *Environmental Baseline* (section 5), most of which we expect will continue in the future. An increase in these activities could similarly increase their effect on ESA-listed species and for some, an increase in the future is considered reasonably certain to occur. Given current trends in global population growth, threats associated with climate change, pollution, fisheries bycatch, aquaculture, vessel strikes and approaches, and underwater noise are likely to continue to increase in the future, although any increase in effect may be somewhat countered by an increase in conservation and management activities. For the remaining activities and associated threats identified in the *Environmental Baseline* and *Climate Change* sections, and other unforeseen threats, the magnitude of increase and the significance of any anticipated effects remain unknown. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance on ESA-listed species populations. Thus, this consultation assumes effects in the future would be similar to those in the past and, therefore, are reflected in the anticipated trends described in the *Status of the Species* (section 4), *Environmental Baseline* (section 5), and *Climate Change* (section 6) sections.

9.0 INTEGRATION AND SYNTHESIS OF EFFECTS

In the effects analysis outlined above, we considered potential effects from fisheries and ecosystem research activities conducted and funded by the NEFSC over the five-year period from 2021-2026. These effects include interactions with NEFSC research gear types such as trawls, gillnets, hook and line gear, pot/trap gear, dredges, and other net gear, as well as handling and sampling effects from fisheries observers when a commercial fisheries bycaught animal is transferred to them. In addition to these gear-related effects, we considered the potential for interactions between ESA-listed species and research/fishing vessels, impacts to their habitats and prey, and noise effects on these species from active acoustic sources used in the studies.

We have estimated that the NEFSC's fisheries and ecosystem research will result in research gear-related collisions or captures of up to 85 NWA DPS loggerhead, 95 Kemp's ridley, 10 North Atlantic DPS green, and 10 leatherback sea turtles; up to 10 shortnose sturgeon; up to 595 Atlantic sturgeon; and up to six Gulf of Maine DPS Atlantic salmon over a five-year period. Up to 10 loggerhead, 15 Kemp's ridley, one green, and five leatherback sea turtles; up to one shortnose sturgeon; up to 30 Atlantic sturgeon; and up to two Atlantic salmon interactions over the five-year period are expected to result in serious injury or mortality. We have also estimated that NEFSC observer program handling and sampling activities will involve up to 124 NWA DPS loggerhead, 40 Kemp's ridley, eight North Atlantic DPS green, and eight leatherback sea turtles; up to one shortnose sturgeon; up to 1,240 Atlantic sturgeon (across the five listed DPSs); and up to eight Gulf of Maine DPS Atlantic salmon over the remainder of the five-year period from now through 2026. As explained in the *Effects of the Actions* section, all other effects to sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon from the NEFSC's fisheries and ecosystem research, including effects to their prey and habitat and from research/fishing vessels and active acoustic sources, will be insignificant and/or discountable.

In the discussion below, we consider whether the effects of the proposed actions reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing the reproduction, numbers, or distribution of the listed species that will be adversely affected by the actions. The purpose of this analysis is to determine whether the proposed actions, in the context established by the status of the species, environmental baseline, and cumulative effects, would jeopardize the continued existence of any listed species.

In the U.S. FWS/NMFS Section 7 Handbook (U.S. FWS and NMFS 1998), for the purposes of determining jeopardy, survival is defined as, "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter."

Recovery is defined as, "Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." We summarize below the status of the species and consider whether the proposed actions will result in reductions in reproduction, numbers or distribution of these species and then considers whether any reductions in reproduction, numbers or distribution resulting from the proposed actions would reduce appreciably the likelihood of both the survival and recovery of these species, as those terms are defined for purposes of the ESA.

9.1 Northwest Atlantic DPS of Loggerhead Sea Turtles

The Northwest Atlantic DPS of loggerhead sea turtles is listed as threatened under the ESA. Based on nesting data, population abundance, and trends at the time, NMFS and U.S. FWS determined in 2011 that the Northwest Atlantic DPS should be listed as threatened and not endangered based on (1) the large size of the nesting population, (2) the overall nesting population remains widespread, (3) the trend for the nesting population appears to be stabilizing, and (4) substantial conservation efforts are underway to address threats (76 FR 58868, September 22, 2011).

It takes decades for loggerhead sea turtles to reach maturity. Once they have reached maturity, females typically lay multiple clutches of eggs within a season, but do not typically lay eggs every season (NMFS and U.S. FWS 2008). There are many natural and anthropogenic factors affecting the survival of loggerheads prior to their reaching maturity as well as for those adults who have reached maturity. As described in the *Status of the Species*, *Environmental Baseline*, and *Cumulative Effects* sections above, loggerhead sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration, vessel interactions, hopper dredging, power plant intakes, and other factors that result in mortality of individuals at all life stages. Negative impacts causing death of various age classes occur both on land and in the water. Many actions have been taken to address known negative impacts to loggerhead sea turtles. However, others remain unaddressed, have not been sufficiently addressed, or have been addressed in some manner but whose success cannot be quantified.

As previously stated, there are five subpopulations of loggerhead sea turtles in the western North Atlantic (recognized as recovery units in the 2008 recovery plan for the species). These subpopulations show limited evidence of interbreeding. Recent assessments have evaluated the nesting trends for each recovery unit. It should be noted, and it is explained further below, that nesting trends are based on nest counts or nesting females. They do not include non-nesting adult females, adult males, or juvenile males or females in the population.

Ceriani and Meylan (2017) and Bolten et al. (2019) looked at trends by recovery unit. Information on nest counts is presented in the *Status of the Species*. Trends by recovery unit were variable. For the Northern Recovery Unit, nest counts at loggerhead nesting beaches in North Carolina, South Carolina, and Georgia declined at 1.9% annually from 1983 to 2005 (NMFS and U.S. FWS 2008). More recently, the trend has been increasing. Ceriani and Meylan (2017) reported a 35% increase for this recovery unit from 2009 through 2013. A longer-term trend analysis based on data from 1983 to 2019 indicates that the annual rate of increase is 1.3% (Bolten et al. 2019).

Nest counts at index beaches in Peninsular Florida showed a significant decline in loggerhead nesting from 1989 to 2007, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington et al. 2009). From 2009 through 2013, a 2% decrease for the Peninsular Florida Recovery Unit was reported (Ceriani and Meylan 2017). Using a longer time series from 1989-2018, there was no significant change in the number of annual nests (Bolten et al. 2019). It is important to recognize that an increase in the number of nests has been observed from 2007 to 2018 (Bolten et al. 2019). Using short-term trends in nesting abundance can be misleading, and trends should be considered in the context of one generation (50 years for loggerheads) (Bolten et al. 2019).

A census for the Dry Tortugas Recovery Unit on Key West, Florida, from 1995 to 2004 (excluding 2002) estimated a mean of 246 nests per year, or about 60 nesting females (NMFS and U.S. FWS 2008). No trend analysis is available because there was not an adequate time series to evaluate the Dry Tortugas Recovery Unit and there are gaps in the data prohibiting a robust analysis (Ceriani and Meylan 2017; Bolten et al. 2019; Ceriani et al. 2019).

Evaluation of long-term nesting trends for the Northern Gulf of Mexico Recovery Unit is difficult given changes to survey coverage (NMFS and U.S. FWS 2008). From 1995 to 2005, the recovery unit exhibited a significant declining trend (Conant et al. 2009, NMFS and U.S. FWS 2008). In the 2009-2013 trend analysis by Ceriani and Meylan (2017), a 1% decrease for this recovery unit was reported, likely due to diminished nesting on beaches in Alabama, Mississippi, Louisiana, and Texas. More recently, nest numbers have increased (Bolten et al. 2019). A longer-term analysis from 1997-2018 found that there has been a non-significant increase of 1.7% (Bolten et al. 2019).

The majority of nesting in the Greater Caribbean Recovery Unit occurs on the Yucatán Peninsula, in Quintana Roo, Mexico, with 903 to 2,331 nests annually (Zurita et al. 2003). Other significant nesting sites are found throughout the Caribbean, including Cuba, with approximately 250 to 300 nests annually (Ehrhart et al. 2003), and over 100 nests annually in Cay Sal in the Bahamas (NMFS and U.S. FWS 2008). In the trend analysis by Ceriani and Meylan (2017), a 53% increase for this Recovery Unit was reported from 2009 through 2013.

Estimates of the total loggerhead population in the Atlantic are not currently available. However, there is some information available for portions of the population. From 2004-2008, the loggerhead adult female population for the Northwest Atlantic ranged from 20,000 to 40,000 or more individuals (median 30,050), with a large range of uncertainty in total population size (SEFSC 2009). The estimate of Northwest Atlantic adult loggerhead females was considered conservative for several reasons. The number of nests used for the Northwest Atlantic was based primarily on U.S. nesting beaches. Thus, the results are a slight underestimate of total nests because of the inability to collect complete nest counts for many non-U.S. nesting beaches within the DPS. In estimating the current population size for adult nesting female loggerhead sea turtles, the report simplified the number of assumptions and reduced uncertainty by using the minimum total annual nest count (i.e., 48,252 nests) over the five years. This was a particularly conservative assumption considering how the number of nests and nesting females can vary widely from year to year (e.g., the 2008 nest count was 69,668 nests, which would have increased the adult female estimate proportionately to between 30,000 and 60,000). In addition, minimal assumptions were made about the distribution of remigration intervals and nests per female parameters, which are fairly robust and well known. A loggerhead population estimate using data from 2001-2010 estimated the loggerhead adult female population in the Northwest Atlantic at 38,334 individuals (SD =2,287) (Richards et al. 2011).

The AMAPPS surveys and sea turtle telemetry studies conducted along the U.S. Atlantic coast in the summer of 2010 provided preliminary regional abundance estimate of about 588,000 loggerheads along the U.S. Atlantic coast, with an inter-quartile range of 382,000-817,000 (NEFSC 2011). The estimate increases to approximately 801,000 (inter-quartile range of 521,000-1,111,000) when based on known loggerheads and a portion of unidentified sea turtle sightings (NEFSC 2011). Although there is much uncertainty in these population estimates, they provide some context for evaluating the size of the likely population of loggerheads in the Atlantic.

Although limited information is available on the genetic makeup of loggerheads in an area as extensive as the action area, it is likely that loggerheads interacting with the proposed actions originate from several, if not all of the recovery units. Sea turtles from each of the five Northwest Atlantic nesting stocks have been documented in the action area. A genetic study on immature loggerheads captured in the Pamlico-Albemarle Estuarine Complex in North Carolina between 1995-1997 indicated that 80% of the juveniles and sub-adults utilizing this foraging habitat originated from the south Florida nesting stock, 12% from the northern nesting stock, 6% from the Yucatán nesting stock, and 2% from other rookeries (including the Florida Panhandle, Dry Tortugas, Brazil, Greece, and Turkey nesting stocks) (Bass et al. 2004). Similarly, genetic analysis of samples collected from loggerheads from Massachusetts to Florida found that all five western Atlantic loggerhead stocks were represented (Bowen et al. 2004). However, earlier studies indicated that only a few nesting stocks were represented along the U.S. Atlantic coast. Mixed stock analysis of a foraging aggregation of immature loggerhead sea turtles captured in coastal waters off Florida, found three stocks: south Florida (69% of the loggerheads sampled) respectively), northern (10%, respectively), and Mexico (20%) (Witzell et al. 2002). Similarly, analysis of stranded turtles from Virginia to Florida indicated that the turtles originated from three nesting areas: south Florida (59%), northern (25%), and Mexico (20%) (Rankin-Baransky et al. 2001).

More recently, Haas et al. (2008) used two approaches in identifying the contribution of each stock in the U.S. Atlantic sea scallop fishery bycatch: an equal contribution from each stock or a weighted contribution by rookery sizes. The sea scallop fishery generally operates in the same areas as the fisheries and ecosystem research activities considered in this Opinion and; therefore, the results are applicable to these actions. When weighted by population size, 89% of the loggerheads captured in the U.S. Atlantic scallop fishery from 1996-2005 originated from the south Florida nesting stock, 4% were from the Mexican stock, 3% were from the northern (northeast Florida to North Carolina) stock, 1% were from the northwest Florida stock, and 0% were from the Dry Tortugas stock. The remaining 3% of loggerheads sampled were attributed to nesting stocks in Greece (Haas et al. 2008). Haas et al. (2008) noted that these results should be interpreted with caution given the small sample size and resulting difficulties in precisely assigning rookery contributions to a particular mixed population.

A re-analysis of loggerhead genetics data by the Atlantic Loggerhead TEWG has found that it is unlikely that U.S. fishing fleets are interacting with the Mediterranean DPS (LaCasella et al. 2013). Given that updated, more refined analyses are ongoing and the occurrence of Mediterranean DPS juveniles in U.S. Atlantic waters is rare and uncertain, if occurring at all, it is unlikely that individuals from the Mediterranean DPS would be present in the action area

(Memorandum from Patricia A. Kurkul, Regional Administrator, to the Record, November 29, 2011). As a result, those records are reapportioned in our analysis in this Opinion to the five Northwest Atlantic stocks, which are expected to contribute to individuals in the action area. Note that when equal contributions of each stock were considered, Haas et al. (2008) found that the results varied from the weighted contributions but the south Florida nesting stock still contributed the majority of scallop fishery bycatch (63%).

These loggerhead nesting stocks in Haas et al. (2008) do not share the exact delineations of the recovery units identified in the 2008 recovery plan. However, the PFRU encompasses the south Florida stock, the NRU is roughly equivalent to the northern nesting stock, the northwest Florida stock is included in the NGMRU, the Mexico stock is included in the GCRU, and the DTRU encompasses the Dry Tortugas stock. The available genetic analyses indicate the majority of bycatch in Northeast and Mid-Atlantic waters comes from the PFRU with smaller contributions from the other recovery units in the Northwest Atlantic DPS. However, the exact percentages of fisheries bycatch from specific nesting beaches and recovery units are not available at this time and may be variable from year to year. As a result, we are relying on the genetic analysis weighted by population size presented in Haas et al. (2008), which is one of the most comprehensive (in terms of the area from which samples were acquired) of the loggerhead genetics studies. The best available information indicates that the proportion of the interactions from each recovery unit is consistent with the relative sizes of the recovery units. We also considered the recent Stewart et al. (2019) mixed stock analysis for bycaught loggerheads in the Northwest Atlantic from 2003-2013, but chose to utilize the percentages from Haas et al. (2008) to align our analyses for loggerheads with those in other recent fisheries and fisheries research Opinions. In addition, the management units identified in Stewart et al. (2019) were smaller and more distinct and their confidence intervals around the stock contributions were much larger.

In this Opinion, we have considered the potential impacts of the proposed actions on the NWA DPS of loggerhead sea turtles. We have estimated that 85 loggerheads are likely to be incidentally taken by the proposed fisheries and ecosystem research activities over the five-year period from 2021-2026, with an additional 124 loggerheads being handled and sampled by the NEFSC observer programs from now through 2026. Of those 209 loggerhead sea turtles that are expected to be incidentally taken, 10 may be seriously injured or killed (all of those in NEFSC research using fishing gear, none during observer program handling and sampling). All other effects to loggerhead sea turtles, including effects to prey and habitat as well as effects from vessel and active acoustic sources, are expected to be insignificant and discountable.

Both collisions with or captures in fishing gear during the NEFSC's fisheries and ecosystem research and being handled and sampled during observer program activities will temporarily prevent these sea turtles from carrying out essential behaviors such as foraging and migrating. However, these behaviors are expected to resume as soon as the turtles are returned to the water (if not seriously injured or killed). The incidental take of live, uninjured loggerhead sea turtles is not likely to reduce the numbers of loggerhead sea turtles in the action area, the numbers of loggerheads in any subpopulation, or the species as a whole. Similarly, as the take of live, uninjured loggerhead sea turtles will not affect the fitness of any individual, no effects to reproduction are anticipated. The take of live, uninjured loggerhead sea turtles is also not likely to affect the distribution of loggerhead sea turtles in the action area or affect the distribution of sea turtles throughout their range. As any effects to live and uninjured loggerhead sea turtles temporarily removed from the water will be minor and temporary there are not anticipated to be any population level impacts.

The lethal removal of ten loggerhead sea turtles from the Northwest Atlantic DPS every five years (on average, two per year) will reduce the number of loggerhead sea turtles compared to the number that would have been present in the absence of the proposed actions (assuming all other variables remained the same). These lethal interactions would also result in a future reduction in reproduction due to lost reproductive potential, as some of these individuals would be females who would have reproduced in the future, thus eliminating each female individual's contribution to future generations. For example, an adult female loggerhead sea turtle in the Northwest Atlantic DPS can lay three or four clutches of eggs every two to four years, with 100 to 126 eggs per clutch (NMFS and U.S. FWS 2008). The annual loss of adult female sea turtles, on average, could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. A reduction in the distribution of loggerhead sea turtles is not expected from lethal interactions attributed to the proposed actions as potential interactions are expected to occur at random throughout the action area and loggerheads generally have large ranges in which they disperse.

Whether the reductions in the Northwest Atlantic DPS of loggerhead numbers and reproduction attributed to the proposed actions would appreciably reduce the likelihood of survival for loggerheads depends on what effect these reductions in numbers and reproduction have on overall population sizes and trends. That is, whether the estimated reductions, when viewed within the context of the *Status of the Species*, *Environmental Baseline*, *Climate Change*, and *Cumulative Effects* are to such an extent that adverse effects on population dynamics are appreciable. Loggerhead sea turtles are a slow growing, late-maturing species, and thus are less tolerant of high rates of anthropogenic mortality. Conant et al. (2009) concluded that loggerhead natural growth rates are low, natural survival needs to be high, and even low (1-10%) to moderate (10-20%) mortality can drive the population into decline. Because recruitment to the adult population is slow, population modeling studies suggest even small increased mortality rates in adults and sub-adults could substantially impact population numbers and viability (Crouse et al. 1987; Crowder et al. 1994; Chaloupka and Musick 1997; Heppell et al. 2005).

Actions have been taken to reduce anthropogenic impacts to loggerhead sea turtles from various sources, particularly since the early 1990s. These include lighting ordinances, predation control, and nest relocations to help increase hatchling survival, as well as measures to reduce the mortality of juveniles and adults in various fisheries and other marine activities. Conant et al. (2009) concluded that the results of their models (i.e., predicted continued declines) are largely driven by mortality of juvenile and adult loggerheads from fishery bycatch that occurs throughout the Northwest Atlantic. While significant progress has been made to reduce bycatch in some fisheries in certain parts of the loggerhead's range, and the results of new nesting trend analyses may indicate the positive effects of those efforts, notable fisheries bycatch persists. The question we are left with for this analysis is whether the effects of the proposed actions appreciably reduce survival and recovery, given the current status of the species and predicted population trajectories, as well as the many natural and human-caused impacts on sea turtles. Although we have seen some shorter term effects of the Deepwater Horizon oil release event and climate change on the population status and trends of loggerheads, there are a number of effects that may not be certain for several years to come.

As described in the *Status of the Species*, we consider that the Deepwater Horizon oil release had an adverse impact on loggerhead sea turtles, and resulted in mortalities, along with unknown lingering impacts outside the action area resulting from nest relocations, non-lethal exposure, and foraging resource impacts. However, there is no information to indicate that a significant population-level impact has occurred that would have changed the species' status to an extent that the expected interactions from NEFSC fisheries and ecosystem research activities would result in a detectable change in the population status of the NWA DPS of loggerhead sea turtles. This is especially true given the size of the population and that, unlike Kemp's ridleys, the NWA DPS of loggerheads is proportionally much less dependent on Gulf of Mexico.

It is possible that the Deepwater Horizon oil release reduced the survival rate of all age classes to varying degrees and may continue to do so for some undetermined time. However, there is no information at this time that it has, or should be expected to have, substantially altered the long-term survival rates in a manner that would significantly change the population dynamics compared to the estimates used in this Opinion. Any impacts are not thought to alter the population status to a degree in which the number of mortalities from the proposed actions would reduce the likelihood of survival of the species.

We have determined that the effects on loggerhead sea turtles associated with the proposed actions are not reasonably expected to cause an appreciable reduction in the likelihood of survival of the Northwest Atlantic loggerhead DPS, even in light of the impacts of the Deepwater Horizon oil release and climate change. Over the course of the proposed actions, we expect the Northwest Atlantic DPS of adult females to remain large (tens or hundreds of thousands of individuals) and to retain the potential for recovery, as explained below. While the effects of the proposed actions will most directly affect the overall size of the population, the lethal take over a five-year period represents a very small fraction, approximately 0.03% (=10/38,334*100) of the overall female population estimated by Richards et al. (2011) and a very small fraction (approximately 0.003%) of the lower inter-quartile estimate of 382,000 loggerheads within the Northwest Atlantic continental shelf from the 2010 AMAPPS surveys. The lethal take estimate includes potential mortalities of both juveniles and adults, while the Richards et al. (2011) population estimate is only for adult females and the NMFS (2011) population estimate from AMAPPS is only for loggerheads in continental shelf waters. Therefore, both percentages are conservative estimates of removals since the action area extends into waters off the continental shelf and both juvenile and adult life stages of loggerheads may be captured by the proposed actions. Overall, abundance estimates accounting for only a subset of the entire loggerhead sea turtle population in the NWA DPS indicate that the population is large (i.e., several hundred thousands of individuals) and we expect that the population will remain large for several decades to come. The proposed actions are also not expected to reduce the genetic heterogeneity, broad demographic representation, or successful reproduction of the population, nor affect loggerheads' ability to meet their life cycle requirements, including reproduction, sustenance, and shelter.

In the recovery plan for loggerheads, the nesting beach Demographic Recovery Criteria are specific to recovery units. This criteria for nests and nesting females were based on a time frame of one generation for U.S. loggerheads, defined in the recovery plan as 50 years. To be considered for delisting, each recovery unit will have recovered to a viable level and will have increased for at least one generation. The rate of increase used for each recovery unit was dependent upon the level of vulnerability of the recovery unit. The minimum statistical level of detection (based on annual variability in nest counts over a generation time of 50 years) of 1% per year was used for the PFRU, the least vulnerable recovery unit. A higher rate of increase of 3% per year was used for the NGMRU and DTRU, the most vulnerable recovery units. A rate of increase of 2% per year was used for the NRU, a moderately vulnerable recovery unit (NMFS and U.S. FWS 2008).

A fundamental problem with restricting population analyses to nesting beach surveys is that they may not reflect changes in the non-nesting population. This is because of the long time to maturity and the relatively small proportion of females that are reproducing on a nesting beach. A decrease in oceanic juvenile or neritic juvenile survival rates may be masked by the natural variability in nesting female numbers and the slow response of adult abundance to changes in recruitment to the adult population (Chaloupka and Limpus 2001). In light of this, two additional Demographic Criteria were developed to ensure a more representative measure of population status was achieved. These criteria are not delineated by recovery unit because individuals from the recovery units mix in the marine environment; therefore, they are applicable to all recovery units. The first of these additional Demographic Criteria assesses trends in abundance on foraging grounds, and the other assesses age-specific trends in strandings relative to age-specific trends in abundance on foraging grounds. For the foraging grounds, a network of index in-water sites, both oceanic and neritic, distributed across the foraging range must be established and monitored to measure abundance. Recovery can be achieved if there is statistical confidence (95%) that a composite estimate of relative abundance from these sites is increasing for at least one generation. For trends in strandings relative to in-water abundance, recovery can be achieved if stranding trends are not increasing at a rate greater than the trends in in-water relative abundance for similar age classes for at least one generation. Recovery criteria must be met for all recovery units in order for the species to be delisted (NMFS and U.S. FWS 2008).

Assuming some or all loggerhead sea turtles killed through interactions with the proposed actions are females, the loss of female loggerhead sea turtles as a result is expected to reduce the reproduction of loggerheads in the NWA DPS compared to the reproductive output of NWA DPS loggerheads in the absence of the proposed actions. In addition to being linked to survival, these losses are relevant to the Demographic Recovery Criteria for nests and nesting females. As described in the *Status of the Species*, nesting trends for each of the loggerhead sea turtle recovery units in the NWA DPS are variable. Overall, short-term trends have shown increases, however, over the long-term the DPS is considered stable.

Assuming that between half (moderate case scenario) and all (worst case scenario) of the loggerhead mortalities from the proposed actions are adult females, the NEFSC's fisheries and ecosystem research would remove between 0.01% and 0.03% of the nesting females from the DPS each year (5 to 10 out of the estimated 38,334 adult female loggerheads in the Northwest Atlantic from Richards et al. 2011). A more plausible scenario is that the proposed actions remove approximately 0.003% or fewer of the total population of loggerheads in the DPS each year, based on the estimate from NMFS (2011) which includes both juvenile and adult life stages in U.S. Atlantic continental shelf waters, of which only a fraction are adult females or individuals of reproductive age. In general, while the loss of a certain number of individuals from a species may have an appreciable reduction on the numbers, reproduction, and distribution of the species, this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range, or the species has extremely low levels of genetic diversity. This situation is not likely in the case of the NWA DPS of loggerheads because the species is widely geographically distributed, it is not known to have low levels of genetic diversity, and there are at least tens to hundreds of thousands of individuals in the DPS.

Even amidst ongoing threats to the species such as fisheries mortality and climate change, the potential loss of up to ten loggerheads from the Northwest Atlantic every five years is not likely to result in any appreciable decline to the NWA DPS. This is due to: (1) the large size of the current nesting population, (2) the fact that the overall nesting population remains widespread, (3) the trend for the nesting population appears to be stabilizing, and short-term trends in some recovery units are increasing, and (4) substantial conservation efforts have been implemented and are underway to address threats.

9.2 Kemp's Ridley Sea Turtles

Kemp's ridley sea turtles are listed as a single species classified as endangered under the ESA. Kemp's ridleys occur in the North Atlantic Ocean and Gulf of Mexico.

Nest count data provides the best available information on the number of adult females nesting each year. As is the case with other sea turtles species, nest count data must be interpreted with caution given that these estimates provide a minimum count of the number of nesting Kemp's ridley sea turtles and do not account for adult males or juveniles of either sex. Without information on the proportion of adult males to females and the age structure of the population, nest counts cannot be used to estimate the total population size (Meylan 1982; Ross 1996) (letter to J. Lecky, NMFS Office of Protected Resources, from N. Thompson, NMFS Northeast Fisheries Science Center, December 4, 2007). Nevertheless, the nesting data does provide valuable information on the extent of Kemp's ridley nesting and the trend in the number of nests laid. It is the best proxy we have for estimating population changes.

Following a significant, unexplained one-year decline in 2010, Kemp's ridley sea turtle nests in Mexico reached a record high of 21,797 in 2012 (Gladys Porter Zoo nesting database, unpublished data). In 2013 and 2014, there was a second significant decline in Mexico nests, with only 16,385 and 11,279 nests recorded, respectively. In 2015, nesting in Mexico improved to 14,006 nests, and in 2016 overall numbers increased to 18,354 recorded nests. There was a record high nesting season in 2017, with 24,570 nests recorded (J. Pena, pers. comm. to NMFS SERO PRD, August 31, 2017, as cited in NMFS 2020a) and decreases observed in 2018 and again in 2019. In 2019, there were 11,140 nests in Mexico. It is unknown whether this decline is related to resource fluctuation, natural population variability, effects of catastrophic events like the Deepwater Horizon oil spill affecting the nesting cohort, or some other factor. A small nesting population is also emerging in the United States, primarily in Texas. From 1980-1989, there were an average of 0.2 nests/year at Padre Island National Seashore, rising to 3.4 nests/year from 1990-1999, 44 nests/year from 2000-2009, and 110 nests/year from 2010-2019. There was a record high of 353 nests in 2017 (NPS 2020). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, characterized by a significant decline in 2010, followed by a second decline in 2013-2014, but with a rebound in 2015-2017 (NMFS 2020a) and decreases in nesting in 2018 and 2019 (NPS 2020).

Estimates of the adult female nesting population reached a low of approximately 250-300 in 1985 (TEWG 2000; NMFS and U.S. FWS 2015). Gallaway et al. (2016) developed a stock assessment model for Kemp's ridley to evaluate the relative contributions of conservation efforts and other factors toward this species' recovery. Terminal population estimates for 2012 summed over ages 2 to 4, ages 2+, ages 5+, and ages 9+ suggest that the respective female population sizes were 78,043 (SD = 14,683), 152,357 (SD = 25,015), 74,314 (SD =10,460), and 28,113 (SD = 2,987) (Gallaway et al. 2016). Using the standard IUCN protocol for sea turtle assessments, the number of mature individuals was recently estimated at 22,341 (Wibbels and Bevan 2019). The calculation took into account the average annual nests from 2016-2018 (21,156), a clutch frequency of 2.5 per year, a remigration interval of two years, and a sex ratio of 3.17 females:1 male. Based on the data in their analysis, the assessment concluded the current population trend is unknown (Wibbels and Bevan 2019). However, some positive outlooks for the species include recent conservation actions, including the expanded TED requirements in the shrimp fishery (84 FR 70048, December 20, 2019) and a decrease in the amount of shrimping off the coast of Tamaulipas and in the Gulf of Mexico (NMFS and U.S. FWS 2015).

Genetic variability in Kemp's ridley sea turtles is considered high, as measured by nuclear DNA analyses (i.e., microsatellites) (NMFS et al. 2011). If this holds true, then rapid increases in population over one or two generations would likely prevent any negative consequences in the genetic variability of the species (NMFS et al. 2011). Additional analysis of the mtDNA taken from samples of Kemp's ridley sea turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006).

In this Opinion, we have considered the potential impacts of the proposed actions on Kemp's ridley sea turtles. We expect the capture of up to 95 Kemp's ridleys during the proposed fisheries and ecosystem research activities over the five-year period from 2021-2026, with an additional 40 Kemp's ridleys being handled and sampled by the NEFSC observer programs from now through 2026. Of those 135 Kemp's ridley sea turtles that are expected to be incidentally taken, 15 may potentially experience serious injury or post-interaction mortality (all of those in NEFSC research using fishing gear, none during observer program handling and sampling).

The proposed actions would reduce the species' population compared to the number that would have been present in the absence of the proposed action, assuming all other variables remained the same. Using the estimate of mature animals (22,341) in Wibbels et al. (2019), the loss of 15 animals every five years represents a small fraction (0.07%) of the overall population. The proposed actions could also result in a potential reduction in future reproduction, assuming at least some of these individuals would be female and would have survived to reproduce in the future. The loss of adult females could preclude the production of thousands of eggs and hatchlings, of which a small percentage are expected to survive to sexual maturity. Thus, the death of any females that would otherwise have survived to sexual maturity would eliminate their contribution to future generations, and result in a reduction in sea turtle reproduction. Based upon past incidental take records, lethal interactions are expected to occur primarily in the Mid- and South Atlantic regions, although could occur anywhere in the action area as Kemp's ridley sea turtles generally have large ranges in which they disperse. Thus, no reduction in the distribution of Kemp's ridley sea turtles is expected from these research interactions. Whether the reductions in numbers and reproduction of Kemp's ridley sea turtles would appreciably reduce their likelihood of survival depends on the probable effect the changes in numbers and reproduction would have relative to current population sizes and trends.

It is likely that the Kemp's ridley was the sea turtle species most affected by the Deepwater Horizon oil spill on a population level. In addition, the sea turtle strandings documented immediately after the oil spill in 2010 and 2011 in Alabama, Louisiana, and Mississippi primarily involved Kemp's ridley sea turtles. Necropsy results indicated that mortality was caused by forced submergence, which is commonly associated with fishery interactions (77 FR 27413, May 10, 2012). As described in the *Environmental Baseline*, regulatory actions have been taken to reduce anthropogenic effects to Kemp's ridley sea turtles. These include measures implemented to reduce the number and severity of Kemp's ridley sea turtle interactions in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries, the Mid-Atlantic scallop dredge and summer flounder trawl fisheries, large mesh gillnet fisheries in Virginia and North Carolina, and the Virginia pound net fishery. The recent expanded TED requirements in the shrimp trawl fishery that will go into effect will further reduce impacts to Kemp's ridley sea turtles.

Overall, the effects from the proposed actions on Kemp's ridley sea turtles are not likely to appreciably reduce overall population numbers over time due to current population size, expected recruitment, and the implementation of additional conservation requirements in the shrimp trawl fishery, even in light of the adverse impacts expected to have occurred from the Deepwater Horizon oil spill.

It is important to remember that with significant inter-annual variation in nesting data, sea turtle population trends necessarily are measured over decades and the long-term trend line better reflects the population increase in Kemp's ridleys. With the recent nesting data, the population trend has become less clear. Even with reported fluctuations in nesting numbers from Mexican beaches, all years since 2006 have reported over 10,000 nests per year, indicating an increasing population over the previous decades. We have determined that this long-term trend in nesting is likely evidence of a generally increasing population, as well as a population that is maintaining (and potentially increasing) its genetic diversity. These nesting data are indicative of a species with a significant number of sexually mature individuals. The loss of up to 15 Kemp's ridleys every five years is not expected to change the trend in nesting, the distribution of, or the reproduction of Kemp's ridley sea turtles. Therefore, we do not expect the proposed actions to cause an appreciable reduction in the likelihood of survival of this species in the wild.

The recovery plan for the Kemp's ridley sea turtle (NMFS et al. 2011) lists the following recovery objectives for downlisting that are relevant to the fisheries assessed in this Opinion:

- Demographic: A population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per season) distributed at the primary nesting beaches

(Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico is attained. Methodology and capacity to implement and ensure accurate nesting female counts have been developed.
- Listing factor: TED regulations, or other equally protective measures, are maintained and enforced in U.S. and Mexican trawl fisheries (*e.g.*, shrimp, summer flounder, whelk) that are known to have an adverse impact on Kemp's ridleys in the Gulf of Mexico and Northwest Atlantic Ocean.

With respect to the demographic recovery objective, the nesting numbers in the most recent three years indicate there were 24,570 nests in 2017, 17,945 in 2018, and 11,090 in 2019 on the main nesting beaches in Mexico. Based on 2.5 clutches/female/season, these numbers represent approximately 9,828 (2017), 7,178 (2018), and 4,436 (2019) nesting females in each season. The number of nests reported annually from 2010 to 2014 declined overall; however, they rebounded in 2015 through 2017, and declined again in 2018 and 2019. Although there has been a substantial increase in the Kemp's ridley population within the last few decades, the number of nesting females is still below the number of 10,000 nesting females per season required for downlisting (NMFS and U.S. FWS 2015). Since we concluded that the potential loss of 15 Kemp's ridley sea turtles every five years is not likely to have any detectable effect on nesting trends, we do not expect the proposed actions to impede progress toward achieving this recovery objective. Non-lethal captures of these sea turtles would not affect the adult female nesting population or number of nests per nesting season. Thus, we assert that the proposed actions will not result in an appreciable reduction in the likelihood of Kemp's ridley sea turtle recovery in the wild.

In regards to the listing factor recovery criterion, the recovery plan states, "the highest priority needs for Kemp's ridley recovery are to maintain and strengthen the conservation efforts that have proven successful. In the water, successful conservation efforts include maintaining the use of TEDs in fisheries currently required to use them, expanding TED-use to all trawl fisheries of concern, and reducing mortality in gillnet fisheries. Adequate enforcement in both the terrestrial and marine environment also is also noted essential to meeting recovery goals" (NMFS et al. 2011). We are currently undertaking several of these initiatives, which should aid in the recovery of the species. The required use of TEDs in shrimp trawls in the United States under sea turtle conservation regulations and in Mexican waters has had dramatic effects on the recovery of Kemp's ridley sea turtles. In addition, the ongoing evaluation of bycatch reduction technologies, including TEDs, in the summer flounder, croaker, and longfin squid fisheries by gear research staff at the NEFSC and GARFO PRD should help in the recovery of the species as well.

Based on the information provided above, the loss of up to 15 Kemp's ridley sea turtles every five years as a result of the NEFSC's fisheries and ecosystem research will not appreciably reduce the likelihood of survival and recovery for Kemp's ridley sea turtles given the long term nesting trend, the population size, and ongoing and future measures (i.e., expanded TED regulations in the shrimp trawl fishery) that reduce the number of Kemp's ridley sea turtles injured and killed.

9.3 North Atlantic DPS of Green Sea Turtles

The North Atlantic DPS of green sea turtles is listed as threatened under the ESA. As is the case with the other three sea turtle species addressed in this Opinion, North Atlantic DPS green sea turtles face numerous threats on land and in the water that affect the survival of all age classes.

There are four regions that support high nesting concentrations in the North Atlantic DPS: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), United States (Florida), and Cuba. Using data from 48 nesting sites in the North Atlantic DPS, nester abundance was estimated at 167,528 total nesters (Seminoff et al. 2015). The years used to generate the estimate varied by nesting site but were between 2005-2012. The largest nesting site (Tortuguero, Costa Rica) hosts 79% of the estimated nesting. It should be noted that not all female green sea turtles nest in a given year (Seminoff et al. 2015). Nesting in the area has increased considerably since the 1970s, and nest count data from 1999-2003 suggested that 17,402-37,290 females nested there per year (Seminoff et al. 2015). In 2010, an estimated 180,310 nests were laid at Tortuguero, the highest level of green sea turtle nesting estimated since the start of nesting track surveys in 1971. This equated to somewhere between 30,052 and 64,396 nesters in 2010 (Seminoff et al. 2015). Nesting sites in Cuba, Mexico, and the U.S. were either stable or increasing (Seminoff et al. 2015). More recent data is available for the southeastern U.S. Nest counts at Florida's core index beaches have ranged from less than 300 to almost 41,000 in 2019. The INBS is carried out on a subset of beaches surveyed during the SNBS and is designed to measure trends in nest numbers. The nest trend in Florida shows the typical biennial peaks in abundance and has been increasing (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). The SNBS is broader but is not appropriate for evaluating trends. In 2019, approximately 53,000 green sea turtle nests were recorded in the SNBS (https://myfwc.com/research/wildlife/sea-turtles/nesting/). Seminoff et al. (2015) estimated total nester abundance for Florida at 8,426 turtles.

We recognize that the nest count data available for green sea turtles in the Atlantic indicates increased nesting at many sites. However, we also recognize that the nest count data, including data for green sea turtles in the Atlantic, only provides information on the number of females currently nesting.

We anticipate up to 10 green sea turtles will be captured in the proposed fisheries and ecosystem research activities over the five-year period from 2021-2026, with an additional eight green sea turtles being handled and sampled by the NEFSC observer programs from now through 2026. All but one of the 18 captured or handled/sampled green sea turtles are expected to be safely removed from the gear being used and returned to the ocean without any long-term injury or mortality. All other effects to green sea turtles, including effects to their prey and habitat and from active acoustic sources, are expected to be insignificant and discountable.

As described above, it is reasonable to expect that both benthic immature and sexually mature green sea turtles may be captured in gillnet, hook and line, or bottom trawl gear as a result of the proposed actions. It is assumed that there is an equal chance of lethally capturing a male or female green sea turtle since available information suggests that both sexes occur in the action area. Lethal interactions would reduce the number of green sea turtles, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same.

Lethal interactions would also result in a potential reduction in future reproduction, assuming some individuals would be females and would have otherwise survived to reproduce. For example, an adult female green sea turtle lays three clutches of eggs, on average (Seminoff et al. 2015), every two to years (Witherington and Ehrhart 1989; Zurita et al. 1994; Troëng and Chaloupka 2007). Green sea turtle clutches range from 108 eggs in Costa Rica to 136 eggs in Florida (Witherington and Ehrhart 1989; Tiwari et al. 2006; Seminoff et al. 2015). A small percentage of the eggs are expected to survive to sexual maturity. A lethal capture of a female green sea turtle would remove reproductive output from the species. Based upon recent captures from the COASTSPAN and NEAMAP surveys, lethal interactions are expected to occur primarily in the Mid-Atlantic and Southeast U.S. portions of the action area, although could occur anywhere as green sea turtles generally have large ranges in which they disperse. Thus, no reduction in the distribution of green sea turtles is expected from these interactions. Whether the reductions in numbers and reproduction of this species would appreciably reduce its likelihood of survival depends on the probable effect the changes in numbers and reproduction would have relative to current population sizes and trends.

We have determined that the proposed actions are not reasonably expected to cause, directly or indirectly, an appreciable reduction in the likelihood of survival of the green sea turtle. Although the anticipated mortalities would result in an instantaneous reduction in absolute population numbers, the U.S. populations of green sea turtles would not be appreciably affected. For a population to remain stable, sea turtles must replace themselves through successful reproduction at least once over the course of their reproductive lives, and at least one offspring must survive to reproduce itself. Since the abundance trend information for green sea turtles is clearly increasing while takes have been occurring, we expect that the lethal interactions attributed to the proposed actions will not have any measurable effect on that trend. In addition, the potential loss of one green sea turtle every five years represents an extremely small fraction of the overall population that can be estimated from recent nest count data in Florida and Costa Rica. As described in the *Environmental Baseline*, although the Deepwater Horizon oil spill is expected to have resulted in adverse impacts to green sea turtles, there is no information to indicate, or basis to conclude, that a significant population-level impact has occurred that would have changed the species' status to an extent that the expected interactions from the NEFSC's fisheries and ecosystem research would result in a detectable change in the population status of green sea turtles in the North Atlantic. Any impacts are not thought to alter the population status to a degree in which the number of mortalities from the proposed actions could be seen as reducing the likelihood of survival and recovery of the species.

As also described in the *Environmental Baseline*, regulatory actions have been taken to reduce anthropogenic effects to green sea turtles in the North Atlantic. These include measures to reduce the number and severity of green sea turtle interactions in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries, the Mid-Atlantic sea scallop dredge and summer flounder trawl fisheries, large mesh gillnet fisheries in Virginia and North Carolina, and the Virginia pound net fishery—all of which are causes of green sea turtle mortality in the North Atlantic. Since most of these regulatory measures have been in place for several years now, it is likely that current nesting trends reflect the benefit of these measures to North Atlantic DPS green sea turtles. Therefore, the current nesting trends for green sea turtles in the North Atlantic are likely to improve as a result of the regulatory actions taken in U.S. commercial fisheries.

The recovery plan for Atlantic green sea turtles (NMFS and U.S. FWS 1991) lists the following recovery objectives which are relevant to the proposed actions in this Opinion, and must be met over a period of 25 continuous years:

- The level of nesting in Florida has increased to an average of 5,000 nests per year for at least six years;
- A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.

Along the Atlantic coast of eastern central Florida, a mean of 5,055 nests were deposited each year from 2001 to 2005 (Meylan et al. 2006) and 10,377 each year from 2008 to 2012 (B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2013, as cited in Seminoff et al. 2015). Nesting has increased substantially over the last 20 years and peaked in 2011 with 15,352 nests statewide (Chaloupka et al. 2008; B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2013 as cited in Seminoff et al. 2015). The status review estimated total nester abundance for Florida at 8,426 turtles (Seminoff et al. 2015). As described above, sea turtle nesting in Florida is increasing. For the most recent six-year period of SNBS data, there were 5,895 nests in 2014, 37,341 in 2015, 5,393 in 2016, 53,102 in 2017, 4,545 in 2018, and 53,011 in 2019 (see https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). Thus, this recovery criterion continues to be met.

Several actions are being taken to address the second objective; however, there are currently few studies and no estimates of absolute abundance available that specifically address changes in abundance of individuals on foraging grounds. A study in the central region of the Indian River Lagoon (along the east coast of Florida) found a 661% increase in juvenile green sea turtle capture rates over a 24-year study period from 1982-2006 (Ehrhart et al. 2007). Wilcox et al. (1998) found a dramatic increase in the number of green sea turtles captured from the intake canal of the St. Lucie nuclear power plant on Hutchinson Island, Florida, beginning in 1993. During a 17-year period from 1976-1993, green sea turtle captures averaged 24 per year. Green sea turtle catch rates for 1993, 1994, and 1995 were 745%, 804%, and 2,084% above the previous 16-year average annual catch rates (Wilcox et al. 1998). In a study of sea turtles incidentally caught in pound net gear fished in inshore waters of Long Island, New York, Morreale and Standora (2005) documented the capture of more than twice as many green sea turtles in 2003 and 2004 with less pound net gear fished, compared to the number of green sea turtles captured in pound net gear in the area during the 1990s. Yet other studies have found no difference in the abundance (decreasing or increasing) of green sea turtles on foraging grounds in the North Atlantic (Bjorndal et al. 2005; Epperly et al. 2007). Given the clear increases in nesting, however, it is reasonably likely that numbers on foraging grounds have increased.

Based on the information provided above, the loss of one green sea turtle every five years from the North Atlantic DPS as a result of the proposed actions will not appreciably reduce the likelihood of survival for green sea turtles in the North Atlantic given that is not expected to measurably affect the increasing nesting trend in Florida, that the population size is relatively large, and that measures to reduce the number of North Atlantic DPS green sea turtles that are injured and killed (which should result in increases to the numbers of green sea turtles in the North Atlantic that would otherwise have not occurred in the absence of those regulatory measures) are in place. Given that the proposed actions are not expected to measurably affect the nesting trend, they will also not appreciably reduce the likelihood of recovery of green sea turtles in the North Atlantic DPS. The NEFSC's fisheries and ecosystem research has no adverse effects on green sea turtles that occur outside of the North Atlantic. Therefore, since the proposed actions will not appreciably reduce the likelihood of survival or recovery of green sea turtles in the North Atlantic, they will not appreciably reduce the likelihood of survival or recovery for the DPS.

9.4 Leatherback Sea Turtles

Leatherback sea turtles are listed as endangered under the ESA. Leatherbacks face a multitude of threats that can cause death prior to and after reaching maturity. Some activities resulting in leatherback mortality have been addressed.

Dutton et al. (2013) evaluated the stock structure of leatherbacks in the Atlantic. Samples from eight nesting sites in the Atlantic and one in the southwest Indian Ocean identified seven management units in the Atlantic and revealed fine scale genetic differentiation among neighboring populations. The mtDNA analysis failed to find significant differentiation between Florida and Costa Rica or between Trinidad and French Guiana/Suriname (Dutton et al. 2013). In 2020, seven leatherback populations that met the discreteness and significance criteria of DPSs were identified (NMFS and U.S. FWS 2020). These include the Northwest Atlantic, Southwest Atlantic, Southeast Atlantic, Southwest Indian, Northeast Indian, West Pacific, and East Pacific. The population found within the action is area is the Northwest Atlantic DPS. While NMFS and U.S. FWS concluded that seven populations met the criteria for DPSs, the species continues to be listed at the global level (85 FR 48332, August 10, 2020). Therefore, this analysis considers the range-wide status.

The most recently published assessment, the 2020 leatherback status review, estimated that the total index of nesting female abundance for the Northwest Atlantic DPS is 20,659 females (NMFS and U.S. FWS 2020). This abundance estimate is similar to other estimates. The TEWG estimated approximately 18,700 (range 10,000 to 31,000) adult females using nesting data from 2004 and 2005 (TEWG 2007). The IUCN Red List assessment for the Northwest Atlantic Ocean subpopulation estimated 20,000 mature individuals (male and female) and approximately 23,000 nests per year (data through 2017) with high inter-annual variability in annual nest counts within and across nesting sites (Northwest Atlantic Leatherback Working Group 2018). The estimate in the status review is higher than the estimate for the IUCN Red List assessment, likely due to a different remigration interval, which has been increasing in recent years (NMFS and U.S. FWS 2020). For this analysis, we found that the status review estimate of 20,659 nesting females represents the best available scientific information given that it uses the most comprehensive and recent demographic trends and nesting data.

Previous assessments of leatherbacks concluded that the Northwest Atlantic population was stable or increasing (TEWG 2007; Tiwari et al. 2013a). However, as described in the *Status of* *the Species,* more recent analyses indicate that the overall trends are negative (Northwest Atlantic Leatherback Working Group 2018, 2019; NMFS and U.S. FWS 2020). At the stock level, the Working Group evaluated the Northwest Atlantic – Guianas-Trinidad, Florida, Northern Caribbean, and the Western Caribbean. The Northwest Atlantic – Guianas-Trinidad stock is the largest stock and declined significantly across all time periods evaluated, which was attributed to an exponential decline in abundance at Awala-Yalimapo, French Guiana as well as recent declines in Guyana, Suriname, and other nesting sites in French Guiana. Declines in Awala-Yalimapo were attributed, in part, due to beach erosion and a loss of nesting habitat (Northwest Atlantic Leatherback Working Group 2018). The Florida stock increased significantly over the long-term, but declined from 2008-2017 (Northwest Atlantic Leatherback Working Group 2018). Slight increases in nesting were seen in 2018 and 2019, however, nest counts remain low compared to 2008-2015 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). The Northern Caribbean and Western Caribbean stocks have also declined. The Working Group report also includes trends at the site-level, which varied depending on the site and time period, but were generally negative especially in the recent period (2008-2017).

Similarly, the leatherback status review concluded that the Northwest Atlantic DPS exhibits decreasing nest trends at nesting aggregations with the greatest indices of nesting female abundance. Though some nesting aggregations indicated increasing trends, most of the largest ones are declining. This trend is considered to be representative of the DPS (NMFS and U.S. FWS 2020). While not anticipated to be in the action area, data also indicated that the Southwest Atlantic DPS is declining (NMFS and U.S. FWS 2020).

Populations in the Pacific have shown dramatic declines at many nesting sites (Santidrián Tomillo et al. 2007, 2017; Sarti Martínez et al. 2007; Tapilatu et al. 2013; Mazaris et al. 2017). The IUCN Red List assessment estimated the number of total mature individuals (males and females) at Jamursba-Medi and Wermon beaches to be 1,438 turtles (Tiwari et al. 2013c). More recently, the leatherback status review estimated the total index of nesting female abundance at 1,277 females for the West Pacific DPS and 755 females for the East Pacific DPS (NMFS and U.S. FWS 2020). The East Pacific DPS has exhibited a decreasing trend since monitoring began with a 97.4% decline since the 1980s or 1990s, depending on nesting beach (Wallace et al. 2013). Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Most recently, the 2020 status review estimated that the total index of nesting female abundance for the Southwest Indian DPS is 149 females and that the DPS is exhibiting a slight decreasing nest trend (NMFS and U.S. FWS 2020). While data on nesting in the Northeast Indian Ocean DPS is limited, the DPS is estimated at 109 females. This DPS has exhibited a drastic population decline with extirpation of the largest nesting aggregation in Malaysia (NMFS and U.S. FWS 2020).

In this Opinion, we have considered the potential impacts of the proposed actions on leatherback sea turtles. We anticipate that up to 10 leatherbacks will be captured in the proposed fisheries and ecosystem research activities over the five-year period from 2021-2026, with an additional eight leatherbacks being handled and sampled by the NEFSC observer programs from now through 2026. All but five of the 18 captured or handled/sampled leatherbacks are expected to be safely removed from the gear being used and returned to the ocean without any injury or mortality. All other effects to leatherback sea turtles, including effects to their prey and habitat and from active acoustic sources, are expected to be insignificant and discountable.

The lethal removal of up to five leatherback sea turtles every five years will reduce the number of leatherback sea turtles as compared to the number that would have been present in the absence of the proposed actions (assuming all other variables remained the same). The lethal interactions could also result in a potential reduction in future reproduction, assuming one or more of these individuals would be female and otherwise survived to reproduce in the future. A leatherback sea turtle will lay multiple nests (clutches) each year. In the Northwest Atlantic DPS, eggs per clutch is 82 for the western Atlantic, and clutch frequency averages 5.5 nests per year (NMFS and U.S. FWS 2020). Therefore, an adult female leatherback sea turtle can produces hundreds of eggs per nesting season. Although a significant portion of the eggs can be infertile (NMFS and U.S. FWS 2020), the annual loss of adult female sea turtles, on average, could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. Thus, the death of any female leatherbacks that would have otherwise survived to reproduce would eliminate the individual's and its future offspring's contribution to future generations. The anticipated lethal interactions are expected to occur anywhere in the action area. Given that these sea turtles generally have large ranges in which they disperse, no reduction in the distribution of leatherback sea turtles is expected from the proposed actions. Whether the estimated reductions in numbers and reproduction of this species would appreciably reduce its likelihood of survival depends on the probable effect the changes in numbers and reproduction have relative to current population sizes and trends.

We have determined that the proposed actions are not reasonably expected to cause, directly or indirectly, an appreciable reduction in the likelihood of survival of leatherback sea turtles in the wild. A maximum of approximately 0.02% of the population (=5 mortalities/20,659 nesting females) is anticipated to be killed through the proposed actions every five years. Both males and females and both juvenile and adult leatherbacks are anticipated to potentially interact with gears used in the NEFSC's fisheries and ecosystem research. It should be noted that the abundance estimate is for nesting females only (i.e., does not include earlier life stages such as juveniles or adult males); therefore, the percent of the population killed is expected to be less than the percentage estimated here. Although the anticipated mortalities would result in a reduction in absolute population numbers, it is not likely this reduction would appreciably reduce the likelihood of survival of this species. If hatchling survival rate to maturity is greater than the mortality in the population, the loss of breeding individuals would be replaced through recruitment of new breeding individuals from successful reproduction of sea turtles unaffected by the proposed actions. Considering the number of lethal interactions relative to the population size, we conclude that the proposed actions are not likely to have an appreciable effect on overall population trends. In addition, the proposed actions are expected to control those impacts by maintaining survey effort levels consistent with those that have occurred in previous years.

Fisheries bycatch has been identified as a threat to the Northwest Atlantic DPS of leatherback sea turtles. The Leatherback Working Group noted that leatherback entanglements in vertical line fisheries (e.g., pot gear targeting crab, lobster, conch, fish) in continental shelf waters off New England and Nova Scotia, Canada, were a potential mortality sink that require continued monitoring and bycatch reduction efforts. Across the range of the DPS, thousands of mature individuals are lost annually due to gillnet bycatch (especially off nesting beaches). In particular, drift and bottom-set gillnets off Trinidad are estimated to kill well over 1,000 leatherback sea turtles annually (NMFS 2020). Longline bycatch is also considered to be a widespread threat to the DPS, likely resulting in the loss of thousands of individuals annually.

As explained in the *Environmental Baseline*, although no direct leatherback impacts (*i.e.*, oiled sea turtles or nests) from the Deepwater Horizon oil spill in the northern Gulf of Mexico were observed, some impacts from that event may be expected. However, there is no information to indicate, or basis to conclude, that a significant population-level impact has occurred that would change the species' status to an extent that the expected interactions from the proposed actions would result in a detectable change in the population status of leatherback sea turtles. Any impacts are not thought to alter the population status to a degree in which the number of mortalities from the proposed actions could be seen as reducing the likelihood of survival and recovery of the species.

As described in the *Environmental Baseline*, regulatory actions have been taken to reduce anthropogenic effects to Atlantic leatherbacks. These include measures to reduce the number and severity of leatherback interactions in the U.S. Atlantic longline fisheries and the U.S. South Atlantic and Gulf of Mexico shrimp fisheries. Reducing the number of leatherback sea turtles injured and killed by these activities is expected to increase the number of Atlantic leatherbacks and increase leatherback reproduction in the Atlantic. Since most of these regulatory measures have been in place for several years now, it is likely that current nesting trends reflect the benefit of these measures to Atlantic leatherback sea turtles.

Based on the information provided above, the loss of up to five leatherback sea turtles in the Atlantic every five years as a result of the proposed actions will not appreciably reduce the likelihood of survival for leatherbacks in the Atlantic given the relatively large population size and measures taken to reduce the number of Atlantic leatherback sea turtles injured and killed in the Atlantic Ocean. The NEFSC's fisheries and ecosystem research has no effects on leatherback sea turtles that occur outside of the Atlantic Ocean. Given that the proposed actions will not appreciably reduce the likelihood of survival for leatherbacks in the Atlantic, they will not appreciably reduce the likelihood of survival of the species.

The recovery plan for Atlantic leatherback sea turtles (NMFS and U.S. FWS 1992) lists the following recovery objective, which is relevant to the proposed actions in this Opinion:

- The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico; St. Croix, U.S. Virgin Islands; and along the east coast of Florida.

The most recently published IUCN Red List assessment for the Northwest Atlantic Ocean subpopulation of leatherbacks estimated approximately 23,000 nests per year (estimate to 2017) (Northwest Atlantic Leatherback Working Group 2019), while the total index of nesting female abundance (20,659 females) from the NMFS and U.S. FWS (2020) status review represents the best available data on the population size for this DPS. The Northwest Atlantic population exhibits an overall decreasing trend in annual nesting activity (Northwest Atlantic Leatherback

Working Group 2018, 2019). The 2020 leatherback status review concluded that the Northwest Atlantic population meets the definition of high extinction risk, largely due to decreasing nest trends (productivity), with moderate confidence because its abundance, spatial distribution, and diversity provides some resilience (NMFS and U.S. FWS 2020). Based on these decreasing nest trends, the Northwest Atlantic population is at or near a level that places its continued persistence in question (NMFS and U.S. FWS 2020). However, from 1990-2017, nesting populations in the U.S. Virgin Islands, Florida, on a few beaches in Puerto Rico, and at a few other locations in the Northwest Atlantic, have shown either a stable or slightly increasing trend (Northwest Atlantic Leatherback Working Group 2019).

The potential loss of five leatherback sea turtles every five years is not likely to have any detectable effect on the above nesting numbers and trends, and therefore, we do not expect that the proposed actions will impede progress toward achieving this recovery objective. Non-lethal interactions with these sea turtles would not affect the adult female nesting population or number of nests per nesting season. Since the proposed actions have no effects on leatherback sea turtles that occur outside of the Atlantic, they will not appreciably reduce the likelihood of recovery for the species. Therefore, we conclude that the proposed actions considered in this Opinion—even amidst other ongoing threats to the species including bycatch mortality from commercial fisheries, other federal actions (i.e., anticipated take issued in other Opinions), and/or and the potential effects of climate change—is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the leatherback sea turtle in the wild, as the number of potential leatherback removals due to the proposed actions is very small.

9.5 Shortnose Sturgeon

The NEFSC proposes to conduct or fund several studies within nearshore/estuarine areas of the action area such as the Penobscot and Hudson River estuaries using non-selective gear types (trawls and potentially seines and fyke nets). We have determined that over the five-year period from 2021-2026, the proposed fisheries and ecosystem research activities are likely to result in the capture of 10 shortnose sturgeon in trawl, seine, and fyke net gear, with up to one gear interaction resulting in mortality, and an additional one shortnose sturgeon is expected to be handled and sampled by the NEFSC observer programs from now through 2026. Some level of minor harassment (e.g., startling, handling stress) or injury (e.g., scrapes, cuts, or abrasions to the scutes or skin) due to capture or release from the sampling gear or observer program handling/sampling may occur, but none would not rise to the level where it would cause a reduction in the species' numbers, reproduction, or distribution. Affected shortnose sturgeon are likely to be from the Penobscot, Kennebec, Androscoggin, Merrimack, Connecticut, Hudson, Delaware, and Chesapeake Bay river spawning populations.

Historically, shortnose sturgeon are thought to have inhabited nearly all major rivers and estuaries along nearly the entire east coast of North America. Today, only 19 populations remain. The present range of shortnose sturgeon is disjunct, with northern populations separated from southern populations by a distance of about 400 kilometers. Population sizes range from under 100 adults in the Cape Fear and Merrimack Rivers to tens of thousands in the St. John and Hudson Rivers.

Based on the number of adults in the population for which estimates are available, there are at least 104,662 adult shortnose sturgeon, including 18,000 in the Saint John River in Canada. Based on the best available information (SSSRT 2010), trends in abundance for shortnose sturgeon in Northeast rivers demonstrate the majority of populations are stable (*i.e.*, Delaware, Hudson, Connecticut, Merrimack). The Kennebec River Complex is the only population in the Northeast that shows an increasing trend in abundance. In the Southeast abundance trends for many riverine populations are unknown due to lack of data (*i.e.*, Chowan, Tar Pamlico, Neuse, New, North, Santee, S-C Reservoir system, Satilla, St. Mary's, and St. John's). The Winyah Bay Complex, Cooper, Savannah, Ogeechee, and Altamaha Rivers show stable trends in abundance. The only riverine population in the Southeast demonstrating increasing trends in abundance is the Ashepoo-Combahee-Edisto (ACE) Basin.

The potential for adverse effects to shortnose sturgeon are possible when fish encounter or are trapped by the sampling gear. These effects could range from altering normal behavior such as a temporary startle or avoidance of the sampling area or result in minor physiological stress and minor physical injury from abrasion associated with physically interacting with the trap, main lead or wings. Non-lethal behavioral responses are expected to be temporary and spatially limited to the area and time fish interact with or are restricted by sampling gear. Capture in sampling gear is anticipated to increase physiological effects associated with handling stress and result in minor injuries that for the majority will not impair the fitness of any individuals or affect survival, however a small percentage could suffer lethal injuries or death. We have determined that any behavioral responses from fish passively interacting with the sampling gear, including in the worst case, an increase in physiological stress associated with physically interacting with the leads, would have insignificant and discountable effects to individuals. We have further determined the behavior and physiological responses as a result of sturgeon becoming captured; would increase physiological stress (i.e., associated with physically removing the animal from the trap) and cause physical injury, which could result in mortality. Therefore, the survival of up to one individual shortnose sturgeon will be affected by the proposed actions during the five-year span of the Opinion. As such, there will be a slight reduction in the numbers of shortnose sturgeon, yet no change in the status of the species or its trend.

Shortnose sturgeon captured in trawl, beach seine, or fyke net gear will experience a disruption in normal behavior for up to 30 minutes and may experience physical injury that may lead to death. As outlined above, no more than ten shortnose sturgeon are likely to become captured in these types of net gear over the course of five years. While precautions will be taken to minimize handling stress, physical injuries due to being captured by net gear could result in lethal injury or mortality. Data from commercial trawling indicates a low mortality rate of shortnose sturgeon incidentally caught in otter trawl gear. Interactions between shortnose sturgeon and beach seines are anticipated to be very brief in duration (<20 minutes) and limited to the immediate area of the net set. Because shortnose sturgeon could become captured in this gear, protocols will be in place to expedite release and reduce stress from handling. Adverse effects may also result from interactions with the fyke nets. Specifically, shortnose sturgeon encountering the fyke nets may become trapped within the fyke net until the net is tended and the catch is processed and released. This will result in the disruption of normal behaviors for a maximum of 24 hours. While fyke net sampling is generally considered to be non-lethal, there is the potential for sturgeon to become trapped or entangled in the gear or otherwise suffer lethal injury or mortality. However, the mortality rate is expected to be very low (around 1-2%).

While the proposed fisheries and ecosystem research activities may result in the mortality of one shortnose sturgeon, this number represents a very small percentage of shortnose sturgeon in the action area, and an even smaller percentage of the total population range-wide. While the death of one adult shortnose sturgeon will reduce the number of shortnose sturgeon in the action area compared to the number that would have been present absent the proposed actions, it is not likely that this reduction in numbers will change the status of this population as this loss represents an extremely small percentage of fish residing in the action area.

The proposed actions are expected to cause an undetectable reduction in reproduction of shortnose sturgeon for the following reasons: (1) the proposed research projects are not likely to intercept any pre-spawning shortnose sturgeon; thus, there will be no delay in migration to the spawning grounds; (2) at worst, the actions will result in the mortality of one adult shortnose sturgeon, as there are many thousands of available spawners in the action area rivers, the reduction in available spawners by no more than one is expected to result in an undetectable reduction in the number of eggs laid or larvae produced and similarly, an undetectable effect on the strength of subsequent year classes. Additionally, the proposed actions will not affect spawning habitats in any way and will not create any barrier to pre-spawning sturgeon accessing their spawning grounds. The proposed actions are not likely to reduce distribution because the action will not impede shortnose sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds. Further, the action is not expected to reduce the river by river distribution of shortnose sturgeon or the ability of shortnose sturgeon to migrate between coastal rivers. Additionally as the number of shortnose sturgeon likely to be killed as a result of the proposed actions is extremely small, there is not likely to be a loss of any unique genetic haplotypes and therefore, it is unlikely to result in the loss of genetic diversity. While generally speaking, the loss of one individual from a subpopulation or species may have an appreciable effect on the numbers, reproduction, and distribution of the species, this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range, or the species has extremely low levels of genetic diversity. This situation is not likely in the case of shortnose sturgeon because: (1) the species is widely geographically distributed; (2) it is not known to have low levels of genetic diversity (see *Status of the Species* section above); and (3) there are thousands of shortnose sturgeon spawning each year.

Based on the information provided above, the death of no more than one shortnose sturgeon as a result of the proposed actions will not appreciably reduce the likelihood of survival (i.e., it will not increase the risk of extinction faced by this species) for this species given that: (1) the death of one shortnose sturgeon represents an extremely small percentage of the number of shortnose sturgeon in the action area and even a smaller percentage of the species as a whole (less than 0.001%); (2) the loss of one shortnose sturgeon will not change the status or trends of the species as a whole; (3) the loss of one shortnose sturgeon is likely to have an undetectable effect on reproductive output of the species as a whole; (4) and, the action will have no effect on the distribution of shortnose sturgeon in the action area or throughout its range.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that shortnose sturgeon will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Section 4(a)(l) of the ESA requires listing of a species if it is in danger of extinction throughout all or a significant portion of its range (i.e., "endangered"), or likely to become in danger of extinction throughout all or a significant portion of its range in the foreseeable future (i.e., "threatened") because of any of the following five ESA listing factors: (1) the present or threatened destruction, modification, or curtailment of its habitat or range, (2) overutilization for commercial, recreational, scientific, or educational purposes, (3) disease or predation, (4) the inadequacy of existing regulatory mechanisms, and (5) other natural or manmade factors affecting its continued existence.

The proposed actions are not expected to modify, curtail, or destroy the range of the species since it will result in only a slight reduction in the number of shortnose sturgeon and since it will not affect the overall distribution of shortnose sturgeon other than to cause minor temporary adjustments in movements within the action area. The proposed actions will not utilize shortnose sturgeon for recreational or commercial purposes or affect the adequacy of existing regulatory mechanisms to protect this species. The proposed actions are likely to result in up to one mortality, a slight reduction in future reproductive output; therefore, the proposed actions are not expected to affect the persistence of shortnose sturgeon range-wide. There will be no change in the status or trend of shortnose sturgeon. As there will be only a slight reduction in numbers or future reproduction, the actions would not cause any reduction in the likelihood of improvement in the status of shortnose sturgeon. The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction since the actions will not cause any significant reduction of overall reproductive fitness for the species. The effects of the proposed actions will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed actions will not appreciably reduce the likelihood that shortnose sturgeon can be brought to the point at which they are no longer listed as endangered. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of this species.

9.6 Atlantic Sturgeon

As explained above, the proposed NEFSC fisheries and ecosystem research activities are likely to result in the incidental capture of up to 595 Atlantic sturgeon in NEFSC research gears over the five-year period of 2021-2026, of which up to 30 are anticipated to be lethal. In addition, up to 1,240 Atlantic sturgeon are anticipated to be handled and sampled by the NEFSC observer programs from now through 2026 (none of which are anticipated to be lethal interactions or result in serious injuries). Based upon the location of the proposed actions and action area, we expect that all of the Atlantic sturgeon incidentally taken will be adult or sub-adult life stages. No captures of eggs, larvae (yolk sac or post-yolk sac), young of the year, or juveniles are anticipated. All other effects to Atlantic sturgeon, including effects from vessel strikes and active acoustic sources as well as effects to habitat and prey due to fisheries and ecosystem research activities, will be insignificant and discountable.

9.6.1 Determination of DPS Composition

Using mixed stock analysis explained above (Kazyak et al. 2020a, 2021), we have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: New York Bight 71.4%; Chesapeake Bay 10.7%; Gulf of Maine 8.7%; South Atlantic 5.6%; Carolina 2.6%; and non-listed Canada 1.0%. As a result of the proposed fisheries and ecosystem research activities, and given the above percentages, it is most likely that of the 595 total Atlantic sturgeon interactions over the five-year period from 2021-2026, 425 would be fish that originate from the NYB DPS, 64 would be fish originating from the CB DPS, 52 would be fish originating from the GOM DPS, 33 would be fish originating from the SA DPS, 15 would be a fish originating from the Carolina DPS, and six would be fish of Canadian origin (non-listed). For the 1,240 observer program handling and sampling takes from now through 2026, we anticipate that 885 would be fish from the NYB DPS, 133 from the CB DPS, 108 from the GOM DPS, 70 from the SA DPS, 32 from the Carolina DPS, and 12 of Canadian origin.

9.6.2 Gulf of Maine DPS

The GOM DPS is listed as threatened, and while Atlantic sturgeon occur in several rivers of the Gulf of Maine region, recent spawning has only been physically documented in the Kennebec River. However, spawning is suspected to occur in the Androscoggin, Piscataqua, and Merrimack Rivers, although not confirmed. Currently we do not have an estimate of the number of Atlantic sturgeon in any river nor is any currently available for the entire DPS; however, NEAMAP data indicates that the estimated ocean population of Gulf of Maine DPS Atlantic sturgeon subadults and adults is 7,455 individuals. Gulf of Maine origin Atlantic sturgeon are subject to numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage or for the DPS as a whole. The ASMFC stock assessment concluded that the abundance of the Gulf of Maine DPS is “depleted” relative to historical levels. The Commission also noted that the Gulf of Maine is particularly data poor among all five DPSs. The assessment concluded that there is a 51% probability that the abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium. The Commission also concluded that there is a relatively high likelihood (74% probability) that mortality for the Gulf of Maine DPS exceeds the mortality threshold used for the assessment ASMFC (2017). However, the Commission noted that there was considerable uncertainty related to these numbers, particularly concerning trends data for the Gulf of Maine DPS. For example, the stock assessment notes that it was not clear if: (1) the percent probability for the trend in abundance for the Gulf of Maine DPS is a reflection of the actual trend in abundance or of the underlying data quality for the DPS; and, (2) the percent probability that the Gulf of Maine DPS exceeds the mortality threshold actually reflects lower survival or was due to increased tagging model uncertainty owing to low sample sizes and potential emigration.

We have estimated that the NEFSC research activities will result in the capture of up to 595 Atlantic sturgeon over the five-year period from 2021-2026, of which up to 52 are expected to be GOM DPS Atlantic sturgeon. We anticipate the serious injury or mortality of only three of the 52 captured individuals from the GOM DPS over the five-year period (or an average of 0.6 fish per year). None of the 108 GOM DPS Atlantic sturgeon anticipated to be handled and sampled by the NEFSC observer programs from now through 2026 are expected to be seriously injured or die; only short-term stress is likely.

With the exception of the three GOM DPS Atlantic sturgeon anticipated to be seriously injured or die in NEFSC bottom trawl or gillnet surveys, all sturgeon captured are anticipated to fully recover from capture without any long-term injury or impact on fitness or future reproductive potential. The short duration of any capture and handling (i.e., less than 45 minutes total, 20-30 minutes per tow or gillnet set plus up to 10-15 minutes of handling time) will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, given the predominantly offshore locations of the NEFSC fisheries and ecosystem research activities, we do not anticipate the capture, handling, or sampling of any spawning individuals. The proposed actions will also not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing foraging or overwintering sites or the spawning grounds. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Here, we consider the effect of the loss of up to three Atlantic sturgeon over the five-year period from the GOM DPS. The reproductive potential of the GOM DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of up to three individuals over the five-year period would have the effect of reducing the amount of potential reproduction as any dead GOM DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed actions, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. As noted above, reproductive potential of Atlantic sturgeon captured and not killed is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior of captured fish will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed actions will also not affect the spawning grounds within the rivers where GOM DPS fish spawn. Additionally, the action will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by Gulf of Maine DPS fish for the same reasons.

Because we do not have a population estimate for the GOM DPS, it is difficult to evaluate the effect of the mortality caused by these actions on the species. However, because the proposed actions will result in the loss of no more than three individuals over the five-year period, or an average of 0.6 mortalities each year, it is unlikely that these deaths will have a detectable effect on the numbers and population trend of the GOM DPS.

The proposed actions are not likely to reduce distribution because the actions will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by GOM DPS sub-adults or adults. Further, the actions are not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of or displacement from the area where effects of the action occur.

Based on the information provided above, the death of up to three GOM DPS Atlantic sturgeon over the five-year period will not appreciably reduce the likelihood of survival of the GOM DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The proposed actions will not affect GOM DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and they will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because the loss of up to three individuals over five years will not change the status or trends of the species as a whole, is not likely to have an effect on the levels of genetic heterogeneity in the population, and is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species. In addition, the proposed actions will have only a minor and temporary effect on the distribution of GOM DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range, and will have no effect on the ability of GOM DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging GOM DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that the GOM DPS will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that the GOM DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the GOM DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Next, we consider whether the proposed actions will affect the population size and/or trend in a way that would affect the likelihood of recovery.

We do not expect the proposed actions to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of GOM DPS Atlantic sturgeon and since it will not affect the overall distribution of GOM DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed actions will result in an extremely small amount of mortality (three individuals over five years) and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the actions to affect the persistence of the GOM DPS of Atlantic sturgeon. These actions will not change the status or trend of the GOM DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed actions will not reduce the likelihood of improvement in the status of the GOM DPS of Atlantic sturgeon. The effects of the proposed actions will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed actions will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed actions will not appreciably reduce the likelihood that the GOM DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual GOM DPS Atlantic sturgeon inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of up to three GOM DPS Atlantic sturgeon over the five-year period of 2021-2026, are not likely to appreciably reduce the survival and recovery of this species.

9.6.3 New York Bight DPS

The NYB DPS is listed as endangered and includes the following: all anadromous Atlantic sturgeon spawned in the watersheds that drain into coastal waters (including bays and sounds) from Chatham, Massachusetts to the Delaware-Maryland border on Fenwick Island. Our recent status review concluded that the status of the DPS has likely neither improved nor declined from what it was when we listed the DPS in 2012, that the DPS's demographic risk is "High," and that no changes to the listing status and listing recovery priority number are needed (NMFS 2022b). As noted in the 5-year review and discussed in section 4.2.3.2, low productivity (e.g., relatively few adults compared to historical levels and irregular spawning success), low abundance (e.g., only a few known spawning populations and low DPS abundance, overall), and limited spatial distribution (e.g., limited spawning habitat within each of the few known rivers that support spawning) puts the NYB DPS at risk of extinction. There is also new information indicating genetic bottlenecks as well as low levels of inbreeding in the Hudson and Delaware spawning populations.

Within the NYB DPS range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Housatonic Rivers (Murawski and Pacheco 1977; Secor et al. 2002; ASSRT 2007). While Atlantic sturgeon occur in several rivers in the New York Bight, recent spawning has only been physically documented in the Hudson and Delaware Rivers. The essential physical features necessary to support spawning and recruitment are present in all the NYB DPS rivers (82 FR 39160; August 17, 2017). However, currently, there is no evidence that spawning is occurring nor are there studies underway to investigate spawning occurrence in the Connecticut and Housatonic Rivers; except one recent study where young-of-the-year fish were captured in the Connecticut River (Savoy et al. 2017). Genetic analysis suggests that the young-of-the-year fish belonged to the SA DPS and at this time we do not know if these fish were the result of a single spawning event due to unique straying of the adults from the SA DPS's spawning rivers.

There are no abundance estimates for the entirety of the NYB DPS nor for either the Hudson or Delaware River populations. There are, however, some abundance estimates for specific life stages (e.g., natal juvenile abundance, spawning run abundance, and effective population size). As noted in the *Status of the Species* (section 4.2.3.2), abundance in both the Hudson and Delaware Rivers is believed to be a fraction of historic levels (also see Secor (2002) and Kahnle et al. (2007)). Although we do not have data to estimate the current adult population of Delaware River Atlantic sturgeon, we do have information that spawner runs consist of between 125 to 250 spawners (section 4.2.3.2). An estimated 3,656 age-1 individuals used the Delaware Estuary as a nursery in 2014 (since oceanward migration begins at age two or older, these juveniles would be of Delaware River origin). An estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson River riverine population based on fishery-dependent data collected from 1985-1995 (Kahnle et al. 2007). In a more recent study, Kazyak et al. (2020b) estimated the 2014 Hudson River spawning run size to be 466 sturgeon (95% CRI = 310-745). In our analysis below, we use a Delaware River spawner abundance of between 125 and 250 adults and a Hudson River spawner abundance of between 400 and 500 adults.

Based on genetic analyses of two different life stages, subadults and natal juveniles, effective population size for the Hudson River spawning population has been estimated to be 198 (95% CI=171.7-230.7; O'Leary et al. 2014) and 156 (95% CI=138.3-176.1) (Waldman et al. 2019), while estimates for the Delaware River spawning population from the same studies were 108.7 (95% CI=74.7-186.1) (O'Leary et al. 2014) and 40 (95% CI=34.7-46.2) (Waldman et al. 2019). The difference in effective population size for the Hudson and Delaware River spawning populations across both studies support that the Hudson River spawning population is the more robust of the two spawning groups. This conclusion is further supported by genetic analyses that demonstrated Atlantic sturgeon originating from the Hudson River spawning population were more prevalent in mixed aggregations than sturgeon originating from the Delaware River spawning population, even when sampling occurred in areas and at times that targeted for adults belonging to the Delaware River spawning population (Wirgin et al. 2015a, 2015b). The Waldman et al. (2019) calculations of maximum effective population size, and comparison of these to four other spawning populations outside of the NYB DPS further supports our previous conclusion that the Hudson River spawning population is more robust than the Delaware River spawning population and is likely the most robust of all of the U.S. Atlantic sturgeon spawning populations.

Given the sizes of the two NYB DPS populations and the fact that the Delaware River population is thought to be considerably smaller than the Hudson River population (see discussion below), the worst case scenario is that all NYB fish that will be killed will be Delaware River fish; however, that is extremely unlikely. We have reviewed several mixed stock analyses available to us that included river distribution information within the DPS determinations. These studies support the notion that the Hudson River spawning population is the more robust of the two spawning groups. This conclusion is further supported by genetic analyses that demonstrates Atlantic sturgeon originating from the Hudson River spawning population were more prevalent in mixed aggregations than sturgeon originating from the Delaware River spawning population, even when sampling occurred in areas and at times that targeted adults belonging to the Delaware River spawning population (Wirgin and King 2011; Wirgin et al. 2015a; Kazyak et al. 2021; Busch 2022). Wirgin et al. (2015a), which sampled migrating Atlantic sturgeon from an area 3 to 12 kilometers from the Delaware coast, found that 10.6% of all the fish sampled were from the Delaware River and 44% were from the Hudson River. Kazyak et al. (2021) found that 37.5% of individuals sampled from the Mid-Atlantic region (Cape Hatteras to Cape Cod) were assigned to populations in the NYB DPS. For the total sample, 11.4% were Delaware River fish and the remaining 26.2% were Hudson River fish. We note that the percentage of Delaware River fish may be high because it includes juveniles (defined as <500 millimeters total length) from the Delaware River. A recent 2022 master's thesis conducted a mixed stock analysis of tissue samples collected from adult and subadult Atlantic sturgeon caught in the Delaware River estuary, Delaware Bay, and in coastal waters off Delaware (Busch 2022). The study found that 8.3% of all fish samples were Delaware River fish and 41.8% were Hudson River fish. Given these results, the proportion of Delaware and Hudson River Atlantic sturgeon as shown in Table 29 supports the conclusion that the Hudson River population is more robust than the Delaware River population.

Table 29. Proportion of Delaware and Hudson River Atlantic sturgeon.

Study	Sample Source	Sample Area	DER	HUR	TOTAL	DER%	HUR%
Wirgin et al. (2015a)	NOAA's Northeast Fisheries Observer Program	GOM to Cape Hatteras	8.7	42.2	50.9	17.1	83
Wirgin et al. (2015b)	Fishery-independent sampling targeted for migratory Atlantic Sturgeon	3 to 12 km from the coast in the vicinity of Bethany Beach, Delaware	13.8	38.3	52.1	26.5	73.5
Kazyak et al. (2021)	Selection by the NMFS	**Mid Region:** Cape Hatteras to Cape Cod including catches from river and estuaries	11.4	26.2	37.6	30.3	69.7

Study	Sample Source	Sample Area	DER	HUR	TOTAL	DER%	HUR%
Busch (2022)	Samples provided by Dr. Dewayne Fox through Delaware State University	Delaware River and Bay (2005-2009), marine waters of coastal Delaware (2009-2017), entrance to the Delaware Bay (2019-2020)	8.3	41.8	50.1	16.6	83.4

The differences in estimated population size for the Hudson and Delaware River spawning populations and in the effective population size estimates of particular life stages further support the notion that the Hudson River spawning population is the more robust of the two spawning groups. This is also supported by the fact that Atlantic sturgeon originating from the Hudson River spawning population are more prevalent in mixed aggregations than sturgeon originating from the Delaware River spawning population as noted above. Still, while the size of the Delaware and Hudson River populations cannot be determined with reasonable certainty, all available information indicates that both populations are below the long-term minimum viable population size. However, Grunwald et al. (2008) concluded that available information suggests that the straying rate is moderate (1.7 and 5.4 migrants/generation) between these rivers and even a straying rate of one per generation (given it includes successful reproduction) can mitigate genetic risks from genetic drift and inbreeding. Thus, the moderate exchange between the two rivers may mitigate some of the genetic risks associated with small populations (Mills and Allendorf 1996). However, this does not take into account other risks to small populations such as demographic stochasticity and catastrophic events.

For this Opinion, we have estimated adult and sub-adult abundance of the NYB DPS based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters (Damon-Randall et al. 2013; Kocik et al. 2013). We concluded that sub-adult and adult abundance of the NYB DPS was 34,566 sturgeon based upon the NEAMAP data. This number encompasses many age classes since sub-adults can be as young as two years old when they first enter the marine environment, and adults can live as long as ~60 years (Hilton et al. 2016). For example, a study of Atlantic sturgeon captured in the geographic NYB determined that 742 of the Atlantic sturgeon captured represented 21 estimated age classes and that, individually, the sturgeon ranged in age from 2 to 35 years old (Dunton et al, 2016). The 2017 ASMFC stock assessment determined that abundance of the NYB DPS is “depleted” relative to historical levels (ASMFC 2017). However, the assessment also determined there is a relatively high probability (75%) that the NYB DPS abundance has increased since the implementation of the 1998 fishing moratorium, and a 31% probability that mortality for the

NYB DPS exceeds the mortality threshold used for the assessment (ASMFC 2017). Yet new information from the latest 5-year review suggests that these conclusions primarily reflect the status and trend of only the Hudson River spawning population (NMFS 2022b). The recent 5-year review indicates that the NYB DPS has likely neither improved nor declined from what it was when we listed the DPS in 2012, that the DPS's demographic risk is "High," and that no changes to the listing status and listing recovery priority number are needed.

NYB DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. The largest single source of mortality appears to be capture as bycatch in commercial fisheries operating in the marine environment. Because early life stages and juveniles do not leave the river, they are not impacted by fisheries occurring in federal waters. Bycatch and mortality also occur in state fisheries; however, the primary fishery that impacted juvenile sturgeon (shad), has now been closed and there is no indication that it will reopen soon. NYB DPS Atlantic sturgeon are killed as a result of anthropogenic activities in the Hudson, Delaware, and other rivers; sources of potential mortality include vessel strikes and entrainment in dredges.

We have estimated that the NEFSC research activities will result in the capture of up to 595 Atlantic sturgeon over the five-year period from 2021-2026, of which up to 425 are expected to be NYB DPS Atlantic sturgeon. We anticipate the serious injury or mortality of 21 individuals from the NYB DPS over the five-year period (or an average of 4.25 fish per year). None of the 885 NYB DPS Atlantic sturgeon anticipated to be handled and sampled by the NEFSC observer programs from now through 2026 are expected to be seriously injured or die; only short-term stress is likely. Of the NYB DPS Atlantic sturgeon likely to be incidentally taken and potentially seriously injured or killed, the studies provided in Table 29 (Wirgin et al. 2015a, 2015b; Kazyak et al. 2021; Busch 2022) indicate that it is more likely that they will be fish from the more robust Hudson River population rather than the Delaware River.

With the exception of the 21 NYB DPS Atlantic sturgeon anticipated to be seriously injured or killed in NEFSC research gear, all Atlantic sturgeon captured are anticipated to fully recover without any long-term injury or impact on fitness or future reproductive potential. The short duration of any capture and handling (i.e., less than 45 minutes total, 20-30 minutes per tow or gillnet set plus up to 10-15 minutes of handling time) will not cause a delay or disruption of any essential behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, given the predominantly offshore locations of the NEFSC fisheries and ecosystem research activities, we do not anticipate the capture, handling, or sampling of any spawning individuals. The proposed actions will also not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing foraging or overwintering sites or the spawning grounds. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Here, we consider the effect of the loss of up to 21 Atlantic sturgeon over the five-year period (approximately four per year) from the NYB DPS. The reproductive potential of the NYB DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of a total of up to 21 individuals over the five-year period, would have the effect of reducing the amount of potential reproduction as any dead NYB DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. As noted above, reproductive potential of Atlantic sturgeon captured and not killed is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior of captured fish will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed actions will also not affect the spawning grounds within the rivers where NYB DPS fish spawn. The actions will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by NYB DPS fish.

Because we do not have a population estimate for the NYB DPS, it is difficult to evaluate the effect of the serious injuries and mortalities caused by these actions on the species. However, because the proposed actions will result in the loss of no more than 21 individuals over the five-year period, or an average of 4.25 per year, it is unlikely that these deaths will have a detectable effect on the numbers and population trend of the NYB DPS.

Based on the information provided above, the death of up to 21 NYB DPS Atlantic sturgeon over the five-year period will not appreciably reduce the likelihood of survival of the NYB DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The proposed actions will not affect NYB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and they will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because the loss of up to 21 individuals over five years, or 4.25 fish annually, represents an extremely small percentage of the species as a whole (21 of 34,566 [0.06%] of estimated adults and sub-adults in Northwest Atlantic Ocean waters alone), will not change the status or trends of the species as a whole, is not likely to have an effect on the levels of genetic heterogeneity in the population, and is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species. In addition, the proposed actions will have only a minor and temporary effect on the distribution of NYB DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range, and will have no effect on the ability of NYB DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging NYB DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that the NYB DPS will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that the NYB DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the NYB DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Next, we consider whether these proposed actions will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed actions are not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of NYB DPS Atlantic sturgeon and since it will not affect the overall distribution of NYB DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed actions will result in a small amount of mortality (no more than 21 individual over five years) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the NYB DPS of Atlantic sturgeon. These actions will not change the status or trend of the NYB DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed actions will not reduce the likelihood of improvement in the status of the NYB DPS of Atlantic sturgeon. The effects of the proposed actions will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed actions will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed actions will not appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual NYB DPS Atlantic sturgeon inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of the cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of up to 21 NYB DPS Atlantic sturgeon over the five-year period of 2021-2026, is not likely to appreciably reduce the survival and recovery of this species.

9.6.4 Chesapeake Bay DPS

The CB DPS is listed as endangered and Atlantic sturgeon occur in and may potentially spawn in several rivers connected to the Chesapeake Bay. There is evidence of spawning in the James River (confirmed); Pamunkey River, a tributary of the York River; and Nanticoke River and its tributary Marshyhope Creek (section 4.2.3.3). In addition, detections of acoustically-tagged adult

Atlantic sturgeon in the Mattaponi and Rappahannock Rivers during the spawning window have occurred. Historical evidence for these rivers as well as the Potomac River supports the likelihood that Atlantic sturgeon spawning populations are present in the Mattaponi, Rappahannock, and Potomac Rivers (NMFS 2017).

Chesapeake Bay origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently no census nor enough information to establish a trend for any life stage, for the James River spawning population, or for the DPS as a whole, although the NEAMAP data indicates that the estimated ocean population of CB DPS Atlantic sturgeon is 8,811 sub-adult and adult individuals. The ASMFC (2017) stock assessment determined that abundance of the Chesapeake Bay DPS is "depleted" relative to historical levels. The assessment also determined there is a relatively low probability (36%) that abundance of the CB DPS has increased since the implementation of the 1998 fishing moratorium, and a 30% probability that mortality for the CB DPS exceeds the mortality threshold used for the assessment (ASMFC 2017).

We have estimated that the NEFSC research activities will result in the capture of up to 595 Atlantic sturgeon over the five-year period from 2021-2026, of which up to 64 are expected to be CB DPS Atlantic sturgeon. We anticipate the serious injury or mortality of only three individuals from the CB DPS over the five-year period (or an average of 0.6 fish per year). None of the 133 CB DPS Atlantic sturgeon anticipated to be handled and sampled by the NEFSC observer programs from now through 2026 are expected to be seriously injured or die; only short-term stress is likely.

With the exception of the three CB DPS Atlantic sturgeon anticipated to be seriously injured or die in NEFSC bottom trawl and gillnet surveys, all sturgeon are anticipated to fully recover from capture without any long-term injury or impact on fitness or future reproductive potential. The short duration of any capture and handling (i.e., less than 45 minutes total, 20-30 minutes per tow or gillnet set plus up to 10-15 minutes of handling time) will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, given the predominantly offshore locations of the NEFSC fisheries and ecosystem research activities, we do not anticipate the capture, handling, or sampling of any spawning individuals. The proposed actions will also not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing foraging or overwintering sites or the spawning grounds. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Here, we consider the effect of the loss of up to three Atlantic sturgeon over the five-year period from the CB DPS. The reproductive potential of the CB DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of a total of up to three individuals over the five-year period, would have the effect of reducing the amount of potential reproduction as any dead CB DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. As noted above, reproductive potential of Atlantic sturgeon captured and not killed is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior of captured fish will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed actions will also not affect the spawning grounds within the rivers where CB DPS fish spawn. The actions will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by CB DPS fish.

Because we do not have a population estimate for the CB DPS, it is difficult to evaluate the effect of the mortality caused by these actions on the species. However, because the proposed actions will result in the loss of no more than three individuals over the five-year period, or an average of 0.6 mortalities each year, it is unlikely that these deaths will have a detectable effect on the numbers and population trend of the CB DPS.

The proposed actions are not likely to reduce distribution because the actions will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by CB DPS sub-adults or adults. Further, the actions are not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the area where suspended sediment levels are high.

Based on the information provided above, the death of up to three CB DPS Atlantic sturgeon over the five-year period will not appreciably reduce the likelihood of survival of the CB DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The proposed actions will not affect CB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and they will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because the loss of up to three individuals over five years will not change the status or trends of the species as a whole, is not likely to have an effect on the levels of genetic heterogeneity in the population, and is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species. In addition, the proposed actions will have only a minor and temporary effect on the distribution of CB DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range, and will have no effect on the ability of CB DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging CB DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that the CB DPS will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that the CB DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the CB DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Next, we consider whether the proposed actions will affect the population size and/or trend in a way that would affect the likelihood of recovery.

We do not expect the proposed actions to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of CB DPS Atlantic sturgeon and since it will not affect the overall distribution of CB DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed actions will result in an extremely small amount of mortality over the next five years and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the actions to affect the persistence of the CB DPS of Atlantic sturgeon. These actions will not change the status or trend of the CB DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed actions will not reduce the likelihood of improvement in the status of the CB DPS of Atlantic sturgeon. The effects of the proposed actions will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed actions will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed actions will not appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual CB DPS Atlantic sturgeon inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of up to three CB DPS Atlantic sturgeon over the five-year period of 2021-2026, are not likely to appreciably reduce the survival and recovery of this species.

9.6.5 Carolina DPS

The Carolina DPS is listed as endangered and consists of Atlantic sturgeon originating from at least five rivers where spawning is still thought to occur. Carolina DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. Historical fishery landings data indicate between 7,000 and 10,500 adult female Atlantic sturgeon were present in North Carolina prior to 1890

(Armstrong and Hightower 2002; Secor 2002). Secor (2002) estimates that 8,000 adult females were present in South Carolina during that same time frame. At the time of listing, the abundance for each river population within the DPS was estimated to have fewer than 300 spawning adults; estimated to be less than 3% of what they were historically (ASSRT 2007). There is currently no census of the number of Atlantic sturgeon in any river nor is any currently available for the entire DPS, although the NEAMAP data indicates that the estimated ocean population of Carolina DPS Atlantic sturgeon, sub-adults and adults, is 1,356 individuals. The 2017 ASMFC stock assessment determined that abundance of the Carolina DPS is "depleted" relative to historical levels (ASMFC 2017). The assessment also determined there is a relatively high probability (67%) that abundance of the Carolina DPS has increased since the implementation of the 1998 fishing moratorium, and a 75% probability that mortality for the Carolina DPS exceeds the mortality threshold used for the assessment (ASMFC 2017).

We have estimated that the NEFSC research activities will result in the capture of up to 595 Atlantic sturgeon over the five-year period from 2021-2026, of which up to 15 are expected to be Carolina DPS Atlantic sturgeon. We anticipate the serious injury or mortality of only one of the 15 captured individuals from the Carolina DPS over the five-year period (or an average of 0.2 fish per year). None of the 32 Carolina DPS Atlantic sturgeon anticipated to be handled and sampled by the NEFSC observer programs from now through 2026 are expected to be seriously injured or die; only short-term stress is likely.

With the exception of the one Carolina DPS Atlantic sturgeon anticipated to be seriously injured or die in NEFSC bottom trawl and gillnet surveys, all sturgeon captured are anticipated to fully recover from capture without any long-term injury or impact on fitness or future reproductive potential. The short duration of any capture and handling (i.e., less than 45 minutes total, 20-30 minutes per tow or gillnet set plus up to 10-15 minutes of handling time) will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, given the predominantly offshore locations of the NEFSC fisheries and ecosystem research activities, we do not anticipate the capture, handling, or sampling of any spawning individuals. The proposed actions will also not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing foraging or overwintering sites or the spawning grounds. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Here, we consider the effect of the loss of up to one Atlantic sturgeon over the five-year period from the Carolina DPS. The reproductive potential of the Carolina DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of a total of up to one individual over the five-year period, would have the effect of reducing the amount of potential reproduction as any dead Carolina DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. As noted above, reproductive potential of

Atlantic sturgeon captured and not killed is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior of captured fish will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed actions will also not affect the spawning grounds within the rivers where Carolina DPS fish spawn. The actions will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by Carolina DPS fish.

Because we do not have a population estimate for the Carolina DPS, it is difficult to evaluate the effect of the mortality caused by these actions on the species. However, because the proposed actions will result in the loss of no more than one individual over the five-year period, or an average of 0.2 mortalities each year, it is unlikely that this death will have a detectable effect on the numbers and population trend of the Carolina DPS.

The proposed actions are not likely to reduce distribution because the actions will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by Carolina DPS sub-adults or adults. Further, the actions are not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the area where suspended sediment levels are high.

Based on the information provided above, the death of up to one Carolina DPS Atlantic sturgeon over the five-year period will not appreciably reduce the likelihood of survival of the Carolina DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The proposed actions will not affect Carolina DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and they will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because the loss of up to one individual over five years will not change the status or trends of the species as a whole, is not likely to have an effect on the levels of genetic heterogeneity in the population, and is likely to have such a small effect on reproductive output that the loss of that individual will not change the status or trends of the species. In addition, the proposed actions will have only a minor and temporary effect on the distribution of Carolina DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range, and will have no effect on the ability of Carolina DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging Carolina DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that the Carolina DPS will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that the Carolina DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the Carolina DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Next, we consider whether the proposed actions will affect the population size and/or trend in a way that would affect the likelihood of recovery.

We do not expect the proposed actions to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of Carolina DPS Atlantic sturgeon and since it will not affect the overall distribution of Carolina DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed actions will result in an extremely small amount of mortality over five years (one individual) and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the actions to affect the persistence of the Carolina DPS of Atlantic sturgeon. These actions will not change the status or trend of the Carolina DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed actions will not reduce the likelihood of improvement in the status of the Carolina DPS of Atlantic sturgeon. The effects of the proposed actions will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed actions will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed actions will not appreciably reduce the likelihood that the Carolina DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual Carolina DPS Atlantic sturgeon inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of up to one Carolina DPS Atlantic sturgeon over the five-year period of 2021-2026, are not likely to appreciably reduce the survival and recovery of this species.

9.6.6 South Atlantic DPS

The SA DPS is listed as endangered and consists of Atlantic sturgeon originating from at least six rivers where spawning potentially still occurs. Secor (2002) estimates that 8,000 adult females were present in South Carolina prior to 1890. Prior to the collapse of the fishery in the late 1800s, the sturgeon fishery was the third largest fishery in Georgia. Secor (2002) estimated from U.S. Fish Commission landing reports that approximately 11,000 spawning females were likely present in Georgia prior to 1890. At the time of listing, only six spawning subpopulations were thought to have existed in the SA DPS: Combahee River, Edisto River, Savannah River, Ogeechee River, Altamaha River (including the Oconee and Ocmulgee tributaries), and Satilla River. Three of the spawning subpopulations in the SA DPS are relatively robust and are considered the second (Altamaha River) and third (Combahee/Edisto River) largest spawning subpopulations across all five DPSs. Peterson et al. (2008) estimated the number of spawning adults in the Altamaha River was 324 (95% CI: 143-667) in 2004 and 386 (95% CI: 216-787) in 2005. Bahr and Peterson (2016) estimated the age-1 juvenile abundance in the Savannah River from 2013-2015 at 528 in 2013, 589 in 2014, and 597 in 2015. No census of the number of Atlantic sturgeon in any of the other spawning rivers or for the DPS as a whole is available. However, the NEAMAP data indicates that the estimated ocean population of SA DPS Atlantic sturgeon sub-adults and adults is 14,911 individuals.

The 2017 ASMFC stock assessment determined that abundance of the SA DPS is "depleted" relative to historical levels (ASMFC 2017). Due to a lack of suitable indices, the assessment was unable to determine the probability that the abundance of the SA DPS has increased since the implementation of the 1998 fishing moratorium. However, it was determined that there is a 40% probability that mortality for the SA DPS exceeds the mortality threshold used for the assessment (ASMFC 2017).

We have estimated that the NEFSC research activities will result in the capture of up to 595 Atlantic sturgeon over the five-year period from 2021-2026, of which up to 33 are expected to be SA DPS Atlantic sturgeon. We anticipate the serious injury or mortality of only two of the 33 captured individuals from the SA DPS over the five-year period (or an average of 0.4 fish per year). None of the 70 SA DPS Atlantic sturgeon anticipated to be handled and sampled by the NEFSC observer programs from now through 2026 are expected to be seriously injured or die; only short-term stress is likely.

With the exception of the two SA DPS Atlantic sturgeon anticipated to be seriously injured or die in NEFSC bottom trawl and gillnet surveys, all sturgeon captured are anticipated to fully recover from capture without any long-term injury or impact on fitness or future reproductive potential. The short duration of any capture and handling (i.e., less than 45 minutes total, 20-30 minutes per tow or gillnet set plus up to 10-15 minutes of handling time) will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, given the predominantly offshore locations of the NEFSC fisheries and ecosystem research activities, we do not anticipate the capture, handling, or sampling of any spawning individuals. The proposed actions will also not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing foraging or overwintering sites or the spawning grounds. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Here, we consider the effect of the loss of up to two Atlantic sturgeon over the five-year period from the SA DPS. The reproductive potential of the SA DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of a total of up to two individuals over the five-year period, would have the effect of reducing the amount of potential reproduction as any dead SA DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. As noted above, reproductive potential of Atlantic sturgeon captured and not killed is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior of captured fish will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed actions will also not affect the spawning grounds within the rivers where SA DPS fish spawn. The actions will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by SA DPS fish.

Because we do not have a population estimate for the SA DPS, it is difficult to evaluate the effect of the mortality caused by these actions on the species. However, because the proposed actions will result in the loss of no more than two individuals over the five-year period, or an average of 0.4 mortalities each year, it is unlikely that these deaths will have a detectable effect on the numbers and population trend of the SA DPS.

The proposed actions are not likely to reduce distribution because the actions will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by SA DPS sub-adults or adults. Further, the actions are not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the area where suspended sediment levels are high.

Based on the information provided above, the death of up to two SA DPS Atlantic sturgeon over the five-year period will not appreciably reduce the likelihood of survival of the SA DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The proposed actions will not affect SA DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and they will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because the loss of up to two individuals over five years will not change the status or trends of the species as a whole, is not likely to have an effect on the levels of genetic heterogeneity in the population, and is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species. In addition, the proposed actions will have only a minor and temporary effect on the distribution of SA DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range, and will have no effect on the ability of SA DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging SA DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that the SA DPS will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that the SA DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the SA DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Next, we consider whether the proposed actions will affect the population size and/or trend in a way that would affect the likelihood of recovery.

We do not expect the proposed actions to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of SA DPS Atlantic sturgeon and since it will not affect the overall distribution of SA DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed actions will result in an extremely small amount of mortality annually (one or two individuals) and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the actions to affect the persistence of the SA DPS of Atlantic sturgeon. These actions will not change the status or trend of the SA DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed actions will not reduce the likelihood of improvement in the status of the SA DPS of Atlantic sturgeon. The effects of the proposed actions will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed actions will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed actions will not appreciably reduce the likelihood that the SA DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual SA DPS Atlantic sturgeon inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of up to two SA DPS Atlantic sturgeon over the five-year period from 2021-2026, are not likely to appreciably reduce the survival and recovery of this species.

9.7 Gulf of Maine DPS of Atlantic Salmon

Albeit on rare occasions, Atlantic salmon have been observed to interact with gear used in the NEFSC's fisheries and ecosystem research in the past. An Atlantic salmon was most recently captured during the 2012 NEFSC spring bottom trawl surveys; upon capture it was released alive. Prior to that, two other Atlantic salmon were captured back in the late 1970s: one during the NEFSC fall bottom trawl surveys on the NOAA ship *Delaware II* in September 1977 and another during a foreign research bottom trawl winter survey in January 1978. In addition, from 1989-2020, there were four observed captures of Atlantic salmon in commercial bottom otter trawl gear and 11 observed captures in gillnet gear in the New England and Mid-Atlantic regions (NEFOP and ASM databases). For the rod and reel tagging project off Greenland, past data from fisheries sampling studies as well as expert opinion from NEFSC biologist Dr. Tim Sheehan (personal communication, May 21, 2021) indicate that it is reasonable to expect the capture of one GOM DPS fish for every 100 salmon captured per year.

Based on these records, we anticipate up to six Gulf of Maine DPS Atlantic salmon interactions will occur as a result of fisheries and ecosystem surveys in the Northwest Atlantic and the rod and reel tagging project off Greenland over the five-year period from 2021-2026, with up to two interactions anticipated to be lethal. We also anticipate that up to eight Gulf of Maine DPS Atlantic salmon will be handled and sampled by the NEFSC observer programs from now through 2026. Due to the sizes of the fish involved and the locations of these past captures, future interactions may be with either post-smolt or adult Atlantic salmon and all are anticipated to be with ESA-listed GOM DPS fish.

The marine phase and life stages of Atlantic salmon of U.S. origin are not as well understood as the freshwater ones. Atlantic salmon of U.S. origin are highly migratory, undertaking long marine migrations from their natal rivers to the Northwest Atlantic Ocean, where they are distributed seasonally over much of the region. The marine phase starts with the completion of smoltification and migration through the estuary of the natal river. Part of the migratory pattern of post-smolts and adults overlaps with the action area at times when the fisheries and ecosystem research are occurring. Atlantic salmon found in U.S. waters of the Northeast continental shelf could be from four primary sources: 1) Gulf of Maine DPS (endangered); 2) Long Island Sound or Central New England DPSs (non-listed); 3) trans-boundary Canadian populations (many southern Canadian stocks are classified as Endangered by Canada); or 4) escaped fish from U.S. or Canada aquaculture facilities. Therefore, only a subset of Atlantic salmon interacting with NEFSC research activities will be ESA-listed fish.

To determine if the proposed actions will jeopardize the GOM DPS of Atlantic salmon, we must conduct an analysis of the effects of the proposed actions on the likelihood of the species' survival and recovery. The 2019 recovery plan for Atlantic salmon (U.S. FWS and NMFS 2019) incorporates an approach termed Recovery Planning and Implementation, which focuses on the three statutory requirements in the ESA, including site-specific recovery actions; objective, measurable criteria for delisting; and time and cost estimates to achieve recovery and intermediate steps. The 2019 recovery plan projects four phases of recovery over a 75-year timeframe to achieve delisting of the GOM DPS of Atlantic salmon. The four phases are:

- Phase 1: The first recovery phase focuses on identifying the threats to the species and characterizing the habitat needs of the species necessary for their recovery.
- Phase 2: The second recovery phase focuses on ensuring the persistence (survival) of the GOM DPS through the use of the conservation hatcheries while abating imminent threats to the continued existence of the DPS. Phase 2 focuses on freshwater habitat used by Atlantic salmon for spawning, rearing, and upstream and downstream migration; it also emphasizes research on threats within the marine environment.
- Phase 3: The third phase of recovery will focus on increasing the abundance, distribution, and productivity of naturally reared Atlantic salmon. It will involve transitioning from dependence on the conservation hatcheries to wild smolt production.
- Phase 4: In Phase 4, the GOM DPS of Atlantic salmon is recovered and delisting occurs. The GOM DPS will be considered recovered once: a) 2,000 wild adults return to each Salmon Habitat Recovery Unit (SHRU), for a DPS-wide total of at least 6,000 wild adults; b) each SHRU has a population growth rate of greater than 1.0 in the 10-year period preceding delisting, and, at the time of delisting, the DPS demonstrates self-sustaining persistence; and c) sufficient suitable spawning and rearing habitat for the offspring of the 6,000 wild adults is accessible and distributed throughout the designated Atlantic salmon critical habitat, with at least 30,000 accessible and suitable HUs in each SHRU, located according to the known migratory patterns of returning wild adult salmon.

We are presently in Phase 2 of the recovery program (ensuring the survival of the GOM DPS through the use of the conservation hatcheries while abating imminent threats to the continued existence of the DPS). As indicated in the 2019 recovery plan for Atlantic salmon, the U.S. FWS and NMFS do not have plans to transition from dependence on conservation hatcheries to wild fish production in the foreseeable future. Therefore, for purposes of our survival analysis, we assume hatchery supplementation will continue in all three SHRUs over the course of the proposed actions. We also expect that as passage improves in certain Gulf of Maine rivers, it may become a higher priority for stocking. The hatchery program, sponsored by the U.S. FWS, has been in place for over 100 years and because we do not have any information to the contrary, we expect it will continue over the duration of the proposed actions. The importance of continuation of the hatchery program is recognized in the 2019 recovery plan and continuation of the hatchery and stocking efforts are an integral part of the recovery strategy.

As detailed in the 2019 recovery plan, in order for the listing status of Atlantic salmon to change, each of the three relevant biological criteria (abundance, productivity, and habitat) must be met in two (downlisting) or three (delisting) of the recovery units. The biological criteria for reclassifying (downlisting) the GOM DPS of Atlantic salmon from endangered status to threatened status are:

- ***Abundance:*** The DPS has total annual returns of at least 1,500 adults originating from wild origin, or hatchery stocked eggs, fry or parr spawning in the wild, with at least 2 of the 3 SHRUs having a minimum annual escapement of 500 naturally reared adults.
- ***Productivity:*** Among the SHRUs that have met or exceeded the abundance criterion, the population has a positive mean growth rate greater than 1.0 in the 10-year (two-generation) period preceding reclassification.

- ***Habitat:*** In each of the SHRUs where the abundance and productivity criterion have been met, there is a minimum of 7,500 units of accessible and suitable spawning and rearing habitats capable of supporting the offspring of 1,500 naturally reared adults.

The biological criteria for removing Atlantic salmon from the endangered species list are:

- ***Abundance*:** The DPS has a self-sustaining annual escapement of at least 2,000 wild origin adults in each SHRU, for a DPS-wide total of at least 6,000 wild adults.
- ***Productivity:*** Each SHRU has a positive mean population growth rate of greater than 1.0 in the 10-year (two-generation) period preceding delisting. In addition, at the time of delisting, the DPS demonstrates self-sustaining persistence, whereby the total wild population in each SHRU has less than a 50% probability of falling below 500 adult wild spawners in the next 15 years based on PVA projections.
- ***Habitat:*** Sufficient suitable spawning and rearing habitat for the offspring of the 6,000 wild adults is accessible and distributed throughout the designated Atlantic salmon critical habitat, with at least 30,000 accessible and suitable Habitat Units in each SHRU, located according to the known migratory patterns of returning wild.

In 2019, 1,528 pre-spawn salmon returned to the GOM DPS (includes wild, naturally-reared, and hatchery raised salmon). Of those, 15% returned to the Downeast Coastal SHRU, 79% returned to the Penobscot Bay SHRU, and 6% returned to the Merrymeeting Bay SHRU. The abundance of returning salmon was more than 20% higher than the 10-year average, and the proportion of the run that was naturally reared (24%) was higher than what has been seen on average over the last decade (16%) (Kircheis et al. 2020). Regardless, the abundance of wild and naturally reared returns remain well below what is needed for either reclassification or delisting (U.S. FWS and NMFS 2019). Based upon the 2019 return percentages summarized above, we expect that 79% of future mortalities from the proposed actions will be salmon from the Penobscot Bay SHRU while the other 21% of mortalities will be from the other two SHRUs. Over a five-year period, that would roughly equate to up to two mortalities of GOM DPS salmon from the larger Penobscot Bay SHRU and no more than one mortality from the smaller Downeast Coastal or Merrymeeting Bay SHRUs.

The mean 10-year population growth rate for the GOM DPS as a whole in 2019 was 1.12, making it the eighth consecutive year where that threshold rate has exceeded 1.0. However, the reclassification and delisting productivity criteria require that each SHRU sustain a population growth rate of more than 1.0, in addition to meeting the relevant abundance criteria. In 2019, the 1.0 threshold was exceeded at both the Merrymeeting Bay (1.84) and Penobscot Bay (1.08) SHRUs, but was not met at the Downeast Coastal SHRU (0.99) (U.S. FWS and NMFS 2019).

In 2019, a minimum of 31 connectivity projects were conducted that improved access to 108 stream miles of rivers in the GOM DPS. These projects do not necessarily lead to gains that can be counted towards the habitat recovery criteria, as many of them are upstream of barriers that have not yet been deemed accessible themselves. However, the most notable project in 2019, the breaching of the Head Tide Dam on the Sheepscot River, restored access to 2,363 habitat units in the Merrymeeting Bay SHRU, which have been added to the total accessible habitat units under the recovery criteria. It should be noted that the number of projects reported in the 2019 SHRU reports are likely an underestimate of the number of projects actually conducted. As of 2019, all three SHRUs have achieved the reclassification (downlisting) goal of at least 7,500 accessible habitat units. However, none of the SHRUs have yet to achieve the delisting goal of 30,000 accessible habitat units (U.S. FWS and NMFS 2019).

The jeopardy analysis below makes a conclusion regarding the survival and recovery of the GOM DPS of Atlantic salmon as a whole, and not just survival and recovery of the species in the action area. Therefore, in the survival and recovery portions of this analysis, we consider how the consequences to individual salmon that were identified in the *Effects of the Proposed Actions* section of this Opinion will affect the marine population of Atlantic salmon, how the consequences to the marine population will affect the Downeast Coastal, Penobscot Bay, and Merrymeeting Bay SHRUs, and then finally, how the consequences to the three SHRUs are likely to affect the survival and recovery of the GOM DPS as a whole. As highlighted in the 2019 recovery plan, the survival and recovery of all three SHRUs is necessary for attainment of the delisting criteria and recovery of the GOM DPS.

Survival Analysis

When considering how a proposed action is likely to affect the survival of a species, we consider effects to reproduction, numbers, and distribution. The number of returning adult Atlantic salmon to the Downeast Coastal, Penobscot Bay, and Merrymeeting Bay SHRUs is a measure of both the reproduction and numbers of the species. We consider the ability of pre-spawn Atlantic salmon to access high quality spawning and rearing habitat in the six major Downeast Rivers (i.e., Dennys, East Machias, Machias, Pleasant, Narraguagus, and Union), the Penobscot River, and the Kennebec and Androscoggin Rivers as a measure of distribution. Below, we analyze whether the proposed actions will reduce the numbers, reproduction, or distribution of the GOM DPS of Atlantic salmon in the action area and the three SHRUs to a point that appreciably reduces the species' likelihood of survival in the wild.

Two lethal interactions every five years would reduce the number of GOM DPS Atlantic salmon compared to their numbers in the absence of the proposed actions, assuming all other variables remained the same. Lethal interactions would also result in a potential reduction in future reproduction, assuming some individuals would be females and would have otherwise survived to reproduce. For example, an adult 2SW female Atlantic salmon can produce a total of 1,500 to 1,800 eggs per kilogram of body weight, yielding an average of 7,500 eggs (Baum and Meister 1971), of which a small percentage are expected to survive to sexual maturity. A lethal capture of an adult female GOM DPS Atlantic salmon in gillnet or bottom trawl gear would likely remove this level of reproductive output from the species. Over a five-year period, up to two adult females could be removed from the Penobscot Bay SHRU and up to one adult female from either the Downeast Coastal or Merrymeeting Bay SHRU. The anticipated lethal interactions could occur anywhere in the action area, but are most likely to occur in the Gulf of Maine or on Georges Bank. Whether the reductions in numbers and reproduction of this species would appreciably reduce its likelihood of survival depends on the probable effect the changes in numbers and reproduction would have relative to current population sizes and trends.

The most recent data available on the population trend of Atlantic salmon indicate that their abundance within the range of the GOM DPS has been generally declining since the 1800s (Fay et al. 2006). Contemporary estimates of abundance for the entire GOM DPS have rarely exceeded 5,000 individuals in any given year since 1967 (Fay et al. 2006), and appear to have stabilized at very low levels since 2000. After a period of slow population growth between the 1970s and the early 1980s, adult returns of salmon in the GOM DPS peaked around 1985 and declined through the 1990s and early 2000s. The population growth observed in the 1970s is likely attributable to favorable marine survival and increases in hatchery capacity, particularly from the Green Lake National Fish Hatchery that was constructed in 1974. Marine survival remained relatively high throughout the 1980s, and salmon populations in the GOM DPS remained relatively stable until the early 1990s. In the early 1990s, marine survival rates decreased, leading to the declining trend in adult abundance observed throughout 1990s and early 2000s. An increase in the abundance of returning adult salmon was observed between 2008 and 2011, but returns then dropped significantly after 2011. The last couple of years have been relatively good years for returns (higher than the 10-year average), but have not been close to what was observed in 2011.

Adult returns for the GOM DPS remain well below conservation spawning escapement (CSE) goals that are widely used (ICES 2005) to describe the status of individual Atlantic salmon populations. When CSE goals are met, Atlantic salmon populations are generally self-sustaining. When CSE goals are not met (i.e., less than 100%), populations are not reaching full potential; and this can be indicative of a population decline. For all GOM DPS rivers in Maine, current Atlantic salmon populations (including hatchery contributions) are well below CSE levels required to sustain themselves (Fay et al. 2006), which is further indication of their poor population status.

The observed declines in Atlantic salmon suggests that the combined impacts from ongoing activities described in the *Environmental Baseline*, *Cumulative Effects*, and the *Status of the Species* (including those activities that occur outside of the action area of this Opinion) are continuing to cause the population to deteriorate. However, we have determined that the proposed actions are not reasonably expected to cause, directly or indirectly, an appreciable reduction in the likelihood of survival of the GOM DPS Atlantic salmon. For the population to remain stable, Atlantic salmon must replace themselves through successful reproduction at least once over the course of their reproductive lives, and at least one offspring must survive to reproduce itself. If the survival rate to maturity is greater than the mortality rate of the population, the loss of breeding individuals would be exceeded through recruitment of new breeding individuals from successful reproduction of Atlantic salmon that were not seriously injured or did not die in the fisheries and ecosystem research. While the abundance trend information for Atlantic salmon is either stable or declining, we affirm that the very small numbers of lethal interactions attributed to the proposed actions will not have any measurable effect on that trend for three reasons. First, the loss of individual Atlantic salmon due to the proposed actions is not expected to impact the genetic heterogeneity of the three SHRUs or the species as a whole because the fisheries and ecosystem research activities are widespread throughout the Gulf of Maine and Georges Bank and not likely to disproportionately capture individuals from the smaller, more vulnerable Merrymeeting Bay and Downeast Coastal SHRUs compared to the larger Penobscot Bay SHRU. Second, although we assume that the Atlantic salmon captures could be of high reproductive value adult females from the GOM DPS, it is possible that they could also be from non-listed Canadian, Saco, Merrimack, or Connecticut River stocks or involve adult male or post-smolt life stages with less reproductive value. Finally, the already existing salmon hatchery programs throughout the range of the GOM DPS should be able to replace the small amount of individuals lost from the DPS due to the fisheries and ecosystem research over time (as long as they continue to operate, biological recovery criteria continue to be met, and freshwater and marine survival do not get significantly worse).

In summary, the proposed actions are anticipated to result in a small decrease in the numbers and reproduction of Atlantic salmon in the action area and the DPS as a whole, compared to current conditions. When compared to a future scenario without the proposed actions (i.e., no NEFSC fisheries and ecosystem research activities), the proposed actions would reduce the potential numbers and reproductive potential (through a reduction in numbers) of Atlantic salmon in the North Atlantic Ocean, but would have a negligible impact on the species' distribution. Based on the analysis provided above, the potential loss of two Atlantic salmon post-smolts or adults every five years will not reduce the likelihood of survival of the GOM DPS of Atlantic salmon.

The *Status of the Species* section and four-phased approach summarized above generally describe the actions needed for recovery of the GOM DPS. Improving the survival of Atlantic salmon in the marine environment is also an important part of meeting the objective of GOM DPS Atlantic salmon recovery (U.S. FWS and NMFS 2019). The average return estimate for all GOM DPS Atlantic salmon from 2010-2019 is 1,247 fish (Kircheis et al. 2020). The number of interactions (0.4) annually is less than 0.04% (=0.4/1,247*100) of the returning population. Given that we determined above that this small number of lethal interactions will not affect the population trends, there is no indication that bycatch in the fisheries and ecosystem research activities assessed here are considered a threat to Atlantic salmon recovery.

As mentioned in the survival analysis above, the proposed actions will not affect Atlantic salmon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment that would prevent Atlantic salmon from completing their entire life cycle, including reproduction, sustenance, and shelter.

Despite the threats faced by individual Atlantic salmon inside and outside of the action area, the proposed actions will not increase the vulnerability of individual Atlantic salmon to these threats, and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. While we are not able to predict with precision how climate change will impact GOM DPS Atlantic salmon in the action area or how the species will adapt to climate change-related environmental impacts, we do not expect the proposed actions to contribute to climate related effects in the action area. We have considered the effects of the proposed actions in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change. Therefore, we conclude that the capture and subsequent loss of two GOM DPS Atlantic salmon every five years as a result of the proposed actions will not reduce the likelihood of recovery the GOM DPS of Atlantic salmon. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of the species.

10.0 CONCLUSION

After reviewing the current status of the species, the environmental baseline and cumulative effects in the action area, and the effects of the NEFSC's fisheries and ecosystem research, it is our biological opinion that the proposed actions may adversely affect, but are not likely to jeopardize, the continued existence of NWA DPS loggerhead, leatherback, Kemp's ridley, and North Atlantic DPS green sea turtles; shortnose sturgeon; the GOM, NYB, CB, Carolina, and SA DPSs of Atlantic sturgeon; and the Gulf of Maine DPS of Atlantic salmon. It is also our biological opinion that the proposed actions are not likely to adversely affect North Atlantic right whales, fin whales, sei whales, blue whales, and sperm whales; hawksbill sea turtles; giant manta rays; oceanic white-tip sharks; and designated critical habitats for North Atlantic right whales, the NWA DPS loggerhead sea turtles, and the Gulf of Maine DPS of Atlantic salmon.

11.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species of fish and wildlife. "Fish and wildlife" is defined in the ESA "as any member of the animal kingdom, including without limitation any mammal, fish, bird (including any migratory, non-migratory, or endangered bird for which protection is also afforded by treaty or other international agreement), amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or parts thereof" (16 U.S.C. 1532(8)). "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. "Otherwise lawful activities" are those actions that meet all State and Federal legal requirements except for the prohibition against taking in ESA section 9 (51 FR 19936; June 3, 1986), which would include any state endangered species laws or regulations. Section 9(g) makes it unlawful for any person "to attempt to commit, solicit another to commit, or cause to be committed, any offense defined [in the ESA]." (16 U.S.C. 1538(g)). A "person" is defined in part as any entity subject to the jurisdiction of the U.S., including an individual, corporation, officer, employee, department, or instrument of the Federal government (see 16 U.S.C. 1532 (13)). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose of carrying out an otherwise lawful activity is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this ITS. In issuing ITSs, NMFS takes no position on whether an action is an "otherwise lawful activity."

The measures described below are non-discretionary, and must be undertaken by the NEFSC so that they become binding conditions for the exemption in section 7(o)(2) to apply. The NEFSC has a continuing duty to regulate the activities covered by this ITS. If the NEFSC (1) fails to assume and implement the terms and conditions or (2) fails to require survey vessels and personnel to adhere to the terms and conditions of the ITS through enforceable terms that are added to permits and/or contracts as appropriate, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the NEFSC must report on the progress of the proposed actions and their impact on ESA-listed species to NMFS GARFO PRD as specified in the ITS [50 CFR §402.14(i)(3)] (See U.S. FWS and NMFS's Joint Endangered Species Act Section 7 Consultation Handbook (1998) at 4-49).

11.1 Anticipated Amount or Extent of Incidental Take

Based on the information provided in this Opinion and by the NEFSC in their December 2020 BA, we anticipate that the fisheries and ecosystem research projects to be conducted and funded by the NEFSC from October 2021 to October 2026 will result in the incidental capture of:

- up to 85 NWA DPS loggerhead sea turtles (up to 10 lethal);
- up to 95 Kemp's ridley sea turtles (up to 15 lethal);
- up to 10 North Atlantic DPS green sea turtles (up to one lethal);
- up to 10 leatherback sea turtles (up to five lethal);
- up to 10 shortnose sturgeon (up to one lethal);
- up to 595 Atlantic sturgeon (up to 30 lethal)
    - up to 425 from the New York Bight DPS (up to 21 lethal),
    - up to 64 from the Chesapeake Bay DPS (up to three lethal),
    - up to 52 from the Gulf of Maine DPS (up to three lethal),
    - up to 33 from the South Atlantic DPS (up to two lethal),
    - up to 15 from the Carolina DPS (up to one lethal),
    - up to six Canadian origin (non-listed);
- up to six Gulf of Maine DPS Atlantic salmon (up to two lethal).

In addition, based on the information provided in this Opinion and by the NEFSC in their March 2023 supplemental BA, we estimate the number of animals to be handled and sampled by the NEFSC's observer programs from now through October 2026 to be as follows:

- up to 124 NWA DPS loggerhead sea turtles (none lethal);
- up to 40 Kemp's ridley sea turtles (none lethal);
- up to eight North Atlantic DPS green sea turtles (none lethal);
- up to eight leatherback sea turtles (none lethal);
- up to one shortnose sturgeon (none lethal);
- up to 1,240 Atlantic sturgeon (none lethal);
    - up to 885 from the New York Bight DPS,
    - up to 133 from the Chesapeake Bay DPS,
    - up to 108 from the Gulf of Maine DPS,
    - up to 70 from the South Atlantic DPS,
    - up to 32 from the Carolina DPS,
    - up to 12 Canadian origin (non-listed).
- up to eight Gulf of Maine DPS Atlantic salmon (none lethal).

Again, we have determined that this level of anticipated take is not likely to result in jeopardy to any species of sea turtle, shortnose sturgeon, or any DPS of Atlantic sturgeon or Atlantic salmon.

11.2 Reasonable and Prudent Measures

NMFS has determined that the following Reasonable and Prudent Measures (RPMs) and associated Terms and Conditions (T&Cs) are necessary and appropriate to minimize and monitor impacts of the incidental take on sea turtles, shortnose sturgeon, the five DPSs of Atlantic sturgeon, and the Gulf of Maine DPS of Atlantic salmon resulting from the proposed actions (Table 30). In order to be exempt from prohibitions of section 9 of the ESA and regulations issued pursuant to section 4(d), the NEFSC and its research partners must comply with the following T&Cs, which implement the RPMs. These T&Cs are non-discretionary. Any taking that is in compliance with the T&Cs specified in this ITS shall not be considered a prohibited taking of the species concerned (ESA section 7(o)(2)).

The RPMs, with their implementing T&Cs, are designed to minimize and monitor the impact of the incidental take resulting from the proposed actions. Specifically, these RPMs and T&Cs will keep us informed of when and where sea turtle, shortnose and Atlantic sturgeon, and Gulf of Maine DPS Atlantic salmon interactions are taking place as well as how NEFSC research and environmental conditions may affect the abundance, density, distribution, and interaction rate of those species. The third column below explains why each of these RPMs and T&Cs are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed actions and how they represent only a minor change to the proposed actions.

In order to effectively monitor the effects of the proposed actions, it is necessary to monitor the impacts of the actions to document the amount of incidental take (i.e., the number of sea turtles, sturgeon, and salmon captured, injured, or killed) and to assess any of these listed species that are captured during this monitoring. Monitoring provides information on the characteristics of sea turtles, shortnose and Atlantic sturgeon, and Gulf of Maine DPS Atlantic salmon encountered and provides data, which will help develop more effective measures to avoid future interactions with ESA-listed species. Aside from the potential injury and mortality to pre-adult Atlantic salmon during the West Greenland trolling and tagging studies (up to two over a five-year period), we do not anticipate any additional injury or mortality to be caused by handling, assessing, and ultimately releasing these species as required in the RPMs listed below.

Table 30. **RPMs, Terms and Conditions, and Justifications.**

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
1. PROTECTED SPECIES OBSERVER AND DISENTANGLEMENT TRAINING: NEFSC staff scientists, crew members, and research affiliates regularly participating in fisheries and ecosystem research, including the Spring and Fall NEFSC BTS, Spring and Fall NEAMAP, APEX Predators, COASTSPAN, ME-NH inshore trawl, and MA DMF bottom trawl, and NEFOP gear training surveys that may interact with ESA-listed species, must possess protected species observer training and sea turtle disentanglement training and have onboard all relevant training materials.	1. The NEFSC must ensure that all fisheries and ecosystem research projects with a history of sea turtle, sturgeon, or salmon interactions or when deploying fishing gear in areas and at times these species are present, have staff scientists, crew members, and research affiliates onboard that possess NEFOP observer training and certification. This training includes, among other things, protected species identification, handling, sampling, release, and reporting protocols. At least one staff scientist, crew member, or research affiliate (preferably, multiple staff on NOAA research platforms) must possess this training, and trained staff must respond to all ESA-listed species interactions. 2. The NEFSC must ensure that fisheries and ecosystem research staff that disentangle sea turtles possess adequate sea turtle disentanglement training and materials. Survey staff should contact the NMFS Greater Atlantic Region Sea Turtle Stranding and Disentanglement Coordinator (currently Kate Sampson; 978-282-8470) or GARFO PRD Sea Turtle Program (978-281-9328) for information on required disentanglement protocols and equipment. Staff possessing the specified training and materials are authorized through this Opinion to disentangle sea turtles captured during the proposed actions according to the Northeast Atlantic Coast STDN Disentanglement Guidelines. All disentanglement activities must be done in accordance with the procedures in "Careful Release Protocols for Sea Turtle Release with Minimal Injury" (SEFSC 2019; https://repository.library.noaa.gov/view/noaa/20283) and described in disentanglement placards to be provided by the NMFS Sea Turtle Program.	RPM #1 and the accompanying Terms and Conditions establish the protected species training and certifications that NEFSC staff scientists, crew members, and research affiliates must possess prior to being deployed. This training will provide these individuals with adequate experience in the identification, handling, sampling, release, and reporting of sea turtles, sturgeon, and salmon that are incidentally captured during the proposed actions. It also establishes the sea turtle disentanglement training and materials those individuals must possess prior to performing a disentanglement. This training and set of materials will provide NEFSC fisheries and ecosystem research staff with adequate guidance in the handling, release, and reporting of sea turtles that may be entangled during the proposed actions.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
2. <u>HANDLING AND RESUSCITATION</u>: Any sea turtle, shortnose or Atlantic sturgeon, or Atlantic salmon captured during the fisheries and ecosystem research activities covered under this Opinion must be handled and resuscitated according to current established protocols and whenever environmental conditions are safe to do so.	3. The NEFSC must ensure that all fisheries and ecosystem research staff have copies of the sea turtle handling and resuscitation requirements found at 50 CFR 223.206(d)(1) or as reproduced in the NMFS GARFO or SERO wheelhouse cards, depending on the geographic area they are surveying. Fisheries and ecosystem survey staff must carry out these handling procedures when a sea turtle is incidentally captured and brought onboard a vessel during the proposed actions. If the sea turtle is unresponsive, resuscitation must be attempted. Whenever possible, trained or NMFS-permitted staff must perform the handling and resuscitation of captured sea turtles. 4. The NEFSC must ensure that fisheries and ecosystem survey staff give priority to the handling and resuscitation of sea turtles, sturgeon, or salmon that are captured or entangled in fishing gear over the handling of non-listed species or the completion of normal survey activities. Handling times for alive and active animals should be minimized (i.e., kept to 15 minutes or less) to limit the amount of stress placed on them. 5. For sea turtles that appear injured (i.e., beyond minor chips, cuts, or abrasions to the carapace or skin), sick, distressed, or dead (including stranded or entangled individuals), fisheries and ecosystem research staff must immediately 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. If unable to contact the Hotline (e.g., due to distance from shore or lack of ability to communicate via phone), the USCG should be contacted via VHF marine radio on Channel 16. If advised by the Hotline, sea turtle stranding network, or GARFO PRD, hard-shelled sea turtles (i.e., non-leatherbacks) may be held onboard for up to 24 hours	RPM #2 and the accompanying Terms and Conditions establish the requirements for handling and resuscitating sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon captured during fisheries and ecosystem research activities in order to avoid serious injuries and post-interaction mortalities to these species from the deployment, hauling, handling, and emptying of gear/equipment.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
	provided that the holding conditions are approved by the stranding network or GARFO PRD and safe handling practices are followed. Unless environmental conditions are unsafe, survey staff must make every effort to get an injured sea turtle to a rehabilitation facility. If the Hotline, stranding network, or GARFO PRD cannot be contacted and the injured animal cannot be taken to a rehabilitation facility, fisheries and ecosystem research staff must not perform activities that could further stress the animal (*e.g.*, additional sampling or handling), allow it to rest and recuperate as conditions dictate, and then return the animal to the water. 6. The NEFSC must ensure that fisheries and ecosystem research staff who handle, and resuscitate as needed, incidentally captured shortnose and Atlantic sturgeon are aware of the current NMFS guidelines for doing so. If a captured sturgeon is determined to be unresponsive or comatose, fisheries and ecosystem research staff should attempt to resuscitate the fish by placing it in oxygenated water or providing a running source of water over the gills. Resuscitation should be attempted on all nonresponsive sturgeon for at least 30 minutes. If the sturgeon remains nonresponsive after 30 minutes, the fish should be considered dead and the carcass reported to either GARFO PRD or a co-investigator, cooperating facility, or laboratory affiliated with the Sturgeon Salvage Network. In the event of a sturgeon mortality, also refer to the requirements in RPM #4 and T&C #11 below. 7. The NEFSC must ensure that fisheries and ecosystem research staff who handle incidentally captured Atlantic salmon release the salmon with care by keeping it in the water at all times. If the fish is brought onboard, fisheries and ecosystem research staff must gently release it as quickly as possible.	

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
3. DATA COLLECTION, SAMPLING, AND TAGGING: Any sea turtles, shortnose or Atlantic sturgeon, or Atlantic salmon captured during fisheries and ecosystem research activities covered under this Opinion must be identified to species, or species group if species identification cannot be determined, and properly documented using appropriate materials and data collection forms created or provided by NMFS. Biological, external and internal tagging, and gear description data must be collected or estimated for all sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon that are captured. External or internal tags must be applied to the animals if it is determined that they have not been tagged already and the survey staff member possesses adequate training or a NMFS issued scientific research permit to do so. Biological samples may also be taken if the survey staff member has adequate training or a NMFS issued permit.	8. The NEFSC must ensure that fisheries and ecosystem research staff are able to identify sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon per the training described in RPM #1 and T&C #1. 9. The NEFSC must ensure that all sea turtles, shortnose or Atlantic sturgeon, or Atlantic salmon incidentally captured are measured and photographed or videoed. The condition of each animal, length/width and weight measurements (estimated if unable to measure), presence of internal (when a PIT tag reader is available) and external tags, and any visible or potential injuries must be documented fully. These data must be entered into the GARFO approved reporting form for each incidental take. In addition, any recorded sturgeon PIT tags must be reported to the U.S. FWS tagging database (Current POC: Mike Mangold at mike_mangold@fws.gov or 410-573-4506). 10. Any invasive sampling (e.g., biopsies, fin clips) or tagging (e.g., flipper, PIT) of incidentally captured sea turtles, shortnose or Atlantic sturgeon, or Atlantic salmon can only be performed by individuals trained in those activities. Fin clip sampling procedures for shortnose and Atlantic sturgeon and Atlantic salmon must be done in accordance with NMFS provided and approved protocols. Fin clips must be taken prior to preservation of other fish parts or whole bodies and must be sent to a NMFS approved laboratory capable of performing genetic analysis. To the extent authorized by law, the NEFSC is responsible for the cost of any genetic/DPS analyses.	RPM #3 and the accompanying Terms and Conditions specify the collection of information for any sea turtles, shortnose or Atlantic sturgeon, or Atlantic salmon observed captured in NEFSC fisheries and ecosystem research activities. This is essential for monitoring the impacts of the proposed actions and the level of incidental take associated with them. Sampling of sea turtle, shortnose and Atlantic sturgeon, and Atlantic salmon tissue is used for genetic sampling. The taking of biopsy samples for sea turtles and fin clips for shortnose and Atlantic sturgeon and Atlantic salmon allows us to fund or conduct genetic analysis to determine the nesting beach/DPS origin of sea turtles and the river/DPS origin of sturgeon and salmon. This allows us to determine if the actual level of take has been exceeded. These procedures do not harm sea turtles, sturgeon, or salmon and are a common practice in fisheries science. Tissue sampling does not appear to impair an animal's ability to swim and is not thought to have any long-term adverse impact. We have received no reports of injury or mortality to any sea turtles, sturgeon, or salmon sampled in this way.

4. RELEASE OR RETENTION: Any live sea turtles, shortnose sturgeon or Atlantic sturgeon, or Atlantic salmon captured in fisheries and ecosystem research activities covered under this Opinion must ultimately be released according to NMFS approved protocols or guidance provided by the Northeast Marine Mammal and Sea Turtle Standing and Entanglement Hotline or identified stranding network, and whenever environmental conditions are safe for those releasing the animals to do so. Sea turtles with significant injuries should be transferred to an appropriately permitted facility identified by the suggestion of the Hotline or identified stranding network. Any dead sea turtles or sturgeon captured during fisheries and ecosystem research activities must be retained, if logistically feasible and instructed by the Hotline, stranding network, or GARFO PRD to do so, and then transferred to an appropriately permitted research facility so that a necropsy can be undertaken. Sea turtle, shortnose sturgeon, and Atlantic sturgeon carcasses should be held in cold storage until shipping or transfer.	11. All live, active, and uninjured sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon that are incidentally captured in fisheries and ecosystem research activities must be released from the gear/equipment and back into the water as quickly as possible to minimize stress to the animal. For all injured sea turtles (i.e., beyond minor chips, cuts, or abrasions to the carapace or skin), research staff should immediately call the Northeast Marine Mammal and Sea Turtle Standing and Entanglement Hotline at 866-755-NOAA (6622) for further guidance on handling and transport, if necessary, to a rehabilitation facility. The NEFSC or its research affiliate must make arrangements with a NMFS-approved facility that agrees to receive any sea turtles injured during the proposed actions. This arrangement must include procedures for transferring these turtles to the care of the facility. To the extent authorized by law, arrangements must address funding of any necessary care and/or rehabilitation. 12. In the event of any lethal takes of sea turtles, shortnose sturgeon, or Atlantic sturgeon, any dead specimens or body parts retained by or on behalf of individuals with NMFS issued permits or authorizations should be preserved (frozen is preferred, although refrigerated is permitted if a freezer is not available) until retention or disposal procedures are discussed with the appropriate Hotline contact, stranding network organization, or GARFO PRD. In the event a permitted stranding network recipient is not available or the carcass is severely damaged or decayed to a degree where a necropsy would not be feasible, the animal should be disposed of at sea. It is up to the fisheries and ecosystem research staff to contact the Hotline or identified stranding network partner for assistance in determining the state of damage/decay and to see whether a necropsy or salvage of the carcass is needed.	RPM #4 and the accompanying Terms and Conditions establish the requirements for releasing or retaining sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon captured in fisheries and ecosystem research gear/equipment in order to provide those animals with the best chance for survival post-capture and to gather additional information on the cause of death of dead animals.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
5. REPORTING: GARFO PRD must be notified of all observed and estimated takes of sea turtles, shortnose and Atlantic sturgeon, Atlantic salmon, and any other ESA-listed species resulting from fisheries and ecosystem research activities covered under this Opinion. Fishing vessels conducting cooperative research under this Opinion must also submit VTRs and report interactions to GARFO PRD for any ESA-listed species they capture or interact with during their activities.	13. In the event of any interactions with or captures of sea turtles, shortnose or Atlantic sturgeon, Atlantic salmon, or any other ESA-listed species (lethal or non-lethal), the NEFSC or a member of its survey staff must follow the species-specific Standard Operating Procedures (SOPs) found on our website at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic). The observer programs should continue to follow their program-specific reporting protocols for ESA-listed species. 14. Aside from animals handled and sampled by the observer programs, the NEFSC must ensure that GARFO PRD is notified within 48 hours of any interaction with a sea turtle, shortnose or Atlantic sturgeon, Atlantic salmon, or any other ESA-listed species. These reports must be sent via e-mail to nmfs.gar.incidental-take@noaa.gov (preferred) or by phone to GARFO PRD at 978-281-9328. A copy of the NMFS Protected Species Incidental Take (PSIT) database submission is acceptable. The report must include, at a minimum: (1) reporter name and affiliation; (2) GPS coordinates (in decimal degrees or degrees/minutes/seconds) or a geographic description describing the specific location of the interaction; (3) portion and details of the gear involved (e.g., bottom trawl, gillnet [net panel or vertical line], longline, dredge, pot/trap); (4) time and date of the interaction; and (5) identification of the animal to the species level. We also request the following information be provided: (1) a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head and carapace showing scutes for sea turtles or mouth for sturgeon); (2) exact or estimated length/width of the animal; (3) ID numbers of	RPM #5 and the accompanying Terms and Conditions specify protocols for the reporting of information to GARFO PRD for any sea turtles, shortnose and Atlantic sturgeon, Atlantic salmon, or any other ESA-listed species observed interacting with or captured in fisheries and ecosystem research activities. This is essential for monitoring the level of incidental take associated with the proposed actions and ensuring that we can track any exceedance of the ITS or adverse effects to species not already considered in the Opinion.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
	external or internal tags either recorded from or applied to the animal; (4) condition of the animal upon retrieval and release/retention (e.g., alive uninjured, alive potentially injured, comatose or unresponsive, fresh dead, decomposed); and (5) a description of any care or handling provided (whether resuscitation was attempted; if not, why not; if yes, details of how long the animal was held, etc.). If reporting within 48 hours is not possible (e.g., due to distance from shore or lack of ability to communicate via phone or email), the interaction must be reported as soon as the survey staff member is in a position to do so and absolutely no later than 48 hours after the vessel returns to port. 15. As part of its annual Omnibus Data submission to GARFO PRD, the NEFSC must provide a report, summary, or spreadsheet of all ESA-listed species interactions that occurred by project ID and species during the previous year. Any reports required by Term and Condition #14 that have not already been entered into the PSIT database or provided to GARFO PRD must be included in this submission. Animals handled and sampled by the NEFSC observer programs should be included in the Omnibus Data submissions for sea turtles and ESA-listed fish that are required by May 31st of every year.	

12.0 CONSERVATION RECOMMENDATIONS

In addition to section 7(a)(2), which requires agencies to ensure that proposed actions are not likely to jeopardize the continued existence of listed species, section 7(a)(1) of the ESA places a responsibility on all Federal agencies to use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species. Conservation Recommendations are discretionary activities designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The following additional measures are recommended regarding incidental take and conservation of sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon:

1. NMFS should advise the Principal Investigator(s) for any projects conducted under this Opinion to provide guidance, before each survey cruise or fishing trip, to the vessel crew members (including scientific crew and vessel operators) that: (a) all personnel are alert to the possible presence of sea turtles, shortnose and Atlantic sturgeon, and Atlantic salmon in the study area, (b) care must be taken when emptying gear to avoid damage to sea turtles, sturgeon, and salmon that may be caught in the gear but are not visible upon retrieval of the gear, and (c) the gear is emptied as quickly as possible after retrieval in order to determine whether sea turtles, sturgeon, or salmon are present in the gear.
2. NMFS should also advise the Principal Investigator(s) as to the mitigation, monitoring, and reporting measures that are required under the MMPA LOA for marine mammal takes, most of which should also benefit ESA-listed species through their implementation (e.g., monitoring of sampling areas prior to gear deployment, mandatory tow times, the “move-on” rule for trawling and longline operations, vessel speed restrictions, etc.).

13.0 REINITIATION OF CONSULTATION

This concludes formal consultation on fisheries and ecosystem research to be conducted and funded by the NEFSC as well as the proposed issuance of an LOA by NMFS OPR to permit marine mammal takes under those projects from 2021-2026. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take exempted in this Opinion is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In the event that the amount or extent of incidental take exempted in this Opinion is exceeded, the NEFSC must immediately request reinitiation of formal consultation.

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APPENDICES

Appendices A, B, and C from March 2023 supplemental BA

APPENDIX A

Northeast Observer Sea Turtle Sampling Description

NEFSC Northeast observer program certified observers, using Northeast observer program protocols and logs, will document all interactions of sea turtles during commercial fishing operations within the Northwest Atlantic Ocean. These data will help assess the impact these fisheries have on sea turtles and help implement sound fisheries management decisions. To accomplish this NEFOP and IFS certified observers are required to handle, identify, photograph, measure, PIT tag scan, collect biopsies, flipper tag, resuscitate and bring in to be transferred to NMFS approved Sea Turtle Stranding and Salvage Network (STSSN) personnel dead or injured turtles that are incidentally taken during commercial fishing operations. ASM certified observers are required to identify, photograph, resuscitate and bring in to be transferred to NMFS approved Sea Turtle Stranding and Salvage Network (STSSN) personnel dead or injured turtles that are incidentally taken during commercial fishing operations.

Gear types include:
Longline, Gillnet, Trawl, Trap/Pot, Dredge, Purse Seine, Handline

ESA APPROVED PROTOCOLS NEFSC/NEFOP CERTIFIED OBSERVERS ARE REQUIRED TO FOLLOW

1. Observers must not intentionally kill or cause any sea turtle to be killed.
2. Care must be taken when handling live turtles to minimize injury to turtles and the observer.
3. Observers will request that all observed sea turtles captured during commercial fishing operations be lowered to the deck as carefully as possible.
4. All sea turtles brought on board will be protected from any weather or fishing activity that may cause injury. The area surrounding the turtle will be free of any material that the turtle might ingest.
5. Healthy, active turtles will not be kept on board longer than 30 minutes.
6. Appropriate resuscitation techniques must be used on any comatose turtle prior to returning it to the water.
7. During release, engines should be in neutral and turtles shall be released away from fishing gear and as close to the surface of the water as possible.
8. The observer will observe the newly released animal and record the behavior on the Marine Mammal, Sea Turtle and Sea Bird Incidental Take Log.
9. When possible, observers should coordinate with the STSSN to transfer stressed or injured animals to rehabilitation facilities ashore. The easiest and quickest way to do this might be through the Area Coordinator.

It is understood that several of these requirements are out of the observers control. In those cases, it is incumbent upon the observer to work with the crew to meet these requirements. If the vessel operator is unable or unwilling to meet a request, then the observer should provide comments on the Marine Mammal, Sea Turtle and Sea Bird Incidental Take Log. Observers are responsible for their actions only, not for those of the crew.

SAFE TURTLE HANDLING/SAMPLING GUIDELINES

1. Sea turtles have powerful jaws. Always keep clear of the head and wear durable footwear when working around them on deck.
2. Sea turtles of all species, except leatherbacks, have claws on their flippers. Keep clear of flapping flippers, especially if the animal is on its back (carapace). Avoid straddling animals when you are working with them.
3. Never pick up sea turtles by the flippers, head or tail. For all turtles except leatherbacks, pick them up by placing one hand at the front and one hand at the back of the carapace.
4. Placing a clean, damp cloth over an agitated turtle's head can sometimes have a calming effect.
5. Turtles brought on deck should be protected from adverse weather conditions as much as possible. If it is sunny and hot, turtles should be covered with a clean damp cloth/towel and kept in the shade. If it is cold, turtles should be insulated with available clean material and kept out of the weather.
6. Extra care should be taken when handling leatherback turtles since they are covered with skin. Leatherback turtles should never be turned over on their carapace and should always be picked by their plastron, i.e., by supporting their underneath instead of just picking up by their carapace. Since leatherback turtles can be large, you will need assistance when moving them - do not try to drag or push them.
7. Wear gloves when possible and clean and disinfect any cuts or abrasions incurred when handling sea turtles.
8. Routinely disinfect hands with provided alcohol wipes.
9. Disinfect the turtle's skin using betadine and alcohol swaps.
10. Clean work area.
11. Use sterile, or new unused, instruments and sampling equipment.

SPECIAL HANDLING GUIDELINES FOR TURTLES WITH FIBROPAPILLOMATOSIS (FP)

All NEFOP observers will be trained on how to safely identify, handle, and sample turtles with FP.

FP is a disease which causes the growth of bulbous tumors on soft tissue around the axial (armpit), inguinal (groin), neck, tail, and eyes. Tumors have also been found around the mouth and between scutes on the carapace and plastron. Tumors typically appear warty or cauliflower-like, and can be normal skin color, pink, purple, or dark gray/black.

Following procedures will be followed by NEFOP Observers when FP is suspected:

1. Always wear gloves when sampling turtles. Properly dispose of contaminated gloves.
2. Separate equipment will be used for turtles displaying FP. Never sample a healthy turtle with equipment used to sample a turtle with FP.
3. Place the PIT tag scanner in a clean, sealed, plastic bag before scanning. Carefully discard the plastic bag after using.
4. Disinfect and quarantine all other equipment used.
5. Label quarantined equipment as exposed to FP.
6. Return quarantined equipment to your Area Coordinator.

7. Only reuse disinfected, quarantined gear on another turtle displaying FP. Then disinfect and quarantine as before.

HANDLING AND RESUSCITATION REQUIREMENTS

Any live sea turtle incidentally taken during the course of commercial fishing activities must be handled with due care to prevent injury. Incidentally taken sea turtles should be observed for activity and then returned to the water according to the following procedures:

Sea turtles that are alive or dead must be released over the stern of the boat.* In addition, they must be released only when fishing 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 fishing gear or vessels.**

Resuscitation must be attempted on sea turtles that are comatose or inactive but not dead by placing the turtle right side up (on plastron) and elevating the hindquarter six inches for a period of 4 up to 24 hours. The amount of the elevation depends on the size of the turtle; greater elevations are needed for larger turtles. Periodically rock the turtle from side to side by holding the outer edge of the carapace and lifting one side about 3 inches. Alternate lifting from one side to the other. This allows the lungs to drain off water. Sea turtles being resuscitated must be protected from the elements at all times. If it is sunny and warm then shade the turtle and keep it moist using clean sea water or clean damp towels. If it is cold then keep the turtle out of the weather and warm by insulating with clean rags or other suitable material. Gently touch the upper eyelid and pinch the tail (reflex test) periodically to see if there is a response. Those that revive and become active must be released over the stern of the boat only when fishing 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 fishing gear or vessels. Sea turtles that fail to respond to the reflex test or fail to move within several hours (up to 24, if possible) must be returned to the water in the same manner.

* Follow the above release guidelines for dead turtles only when it is not possible to salvage the dead animal and bring it in due to trip length.

** Live and resuscitated animals should be released as close to the water surface as possible

Important: Do not assume that an inactive turtle is dead. The onset of rigor mortis or the rotting of flesh is often the only definitive indication that a turtle is dead. Otherwise the turtle is determined to be comatose or inactive and resuscitation attempts are necessary. There are three methods that may elicit a reflex response from an inactive animal:

1. Cloaca or tail reflex. Stimulate the tail with a light touch. This may cause a retraction or side movement of the tail.
2. Eye reflex. Lightly touch the upper eyelid. This may cause an inward pulling of the eyes, flinching or blinking response.
3. Nose reflex. Press the soft tissue around the nose which may cause a retraction of the head or neck region or an eye reflex response.

GENETIC/ISOTOPE SAMPLING PROTOCOLS FOR LIVE, COMATOSE OR DEAD TURTLES

Genetic samples provide valuable information on stock structure. Small skin biopsies provide a simple method to obtain tissue samples for genetic studies from live and dead sea turtles. For turtles larger than 25 cm Notch-to-Tip (Total Length) carapace length, tissue samples large enough for genetic analysis can be obtained using a sterile 6mm disposable biopsy punch.

This tool consists of a plastic handle that supports a sharp circular blade. Tissue samples are preserved in 5 ml vials filled with saturated NaCI.

Prior to using any sampling equipment, thoroughly disinfect with 70% alcohol wipes.

1. Put on a pair of latex gloves and thoroughly wipe the ventral and dorsal surfaces of the rear flipper with a Betadine wipe followed by a 70% alcohol wipe. This area is along the posterior edge (trailing) of the flipper and is just past (away from the body) the Inconel tag location, which is the first scale closest to the body.

2. Use an alcohol swab to wipe the hard surface (plastic dive slate, biopsy vial cap or other available clean surface) that will be used under the flipper, and place this surface underneath the Betadine treated flipper.

3. Holding a new biopsy punch by the thumb and index finger, press the biopsy punch firmly into the flesh. The punch should actually be aligned a little past the flipper edge, creating a 3/4 crescent shaped biopsy. This technique promotes quicker healing. Rotate the punch one or two complete turns to make a cut all the way through the flipper. The biopsy tool has a sharp cutting edge so exercise caution at all times. Wipe the punched area with a Betadine swab.

4. Repeat the procedure to the other rear flipper using the same biopsy punch (if not too dull). You will now have two samples from this turtle in the same biopsy punch.

5. Remove the tissue plugs by using a pair of tweezers cleaned with alcohol wipes, a clean toothpick or by tapping the punch on the edge of the vial. Place the plugs directly into a vial containing saturated NaCI. It is important that tissue samples do not come into contact with any other surface or materials during collection.

6. Secure the vial cap. Using a fine point permanent marker (Sharpie) label the vial with the same consecutive identification number (PSID) used on your Sea Turtle Biological Sample Log and the trip number. Then cover the writing with a piece of clear tape to prevent smearing. Tightly wrap a piece of Parafilm around the vial cap and place it in a Whirl-pak. Label the Whirl-pak with trip number, collection date and species. Record all pertinent information on the Sea Turtle Biological Sample Log and the Marine Mammal, Sea Turtle and Sea Bird Incidental Take Log.

7. Be sure to indicate that a biopsy sample was taken on the Sea Turtle Biological Sample Log.

8. Properly dispose of the used biopsy punch. It is very important to use a new punch for each turtle.

9. Submit the vial with your data.

PROTOCOLS FOR INCONEL FLIPPER TAGGING

1. All turtles should be examined for existing external and/or PIT tags prior to applying new Inconel tags. To check for PIT Tags, NEFOP observers scan using the BIOMARK GPR+ PIT Tag Reader over the entire body. All existing tags should be recorded accurately. PIT tags are recorded on the Sea Turtle Biological Sample Log. Inconel and other external tags are recorded on the Marine Mammal, Sea Turtle and Sea Bird Incidental Take Log. Any damaged or unreadable tags should be removed. Prior to release, each turtle larger than 30 cm Standard Carapace Length (Notch-to-Tip) should have two well attached and clearly legible external Inconel tags. Metal Inconel tags are 1 and 1/8 inches long X 1/4 inch wide. Turtles should have no more than one tag per flipper for a total of two flipper tags including existing tags.

2. Inconel tags should be cleaned of the protective oil coat they are shipped with and stored in a sealed plastic bag. Thoroughly disinfect tags with alcohol wipes just before using. Remove one at a time as needed. Inconel tags are expensive. Take care of them and don't pass your tags to other observers.

3. Due to tag loss, double tagging is standard procedure, with one Inconel tag placed proximal to the first scale (scale closest to the body) of the trailing edge of each rear flipper for all turtles except leatherback.

4. Leatherback turtles should be tagged along the posterior (trailing) edge of the rear flipper. The preferred site is approximately 5 cm (~ 2 inches) out from the base of the tail (leatherback turtles do not have flipper scales).

5. Only Inconel tag turtles that are larger than 30 cm Standard Carapace Length (Notch-to-Tip) carapace length. If the recommended tagging site is damaged or is for some reason unsuitable for tag application, then an alternative site along the trailing edge of the front flipper may be used.

6. To prepare the rear flippers for tagging thoroughly swab the areas with betadine followed by 70% isopropyl alcohol. If someone is available to help, have them hold the flipper to improve leverage while you are applying the Inconel tag. Record the tag identification number prior to placing it into the applicator. Place the pointed (piercing) side of the tag up and place the end of your index finger inside the tag against the bend. Pull the tag straight back into the open jaws of the applicator, aligning the pointed side of the tag opposite to the side of the pliers that has the small depression. It can be helpful to mark one jaw of the applicator with colored paint as a reminder of the correct way to insert the tag. Do not squeeze the pliers before you are ready to tag or the tag will fall out.

7. Position the Inconel tag so that it extends slightly past (approx. 1/3 the length of the tag) the trailing edge of the rear flipper. It should not be cinched in too tight against the flipper without room to move freely. Also avoid positioning the tag close to the edge of the flipper where it can rip out or catch on fishing gear.

8. There are two distinct motions involved in applying Inconel tags. The first step is to squeeze the applicator so the tag point pierces the flipper. The second step, a moment later, involves applying greater force to drive the point through the tag hole and make it bend over completely. Use both hands and squeeze in a firm, steady manner to ensure that the tag will fully lock. The handles of the applicator should always be gripped as far back as possible to gain maximum leverage. The tag point should pierce the flipper and lock into place with the tip bending securely over by 3-5 mm. After attachment, feel the tag with your finger and visually inspect to make sure the point has bent over into a fully locked position. Repeat the procedure and apply a second tag on the other rear flipper. All turtles should be double tagged in this manner. If possible use consecutive tag numbers on the same turtle.

9. In the event that the Inconel tag does not lock, fit the pliers back around the tag and apply greater pressure. Tags that fail to lock when applied to a turtle are difficult, frustrating and sometimes impossible to properly correct, even when using additional tools. Improperly applied tags can be shed quickly. A tag that malfunctions should be removed, recorded as being destroyed and replaced with a new tag. If you are having persistent problems when attempting to apply Inconel tags please contact the NEFOP staff for additional training.

10. When you have finished working with one turtle, clean and disinfect the applicator (plier) to avoid cross contamination between turtles with alcohol swabs. Maintain the tag applicators so they continue to work properly by washing them in fresh water after use, spraying the spring and pivot surface with WD40, and storing them in a sealed plastic bag.

PHOTOGRAPHIC DOCUMENTATION

Observers are required to photograph all sea turtles that are observed taken during commercial fishing operations. Although a properly completed Sea Turtle Biological Sample Log should provide all identifying characteristics used for species determination, it is imperative that the observer also provide photographic documentation to verify this identification for every live or dead turtle reported. Photographs should be taken of the head, flippers, carapace, and plastron. Photographs should also be taken of any injuries, healed scars or unusual markings. Digital photos should be uploaded and sent in using NEFOP protocols. Additional photographic instructions are given in the Photo Log section of the NEFOP Program Manual.

PROTOCOLS FOR MEASURING

Accurate and precise measurements are critical. All measurements should be recorded to the nearest 0.1 mm. The following guidelines apply to over the curve (curvilinear) measurements using a flexible tape. The standard measure of curved carapace length (CCL) is Notch-to-Tip. This is measured along the centerline from the center of the carapace nuchal notch to the longest posterior tip. Because the posterior tips are frequently broken in juveniles, or worn away in adults, it is recommended that a nuchal notch to posterior notch measurement also be taken. This is known as a Notch-to-Notch length. Carapace width is measured perpendicular to the centerline of the carapace at the widest point. If epibiota is present do not include it, if possible, when taking measurements. If it is unavoidable and your measurements do include epibiota please be sure to include detailed comments in your Marine Mammal, Sea Turtle and Sea Bird Incidental Take Log.

REPOSITORY FOR TISSUE SAMPLES

Once all data and samples are delivered to the Northeast Observer Program Training Center, the data edited and the observer debriefed, all tissue samples and the necessary corresponding data will be sent to NOAA’s Northeast Fisheries Science Center (NEFSC) in Woods Hole, MA, in accordance with the permit.

APPENDIX B

Northeast Observer Atlantic Sturgeon Sampling Description

NEFSC Northeast observer program certified observers, using Northeast observer program protocols and logs, will document all interactions of Atlantic Sturgeon during commercial fishing operations within the Northwest Atlantic Ocean. These data will help assess the impact these fisheries have on Atlantic Sturgeon and help implement sound fisheries management decisions. To accomplish this NEFOP and IFS certified observers are required to handle, identify, photograph, measure, PIT tag scan, and collect fin clips from Atlantic Sturgeon that are incidentally taken during commercial fishing operations. ASM certified observers are required to identify and photograph Atlantic Sturgeon that are incidentally taken during commercial fishing operations.

Gear types include:
Longline, Gillnet, Trawl, Trap/Pot, Dredge, Purse Seine, Handline

PROTOCOLS NEFSC/NEFOP CERTIFIED OBSERVERS ARE REQUIRED TO FOLLOW

1. Observers must not intentionally kill or cause any Atlantic Sturgeon to be killed.
2. Care must be taken when handling live Atlantic Sturgeon to minimize injury to Atlantic Sturgeon and the observer.
3. Observers will request that all observed Atlantic Sturgeon captured during commercial fishing operations be made available for sampling.
4. During release, engines should be in neutral if possible. Atlantic Sturgeon should be released away from fishing gear and as close to the surface of the water as possible.
5. The observer will observe the newly released Atlantic Sturgeon and record the behavior on the Individual Animal Log.

It is understood that several of these requirements are out of the observers control. In those cases, it is incumbent upon the observer to work with the crew to meet these requirements. If the vessel operator is unable or unwilling to meet a request, then the observer should provide comments on the Individual Animal Log and Haul Log. Observers are responsible for their actions only, not for those of the crew.

SAFE ATLANTIC STURGEON HANDLING/SAMPLING GUIDELINES

1. Atlantic Sturgeon brought on deck should be protected from adverse weather conditions and released expeditiously to minimize the potential adverse impacts of sampling. Gently run saltwater over live fishes gills while collecting data. If it is sunny and hot, Atlantic Sturgeon should be gently hosed off periodically.
2. Atlantic Sturgeon have powerful tails. Always wear durable footwear when working around them on deck.
3. Pick Atlantic Sturgeon up by placing one hand on each side of the body and lift with the legs. For larger Atlantic Sturgeon, assistance from a crew member may be needed.
4. Wear gloves when possible and clean and disinfect any cuts or abrasions incurred when handling Atlantic Sturgeon.
5. Clean work area.

6. Use cleaned, or new instruments and sampling equipment.

HANDLING REQUIREMENTS

Any live Atlantic Sturgeon incidentally taken during the course of commercial fishing activities must be handled with due care to prevent injury. Live Atlantic Sturgeon should have saltwater run over their gills gently while collecting data if possible. Incidentally taken Atlantic Sturgeon should have the necessary data collected, be briefly observed for activity, and returned to the water according to the following procedures:

Atlantic Sturgeon that are alive or dead must be released. They should be released when fishing gear is not in use or as far from the gear as possible and when the engine gears are in neutral position when possible so they are unlikely to be recaptured or injured by fishing gear or vessels.

* Live animals should be released as close to the water surface as possible.

GENETIC SAMPLING PROTOCOLS FOR LIVE OR DEAD ATLANTIC STURGEON

Genetic samples provide valuable information on stock structure. Small fin clips provide a simple method to obtain tissue samples for genetic studies from live and dead Atlantic Sturgeon. Tissue samples should be taken from the posterior or trailing edge of the pelvic fin approximately 1-2 cm^2 in size, enough for genetic analysis to be obtained, using a clean knife or pair of scissors.

Tissue samples are preserved in 2 ml vials filled with RNAlater™.

1. Put on a pair of gloves.

2. Use a pair of clean tweezers to grasp the posterior edge of one of the pelvic fins and cut around the tweezers using a clean pair of scissors or knife to obtain a 1-2 cm^2 tissue sample. Place the tissue sample directly into a vial containing RNAlater™. Take caution to not unnecessarily damage the fin while collecting the sample.

3. Secure the vial cap. Using a fine point permanent marker (Sharpie) label the vial with the same consecutive identification number (sequence number) used on your Individual Animal Log (SEQ#), haul number, and the tripID number. Then cover the writing with a piece of clear tape to prevent smearing. Tightly wrap a piece of Parafilm around the vial cap and place it in a small plastic bag to reduce evaporation or leakage.

4. Fill out a Tyvek tag with trip number, collection date, species, and all other pertinent information. Place the Tyvek tag in the small plastic bag with the vial.

5. Be sure to indicate that a tissue sample was taken on the Individual Animal Log. Vials can be stored at room temperature.

6. Submit the vial with your data.

PHOTOGRAPHIC DOCUMENTATION

Observers are required to photograph all Atlantic Sturgeon that are observed taken during commercial fishing operations. Although a properly completed Individual Animal Log should provide all identifying characteristics used for species determination, it is imperative that the observer also provide photographic documentation to verify this identification for every live or dead sturgeon reported. Photographs should be taken of the dorsal view of the head, ventral view of the mouth and snout, post dorsal fin plates, bony plates between the anal fin base and lateral row plates, and ventral view of the post anal scutes. All photographs should include an item for scale (e.g. tape measure, field notebook). Photographs should also be taken of any injuries, bruises, or unusual markings. Digital photos should be uploaded and sent in using NEFOP protocols.

PROTOCOLS FOR MEASURING

Accurate and precise measurements are critical. All measurements should be recorded to the nearest 0.1 cm. The standard measure of fork length should be collected. This is measured along the centerline from the center of the head to the fork of the tail. An actual weight should be collected as well, if possible, or an estimated weight if not.

PROTOCOLS FOR PIT TAG SCANNING

If applicable, use the PIT tag reader to scan for PIT tags on the entirety of the Atlantic Sturgeon (if issued a PIT tag scanner). If present, record the PIT tag number in the tag number field on the Individual Animal Log.

*All other tags found should be recorded on the Individual Animal Log, both tag number and type of tag.

REPOSITORY FOR TISSUE SAMPLES

Once all data and samples are delivered to the Northeast Observer Program Training Center, the data edited and the observer debriefed, all tissue samples and the necessary corresponding data will be sent to the United States Geological Services (USGS) Science Center in Leetown, WV.

APPENDIX C

Northeast Observer Atlantic Salmon Sampling Description

NEFSC Northeast observer program certified observers, using Northeast observer program protocols and logs, will document all interactions of Atlantic Salmon during commercial fishing operations within the Northwest Atlantic Ocean. These data will help assess the impact these fisheries have on Atlantic Salmon and help implement sound fisheries management decisions. To accomplish this NEFOP and IFS certified observers are required to handle, identify, photograph, measure, PIT tag scan, and collect fin clips from Atlantic Salmon that are incidentally taken during commercial fishing operations. ASM certified observers are required to identify and photograph Atlantic Salmon that are incidentally taken during commercial fishing operations.

Gear types include:
Longline, Gillnet, Trawl, Trap/Pot, Dredge, Purse Seine, Handline

PROTOCOLS NEFSC/NEFOP CERTIFIED OBSERVERS ARE REQUIRED TO FOLLOW

1. Observers must not intentionally kill or cause any Atlantic Salmon to be killed.
2. Care must be taken when handling live Atlantic Salmon to minimize injury to Atlantic Salmon and the observer.
3. Observers will request that all observed Atlantic Salmon captured during commercial fishing operations be made available for sampling.
4. During release, Atlantic Salmon should be released away from fishing gear and as close to the surface of the water as possible.
5. The observer will observe the newly released Atlantic Salmon and record the behavior on the Individual Animal Log.

It is understood that several of these requirements are out of the observers control. In those cases, it is incumbent upon the observer to work with the crew to meet these requirements. If the vessel operator is unable or unwilling to meet a request, then the observer should provide comments on the Individual Animal Log and Haul Log. Observers are responsible for their actions only, not for those of the crew.

SAFE ATLANTIC SALMON HANDLING/SAMPLING GUIDELINES

1. Atlantic Salmon brought on deck should be protected from adverse weather conditions and released expeditiously to minimize the potential adverse impacts of sampling. Gently run saltwater over live fishes gills while collecting data or place salmon in a tote with running water to allow for the salmon to recover between sampling activities.
2. Wear gloves when possible and clean and disinfect any cuts or abrasions incurred when handling Atlantic Salmon.
3. Clean work area.
4. Use cleaned, or new instruments and sampling equipment.

HANDLING REQUIREMENTS

Any live Atlantic Salmon incidentally taken during the course of commercial fishing activities must be handled with due care to prevent injury. Live Atlantic Salmon should have saltwater run over their gills gently while collecting data or place salmon in a tote with running water to allow for the salmon to recover between sampling activities, if possible. Incidentally taken Atlantic Salmon should have the necessary data collected, be briefly observed for activity, and returned to the water according to the following procedures:

Atlantic Salmon that are alive must be released*. They should be released when fishing gear is not in use or as far from the gear as possible so they are unlikely to be recaptured or injured by fishing gear or vessels. If the fish is dead and not badly decomposed, freeze the animal for transport back to NMFS for necropsy AFTER collecting data and samples. If the fish is dead and badly decomposed, dispose of the carcass at sea AFTER collecting as much data as possible.

*Live animals should be released as close to the water surface as possible.

GENETIC SAMPLING PROTOCOLS FOR LIVE OR DEAD ATLANTIC SALMON

Genetic samples provide valuable information on stock structure. Small fin clips provide a simple method to obtain tissue samples for genetic studies from live and dead Atlantic Salmon. Tissue samples should be taken from the caudal fin and be approximately 1 cm^2 in size, enough for genetic analysis to be obtained, using a clean knife or pair of scissors.

Tissue samples are placed in a small manilla envelope used for age samples with a piece of paper inside to help absorb excess liquid.

1. Put on a pair of gloves.

2. Use a pair of clean tweezers to grasp the caudal fin and cut around the tweezers using a clean pair of scissors or knife to obtain a 1-2 cm^2 tissue sample. Place the tissue sample directly into an age envelope. Take caution to not unnecessarily damage the fin while collecting the sample.

3. Using a pencil, fill in the fields on the envelope with the TripID, haul number, haul date, statistical area, species name, length in centimeters, disposition code, and sex code. The Individual Sequence Number should also be recorded on the envelope along with the label "Tissue".

4. Be sure to indicate that a tissue sample was taken on the Individual Animal Log. Envelopes can be stored at room temperature and should not be placed into sealed plastic bags.

5. Submit the envelope with your data.

PHOTOGRAPHIC DOCUMENTATION

Observers are required to photograph all Atlantic Salmon that are observed taken during commercial fishing operations. Although a properly completed Individual Animal Log should provide all identifying characteristics used for species determination, it is imperative that the observer also provide photographic documentation to verify this identification for every live or dead salmon reported. Photographs should be taken from the side view of the entire fish. All photographs should include an item for scale (e.g. tape measure, field notebook). Photographs should also be taken of any injuries, bruises, or unusual markings. Digital photos should be uploaded and sent in using NEFOP protocols.

PROTOCOLS FOR MEASURING

Accurate and precise measurements are critical. All measurements should be recorded to the nearest 0.1 cm. The standard measure of fork length should be collected. This is measured along the centerline from the center of the head to the fork of the tail. An actual weight should be collected as well, if possible, or an estimated weight if not.

PROTOCOLS FOR PIT TAG SCANNING

If applicable, use the PIT tag reader to scan for PIT tags on the entirety of the Atlantic Salmon (if issued a PIT tag scanner). If present, record the PIT tag number in the tag number field on the Individual Animal Log.

*All other tags found should be recorded on the Individual Animal Log, both tag number and type of tag.

PROTOCOLS FOR SCALE COLLECTION

Using the blunt side of a small clean knife, gently scrape 10-20 scales from the scale collection area between the dorsal and adipose fin above the lateral line on the side of the Atlantic Salmon. Place Scales in a small manilla age envelope, fill in all fields on the envelope described above, and add the Individual Sequence Number along with the label “Scales”.

REPOSITORY FOR TISSUE SAMPLES

Once all data and samples are delivered to the Northeast Observer Program Training Center, the data edited and the observer debriefed, all tissue samples and the necessary corresponding data will be sent to the Fish and Wildlife Service facility in Lamar, PA.