US Army Corps of Engineers®
New York District

NEW YORK AND NEW JERSEY HARBOR DEEPENING CHANNEL IMPROVEMENTS

NAVIGATION STUDY

INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL ASSESSMENT

APPENDIX A1:

ENDANGERED SPECIES ACT

Biological Assessment

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1. Introduction

1.1 Purpose

This Biological Assessment (BA) is submitted to the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) by the U.S. Army Corps of Engineers (USACE)-New York District (District) as to reinitiate the formal consultation process under Section 7 of the Endangered Species Act (ESA), as amended November 10, 1978. This BA assesses potential impacts to threatened and endangered species from proposed construction of channel improvements to the already completed 50 Foot New York/New Jersey (NY/NJ) Harbor Deepening Project (HDP). The purpose of this document is to evaluate the potential effects to endangered species from the newly authorized Harbor Deepening Channels Improvement Study (HDCI). In March 2018, an Initial Appraisal Report, per compliance with Section 216 of WRDA 1970, was completed to determine if there is potential federal interest to undertake modifications to the existing 50-foot federal navigation project. The Initial Appraisal Report states that the accelerating expansion of the volume of trade that has taken place since the existing 50-foot federal navigation project was authorized has led to the existing project's dimensions, based on the design vessel the *Regina Maersk* as recommended in the 1999 Study, being superseded in use in the Port of New York and New Jersey much sooner than anticipated. This fact has a material effect on the economics and engineering design of the 50-foot federal navigation project. The Initial Appraisal Report found "a comparison of these facts with the requirements §216 indicates that all of the requirements of §216 have been meet." The Initial Appraisal Report made the recommendation to "investigate and determine if there is a Federal interest in continuing the project with the preparation of cost-shared feasibility report for analyzing alternatives to address the identified problems though possible modifications of the project." As an outcome of the Initial Appraisal Report, the resulting study is called the New York and New Jersey Harbor Deepening Channel Improvements, Navigation Feasibility Study (HDCI Study). Water Resources Development Act 1970 Section 216 limits the analysis of the NYNJHDCI Study to the constructed 50-foot federal navigation project.

Section 7 of the ESA requires that a BA be prepared for all major Federal actions when a federally listed or proposed endangered or threatened species may be affected.

1.2 Endangered Species Act

This BA is submitted as part of the process provided under Section 7 of the ESA. Section 7(a)(4) of the Act to provide NMFS and other Federal agencies a mechanism for identifying and resolving potential conflicts between a proposed action and proposed species at an early planning stage. Detailed procedures for the consultation process required under the ESA are defined in 50 CFR 402.

1.3 Consultation History

The NYNJ Harbor is a major shipping port and center of commerce, and key channels have to be dredged to meet the growing demands of the Port, which is the nation's third largest container port. The primary goal of the HDP was to provide access to and accommodate the demand for international cargo through the New York and New Jersey Region by deepening several navigation channels in the Port of NY & NJ to a depth of -50 feet below mean lower low water (MLLW). It was authorized for construction under the Water Resources and Development Act of 2000 (Public Law No. 106-541, Dec 11, 2009). The initial BA was completed for the HDP by the District in 1999. A supplemental BA was prepared for the HDP to include the newly listed Atlantic Sturgeon in 2012. In May 2013 the District requested reinitiation of consultation for the Shoal Removal and Utility Contract (SRUC) of the HDP, with NMFS determining that reinitiation of consultation was not required as the additional construction contract was accounted for under the 2012 consultation. Biological opinions (BOs) were issued by NMFS for both the 1999-2000 BA (issued October 13, 2000) and the 2012 BA (issued October 25, 2012), and the 50-foot HDP completed construction in 2016. The project improved navigational safety to accommodate larger, deeper-draft vessels that were accessing the port facilities. One take of Atlantic sturgeon occurred at the Ambrose Channel under the HDP over the 12-year construction period of the project.

The purpose of this request for reinitiation of consultation is to address potential impacts to protected species under NMFS jurisdiction that may result from the proposed channel improvements to the HDP, as recommended under the HDCI authorization**.** Reinitiation of consultation is required and shall be requested by the Action Agency or by NMFS where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) If 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 in the consultation; (b) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this consultation; (c) If a new species is listed or critical habitat designated that may be affected by the identified action or if a new species is listed or critical habitat designated may be affected by the action. Specifically, as additional volumes of dredged material will be removed beyond that which was removed under the HDP and utilizing construction equipment that could pose an adverse risk to protected species, the District requests this reinitiation of consultation.

This BA relies heavily on and directly incorporates, references, and cites all relevant information and analyses from the 1999 and 2012 Harbor Deepening BA and BO (USACE 2012.), in addition to relying on applicable analyses contained in the HDCI draft EA. The Historic Area Remediation Site (HARS, see map Appendix A) is a proposed placement site for beneficial use of suitable dredged material and is a permitted site (USACE SEIS/ROD 2012). As the study, conducted under SMART, moves through the authorization process to the Pre-Engineering and Design (PED) and Construction (CO) phases of a project, if there are any significant changes to the proposed action, or to the action area, the District will reinitiate consultation with NMFS, as is required under ESA, and under USACE implementing regulations.

2. Description of the Federal Action

The purpose of this document is to evaluate the potential effects to threatened and endangered species resulting from the implementation of the newly authorized Harbor Deepening Channel Improvements Study (HDCI). In March 2018, an Initial Appraisal Report, per compliance with Section 216 of WRDA 1970, was completed to determine if there is potential federal interest to undertake modifications to the existing 50-foot federal navigation project. The Initial Appraisal Report states that the accelerating expansion of the volume of trade that has taken place since the existing 50-foot federal navigation project was authorized has led to the existing project's dimensions, which was based on the design vessel the *Regina Maersk* as recommended in the 1999 Study, and has being superseded in use in the Port of New York and New Jersey much sooner than anticipated in the 1999 Study. This fact has a material effect on the economics and engineering design of the 50-foot federal navigation project. The Initial Appraisal Report found "a comparison of these facts with the requirements §216 indicates that all of the requirements of §216 have been meet." The Initial Appraisal Report made the recommendation to "investigate and determine if there is a Federal interest in continuing the project with the preparation of a cost-shared Feasibility Report for analyzing alternatives to address the identified problems though possible modifications of the project."

2.1 Tentatively Selected Plan

The national economic development (NED) plan is the Tentatively Selected Plan (TSP) identified for this study (see Figure 1 for TSP Overview). The TSP involves deepening the Ambrose Channel, Anchorage Channel and Port Jersey Channel, the Kill Van Kull, Newark Bay Channel, South Elizabeth Channel and Port Elizabeth Channel by 5 feet. This includes the additional width required for structural stability and for the navigation of a *Triple E Class* vessel to transit from sea to Port Elizabeth and Port Jersey. Channel configurations were designed to avoid and minimize environmental and cultural resource impacts while still meeting navigation safety requirements. The TSP is anticipated to become the Recommend Plan (RP) upon the Action Agency's determination of the Finding of No Significant Impact, per National Environmental Policy Act (NEPA) requirements. If there are changes or revisions to the TSP or

RP that would warrant reinitiation of consultation with NMFS, the District would undertake such reinitiation according to ESA statutory requirements. This BA does not include any work that will be conducted for the future Operation and Maintenance (O&M) of the Federal channels since that work is not authorized under this study. O&M projects are separately funded and authorized from Civil Works studies and projects, and as such O&M projects will seek to meet statutory compliance obligations under their own separate authority.

Figure 1. Tentatively Selected Plan Overview for HDCI.

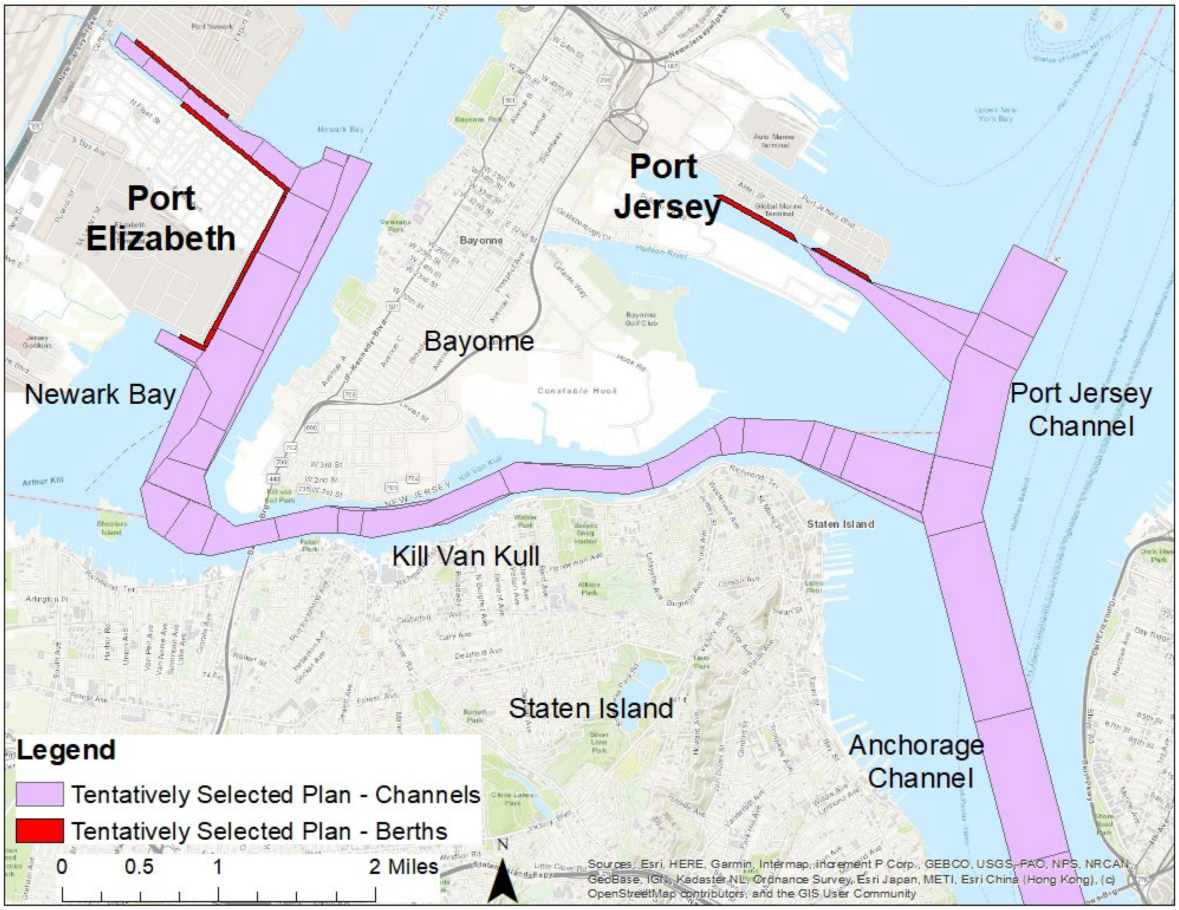


Figure 2. TSP/RP Channel Configurations. Note: Berth Deepening is included in the TSP as an Associated Cost, only, per USACE regulations. Berths, which are proposed for deepening regardless of the HDCI implementation will not be deepened under the HDCI Project.

The following table (Table 1) describes the current TSP Dimensions and Characteristics. Contract designations in the footnotes from the HDP are used for illustrative purpose, only. The HDCI study has not yet identified each construction contract. All volumes projections are subject to change. It is impossible to calculate exact volumes of material to be dredged at this time of the study. Any significant changes to the proposed action that is not addressed in this BA and changes the level of effects will be cause for reinitiation of formal consultation with NMFS. NMFS will be apprised of any changes to the proposed project over the course of the 15 year project, as is required, and as has been the history of our interagency coordination.

Table 1: TSP/RP Channel Dimensions and Characteristics

	Proposed Maintained Channel Level[a] [ft MLLW]	Proposed Authorized Channel Level[b] [ft MLLW]	Total Depth[c] [ft MLLW]	Length of Improve-ment [ft]	Quantity to be Dredged (cy)	Channel Bottom Width	Predominant Side Slope	Predominant Channel Bottom Material Type
Ambrose Channel	-58	-58	-59	90,000	6,389,000	2,000	3:1	Sand
Anchorage Channel	-55	-55	-56.5	31,000	3,800,000	2,000	3:1	Sand
Port Jersey Channel	-55	-57	-58.5	6,000	3,003,000	450 to 2,313	3:1/1:1 against berths	Sand/sediment
Kill Van Kull	-55	-57	-58.5	28,000	4,451,000	800 to 2,313	3:1/1:1 through rock	HARS suitable material & moderately hard rock and till
Newark Bay	-55	-57	-58.5	13,000	14,148,000	1,740 to 2,008	3:1/1:1 through rock & against berths	Non-HARS suitable material & moderately hard rock and till
South Elizabeth Channel	-55	-57	-58.5	2,000	423,000	500 to 640	3:1/1:1 through rock & against berths	Non-HARS suitable material & moderately hard rock and till
Port Elizabeth Channel	-55	-57	-58.5	8,000	1,024,000	500 to 750	3:1/1:1 through rock & against berths	Non-HARS suitable material & moderately hard rock and till

[a]Maintained channel level includes the summer salt water draft, squat, salinity, wave motion, and safety clearance. The channels will be maintained at this depth.
[b]The authorized channel level includes additional safety clearance needed for hard bottom.
[b]The total depth includes an additional dredging tolerance (paid overdepth). This is the sum of the depths and specific to each plan.

The major channels under study in the HDCI will provide access to three main existing container terminals: The Port Newark Terminal and Elizabeth Marine Terminal in Newark Bay and the Global Marine Terminal on the Port Jersey Peninsula.

Dredging and placement equipment will be comprised of mid to large hopper dredges, cutterhead dredges, and open and closed clamshell dredges. A blast barge may be utilized in areas where unfractured rock is determined to remain, notably in the Newark Bay-Kill Van Kull complex area. Hoppers are assumed to be deployed in sandy and unconsolidated till areas that are presumed to be suitable for placement at the HARS, such as in the Ambrose and Anchorage channels (as they were under the HDP), while clamshell, cutterhead dredges and blast barges are assumed to be deployed, respectively, in areas unsuitable for HARS placement and in harder material suitable for HARS or reef placement. All dredged material will be placed at permitted sites that are already covered under ESA consultation or where an ESA consultation is not necessary (i.e., upland). Therefore, the effects of placement will not be considered further.

Blasting operations, which will be required to abide by state and local noise and vibration regulations, will include one blast barge and at least one tender vessel. Typically, they are staged in the highly restricted and USCG monitored target area according to well-established overall safety protocols. These protocols can be unique to each individual blasting operation. A blasting program conducted under the HDP that included voluntary fish monitoring describes a typical operation and is available for review in Appendix B. Typical BMPs for a blast operation include time of day restrictions (daylight, only), property distance offsets, adherence to local noise and vibration thresholds, and adherence to all state and NMFS-mandated seasonal restrictions. Until the blasting plan for the HDCI is determined, it is assumed that the plan will be similar to what was done for the HDP (as described in the HDP Monitoring Program (Appendix B)). Any new plan will be at least as protective as the 2012 HDP blasting plan. A site-specific blasting plan will be submitted to NMFS 14 days prior to the conduct of the work for review and input as pertains specifically to NMFS trust resources. The NMFS comments will be due to the District no later than 14 days upon their receipt of the blast plan. The District will incorporate only those resource protective BMPs that are determined to be feasible, per our Environmental Operating Principles and per our obligations under the ESA, so as not to adversely affect the construction schedule. The blast plan will establish the expected pressure levels, proposed timing, and minimization measures.

According to the HDP blasting monitoring program, the blasting process entails the use of barge-mounted drill towers to bore a series of holes into the bedrock. For the HDP specifically, the 4.5-in. diameter holes were 10- to 15-feet deep into bedrock and arranged approximately 12 feet apart in a row configuration referred to as a range. Each range typically consisted of 6 holes in a line. Each blast event (shot) had up to 5 parallel ranges separated by 10 feet with boreholes staggered between adjacent ranges. The arrangement of holes varied among shots, depending on factors such as location, thickness of rock to be removed, and specific objective of the shot. Each hole was packed with water gel ammonium nitrate derivative high explosive, and stemmed with coarse gravel at the top of the hole to confine and direct the blast energy into the rock. A detonation cord runs from the barge to a booster at each hole. Delays were used for detonation of each shot, i.e., the charges in individual holes were detonated in sequence with a detonation delay of 25 m-seconds between holes.

The main blasting agent used in October 2003 by the Joint Venture was EL957C, a water gel emulsion, manufactured by ETI Canada Ltd. The emulsion is not cap sensitive. The emulsion has a specific gravity of 1.30 and a detonation velocity of 20,000 feet/second (fps). The blasting agent was packaged in 2.75-inch (in) diameter polythene sleeves, each weighing 4.23 pounds (lb). Typically charges ranged between 25 and 29 lb per shot hole, depending on the height of rock relative to the dredge depth of 53.5 feet (ft). Larger emulsion weights were often used in one or more holes for each shot.

The initiation system was comprised of a Detaline dual path, precision delay, non-electric initiation cord and components. By using a non-electric initiating system the shot was safely initiated and connected without concern for radio silence. Radios can initiate electric systems. The system utilizes a fine extruded detonating cord with a PETN explosive core of 2.4 grains per ft. The timing and delay sequence to the shot holes were achieved with “Detaslide Delays” detonators. The detonators were used in each booster and were connected via Detaline to “Detaline Surface Delays.” The surface delays were connected to a dual trunk of Detaline.

All the shot holes were drilled, loaded and connected to the dual trunk line. The shot was initiated using a “Noiseless Lead-in-Line.” An instantaneous detonator was attached to a 500-ft length of hollow shock tube that contained explosive dust. The entire shot was initiated by a simple shot-shell primer, which was fired into the shock tube connected to the trunk line delay system to the individual shot holes.

Upon initiating the blast, each cord carries the detonation to its shot hole. In doing so, the cord itself sets up a “tubular” pressure front that forms around the cord along its entire length. How the pressure from the multitude of Detalines affected the recorded blast pressures or how the lines may impact fish (if separate from the confined blasts) is unknown at this time. It can only be assumed that these “other” pressures were incorporated into recorded values.

The delay sequence was resolved by a predetermined evaluation plan and placed by the number of holes drilled in each range and the number of ranges for the particular shot. Thus the actual delay timing deployed was a process of both the plan and the actual holes that were found above the pay grade.

The charge weight per delay is an important element of the blast vibration and water-borne pressure waves. The maximum charge weight per delay is the parameter that will likely be the predictor of the maximum vibration in particle velocity and the maximum water pressure. The maximum charge weight per delay is the largest weight of blasting agents shot at a single delay interval of less than 9 milliseconds (ms), 0.009 second (s). The largest weight may be attributed to a single shot hole or several shot holes with the same delay timing. It so happens that the recorded shots were from single shot holes with maximum charge weights per delay in the 70 to 90 lb per delay range.

Based upon past operations, it is assumed that the blasting may occur during daylight hours only, Monday through Saturday, and will occur only from July 1 through February 28 of any year, in discreet locations within the NB complex, only. Blast operations are very site specific, as there are new or different considerations with each blast proposal at each site requiring blasting. As it is currently unknown exactly where, or if, blasting will occur, and if it does, which BMPs will be required, we can only assume at this time that some parts of the NB Complex (South Elizabeth and Port Elizabeth Channels), especially near the KVK intersection, might require blasting. It is unknown at this time whether fish monitoring will be a requirement for this project so it will not be considered further. The initial dredging and blasting events are expected to occur from 2025-2039 (Table 2).

The proposed HDCI improvements will not increase vessel traffic (see Feasibility Report Economic Appendix) or the size of the vessels that can currently access the action area. These improvements will permit larger and cleaner vessels (ex. Triple-E Class Container Ship, Denmark (ship-technology.com) and *CMA CGM Marco Polo* to Port Elizabeth on 20 May 2021; dimensions are 1299' LOA x 176' Beam x 52.5' draft with from 16,000 and possibly up to 18,000 nominal twenty-foot equivalent units (TEU) capacity) that are already accessing the port facilities to more safely do so due to the deeper and wider channels, reducing scouring, and will permit more efficiency, eliminating the need to ride the tides, which will reduce the risk of vessel strikes to prone aquatic species. The greater efficiency associated with permitting safe navigation for larger, newer and cleaner vessels is anticipated to reduce overall vessel calls to the port since demand for goods, which is disconnected with channel dimensions or vessel size, will not increase port calls by the larger, but will result fewer, more efficient vessels calling on the port. Because some smaller vessels have been retired in recent years and replaced by larger vessels that may be used more diversely and efficiently (i.e., options to carry large loads or smaller capacity loads when needed), the increase in larger vessel usage may not be related to a greater need for deeper draft tankers, but rather indicative of versatile usage of available vessels to transport goods.

The continued deepening is not expected to increase vessel usage of the channel above baseline levels for the duration of the action (until 2039) nor can it be correlated to any changes in the size of vessels using the channel.

To be conservative, the District will assume the temporary addition of 6 vessels during construction to the action area resulting from the Federal action. The addition of these project-related vessels will be intermittent and temporary (7-8 trips per day during construction from

2025-2039) and restricted to a small portion of the overall action area on any day dredging occurs. Table 2 includes a summary of the presumed operations. All volume projections are subject to change.

Contract Area	Sediment Type	Volume (CY)	Equipment	# Vessels	Trips/Day (to ocean/offshore placement site)	Placement Site	Dredge Window
Amb	Sand	6,389,000	*Hydraulic	3	4	HARS	Year Round
Anch	Sand/Silt	3,800,000	**Hydraulic	3	3	HARS/Non HARS	Year Round
PJ	Sand/Silt	3,003,000	**Hydraulic	3	3	HARS/Non HARS	June 1-Jan 14
KVK	Silt/Rock	4,451,000	Mech/Blast	3	3	HARS/Non HARS	July 1-Feb 28
NB	Silt/Rock	14,148,000	Mech/Blast	3	3	HARS/Non HARS	July 1-Feb 28
SE	Silt/Rock	423,000	Mech/Blast	3	3	Upland/Reef	July 1-Feb 28
PE	Silt/Rock	1,024,000	Mech/Blast	3	3	Upland/Reef	July 1-Feb 28
Total Hydraulic Volume		13,192,000					
Total Mech Volume		20,046,000					
Total Volume		33,238,000					

Table 2. Summary Table of Proposed Federal Action Operations. * Assumes hopper, only; ** Assumes hopper and cutterhead.

Best Management Practices

The District has incorporated Best Management Practices (BMPs) into our civil works programs, including abiding by seasonal restrictions designed to be protective of Federal, state and locally regulated and protected aquatic resources. Currently, there are seasonal restrictions to be protective of aquatic species that prohibit dredging operations throughout the HDCI study footprint. Specifically, to protect migratory finfish a seasonal no dredge (including blasting) restriction is placed throughout the KVK channel (beginning at its junction with Anchorage Channel) and up through the Newark Bay Main Stem Channel from March 1- June 30. Another seasonal no dredge restriction is placed at the outer portion (intersect with Anchorage Channel) of the PJ channel from January 15 through May 31.

Additionally, at this time, the District is requiring the use of a turtle excluder device (TED), in addition to UXO screens, and ESA Protected Species Observers (PSO) on Hopper dredges operating in the Ambrose channel only.

If the bridge lookout on board the hopper dredge observes a whale in the vicinity of the vessel during transit throughout the project area, maximum vessel speeds would be limited to 10 knots. If a Right Whale is observed, the vessel would maintain a 500-yard buffer from the whale. For all other whale species, a 100-yard buffer would be maintained.

2.2 Action Area Description

The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area for this consultation includes the New York and New Jersey Harbor, specifically those areas of the Harbor located in the Upper Bay, the Lower Bay, and Newark Bay, where initial dredging/deepening events will be completed (i.e., Ambrose Channel, Anchorage Channel and Port Jersey Channel, the Kill Van Kull, Newark Bay Channel, South Elizabeth Channel and Port Elizabeth Channel) and the underwater areas where the consequences of deepening could be experienced (i.e., increases in suspended sediment from dredging, blasting, noise, etc.). In addition, the action area also includes the waters between and immediately adjacent to these areas where project vessels will travel. The 20 square mile HARS is located approximately 20 miles south from the channels to be deepened in the Upper Bay of the Harbor (i.e. Kill van Kull, and Newark Bay Channels) and approximately 3 miles south from the channel to be deepened in the Lower Bay of the Harbor (i.e., Ambrose Channel) Figure 3.

Based on this information, the action area consists of the project footprint of the areas that will be dredged, up to a 1,200 meter radius around the dredge sites, up to a 152 meter radius around the blasting sites, and all routes traveled by the project vessels.

Baseline benthic sampling in Anchorage Channel revealed a similar community composition to that of Ambrose Channel prior to dredging with blue mussels also being dominant. Amphipods

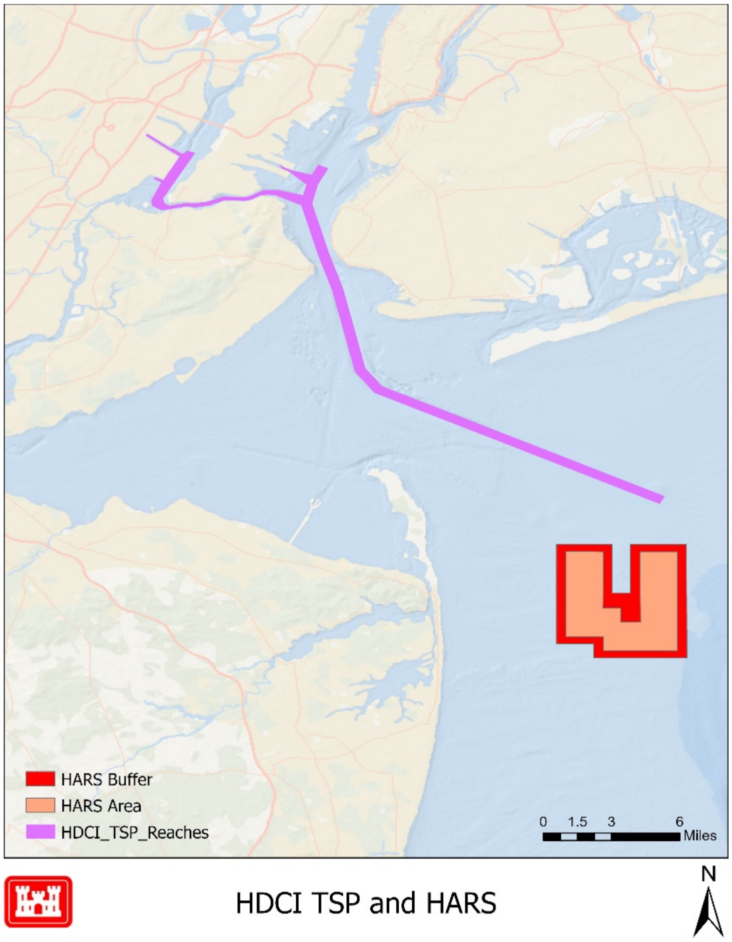
(Ampeliscidae), northern dwarf tellin (*Tellina agilis*), and the annelid species (*Spio setosa*) comprised dominant taxa in the benthic assemblage in this area. A much higher percentage of pollution tolerant taxa (29%) was present following dredging in 2009 compared to pre-dredging (10%) and blue mussels were absent post-dredging. The pre-dredging benthic community dredging, annelids dominated the benthos, primarily due to high densities of *Sabellaria vulgaris*. The abundance of pollution tolerant species doubled between the pre- and post-dredging sampling events.

Sediment contamination in NY/NJ Harbor includes synthetic compounds used in herbicide and pesticide production, metals, and petroleum hydrocarbons. Sources of contamination include combined sewer discharges, urban runoff, stormwater runoff, industrial discharges, and maritime and industrial accidents. Additionally, it is noteworthy that the average current throughout the action area is at or exceeds 1 knot/1 nm/hr.

The HDP Aquatic Biological Sampling Program (ABS) included benthic and fish sampling and monitoring from 2000 through 2010, at a minimum. The reports are located at:

New York and New Jersey Harbor Navigation Program (army.mil).

Additionally, as this BA is appended to the Feasibility Report and EA for the HDCI, the EA, and as cited, contains the latest information on many of these parameters and resources, as well.



HDCI TSP and HARS

3. Federally Listed Species in the Project Area

The federally listed species that may occur in the action area are: the endangered Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), the threatened Northwest Atlantic Ocean Distinct Population Segment (DPS) of the loggerhead turtle (*Caretta caretta*); the threatened North Atlantic DPS of green turtle (*Chelonia mydas*); the endangered Kemp's ridley turtle (*Lepidochelys kempi*); the endangered leatherback turtle (*Dermochelys coriacea*); the endangered North Atlantic right whale *(Eubalaena glacialis*); and the endangered fin whale (*Balaenoptera physalus*). Their NMFS listing and recovery plan citations follow:

- North Atlantic right whale (*Eubalaena glacialis*)(73 FR 12024; Recovery plan: NMFS 2005)
- Fin whale (*Balaenoptera physalus*)(35 FR 18319; Recovery plan: NMFS 2010)
- Loggerhead turtle (*Caretta caretta*)(76 FR 58868; Recovery plan: NMFS & USFWS 2008)
- Leatherback turtle (*Dermochelys coriacea*)(35 FR 8491; Recovery plan: NMFS & USFWS 1992)
- Green turtle (*Chelonia mydas*)(81 FR 20057; Recovery plan: NMFS & USFWS 1991)

- Kemp's ridley turtle (*Lepidochelys kempii*)(35 FR 18319; Recovery plan: NMFS et al. 2011)
- Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)(77 FR 5880 and 77 FR 5914)

There is no designated critical habitat for any protected species in the action area.

Per the NMFS 2012 HDP BO, shortnose sturgeon are not expected to occur in the action area, which terminates at the Port Jersey Channel. Shortnose sturgeon have only been observed as far south as the Statue of Liberty which is approximately 2,200 meters north of the dredging site at the Port Jersey Channel (Table 4). Therefore, the effects to shortnose sturgeon will not be considered further.

4. ESA-Listed Species in the Action Area

4.1 Atlantic Sturgeon

Five Distinct Population Segments (DPS) of Atlantic sturgeon occur in the action area:

Gulf of Maine DPS - Threatened

New York Bight DPS - Endangered

Chesapeake Bay DPS - Endangered

South Atlantic DPS - Endangered

Carolina DPS- Endangered

The first observations of sturgeon in the Hudson River date back to accounts of human settlement in the area. Fishery landings were recorded starting in 1880 and the large gear size in the fishery indicates that most of the harvest was Atlantic sturgeon (Bain et al. 2000). Scientific observations of the Hudson River population were first recorded in the 1930s and include documentation of sturgeon distributions by size and age (Bain 1997). Approximately 40 years elapsed before concern over potential impacts from electrical power plants initiated long-term monitoring programs in the 1970s that resulted in reports of sturgeon distributions and life history characteristics (Young et al. 1988). Due to a collapse in the fishery, the Atlantic sturgeon attracted little commercial interest in the Hudson River from 1900 through 1979 (Bain et al. 2000), however, the population exhibited a recovery in the 1980s and fishing for Atlantic sturgeon became a significant activity in the system in the 1990s, attracting the attention of fishery management agencies (Bain et al. 2000).

The Hudson River and estuary system is oriented in a north-south direction from NY/NJ Harbor (southern tip of Manhattan Island = km 0) with Atlantic sturgeon distributed within the tidal portion ranging as far north as the Troy Dam (km 246). Adult Atlantic sturgeon (> 150 cm TL) marked in the Hudson River have been recaptured in coastal areas from North Carolina to Massachusetts (Bain 1997). Adult females migrate to spawning grounds, which are deep, channel or off-channel habitats within the Hudson River Estuary starting in April through July (Breece 2021) and return to marine habitat the following fall (Dovel and Berggren 1983, Van Eenennaam et al. 1996). Mature males are present in the Hudson River for a longer time period than mature females, extending from April to November (Dovel and Berggren 1983) and appear at spawning sites in association with females, suggesting they search for females while moving about in the river (Van Eenennaam et al. 1996). In April 2014, NMFS received information from researchers working in the Hudson River which, through detection of tagged individuals on a receiver array, confirms the presence of adult Atlantic sturgeon upstream of RKM 193 from late April - late July (Dewayne Fox, DSU and Kathy Hattala, NYDEC, personal communication April 2014). At this time the available data are limited to three fish comprised of two males in spawning condition and an assumed male. However, given the time of year, the reproductive conditions of the fish and the known presence of suitable spawning substrate upstream of RKM 193, this strongly suggests that Atlantic sturgeon are spawning further upstream than previously suspected.

The Hudson River population of Atlantic sturgeon is one of two U.S. populations for which there is an abundance estimate (Kazyak et al 2020), with approximately 870 spawning adults/year, 600 males and 270 females (Kahnle et al. 2007) and it is considered one of the healthiest populations in the U.S. (ASSRT 2007). The NY State Department of Environmental Conservation (DEC) conducted a tagging study in collaboration with the Hudson River Estuary Program, US Fish and Wildlife Service, Pew Institute, Hudson River Foundation, and National Fish and Wildlife Foundation. In this study, Atlantic sturgeon are captured in the lower river and tagged with sonic tags. Preliminary results indicate that adults are attracted to muddy substrates, followed by sand, with lowest observances over gravel (*http://www.dec.ny.gov/animals/37121.html*).

As part of project specific biological monitoring conducted by the District, there have been several sightings of sturgeon in Upper, Lower and Raritan Bays. From 1998 through 2010, bottom trawl surveys were conducted as part of the HDP. A primary goal of the Aquatic Biological Survey (ABS) was to collect data on finfish, shellfish, macroinvertebrates, and water quality, with a focus on fish community structure, distribution and seasonal patterns of habitat use in NY/NJ Harbor. ABS sampling occurred from December to June throughout the Harbor, with stations in Newark Bay, Arthur Kill, Upper Bay and Lower Bay. These station locations include channel stations and stations in close proximity to past and future dredging sites. Throughout the 12-year sampling period, two Atlantic sturgeon were captured in bottom trawls (Table 3). The first Atlantic sturgeon was captured in June 2005 at a non-channel station in the Upper Bay. It measured 790 mm total length and presumably was a subadult. The other Atlantic sturgeon captured in the ABS surveys was 638 mm total length and was captured in December of 2009 at a channel station in the Lower Bay.

Bottom trawl surveys were also conducted in the fall of 2008 for a few days in Lower Bay as part of investigations of navigational hazards. Two Atlantic sturgeon were captured in October 2008 . The first Atlantic sturgeon measured 1,220 mm and the second measured 1,180 mm.

Additional sightings and captures of sturgeon occurred during other monitoring activities by the District and are summarized below in Table 3. Although the District conducted migratory finfish surveys in the HDP area in 2006 (USACE 2007), and reinitiated the study in 2011, no Atlantic or shortnose sturgeon observations were reported. The majority of the observations described in Table 3 were collected as part of long term and rigorous data collection efforts in the NY/NJ Harbor. Excluding the 1995 observation, only 13 sturgeon were observed over 14 years (1998-2011).

Table 3 Sturgeon observations in and around the HDP area

Species	***Date***	***Location***	***Length***	***Data Source/Comments***
Atlantic sturgeon	June 2005	Port Jersey (east of Liberty Golf Course)	790 mm	HDP ABS program
Atlantic sturgeon	October 2008	Lower Bay near approach to Ambrose Channel (between 40.457833, -73.89633 and 40.46117, -73.90267	1220 mm	Investigations near navigational obstructions
Atlantic sturgeon	October 2008	Lower Bay near approach to Ambrose Channel (between 40.457833, -73.89633 and 40.46117, -73.90267	1180 mm	Investigations near navigational obstructions
Atlantic sturgeon	December 2009	Lower Bay(chapel hill south channel)	638 mm	HDP ABS program
Shortnose Sturgeon	June 2003	Upper Bay (near Statue of Liberty)	780 mm	HDP ABS program
Shortnose Sturgeon	June 2003	Upper Bay (near Statue of Liberty)	690 mm	HDP ABS program
Shortnose Sturgeon	June 2005	Port Jersey (east of Liberty Golf Course)	1250 mm	HDP ABS program
Shortnose Sturgeon	June 2005	Port Jersey (east of Liberty Golf Course)	840 mm	HDP ABS program
Shortnose Sturgeon	May 2008	Port Jersey (east of Liberty Golf Course)	900 mm	HDP ABS program
Shortnose Sturgeon	May 2009	Port Jersey (east of Liberty Golf Course)	910 mm	HDP ABS program
Sturgeon (species not identified)	October 1998	Port Jersey (adjacent and east of Global Marine Terminal)	not recorded	HDP ABS program

Species	Date	Location	Length	Data Source/Comments
Sturgeon (species not identified)	October 2008	East of Sandy Hook between coordinates: 40.41087, -73.88474 to 40.41080, -73.88464	not recorded	Found in turtle cage during dredged material inspection. Noted on disposal log sheets from Dredged Material Inspectors, who accompany all vessels disposing dredged material at the HARS)
Sturgeon (species not identified)	September 2010	1 1/2 miles south of the Verrazano Bridge and 1/2 mile east of Hoffman Island near coordinate 40.57917, -74.04017	42"- 48" long (estimate)	Injured sturgeon (head injury) spotted by USACE vessel while conducting routine drift patrol
Atlantic sturgeon	1995	borrow area (BBA-5), between Belmar and Manasquan	Not recorded	Biological Monitoring program, Atlantic Coast of NJ: Asbury Park to Manasquan

In the Hudson River estuary, spawning, rearing, and overwintering habitats were reported to be intact by Bain (1997), supporting the largest remaining Atlantic sturgeon stock in the U.S., however, a population decline from overfishing has also been observed for this area (Bain 1997, Bain 2001, Peterson et al. 2000). Several life history characteristics make Atlantic sturgeon susceptible to overfishing, including their delayed age at maturity, vulnerability to capture, and long periods of non-spawning (Boreman 1997). Commercial landings of Atlantic sturgeon are available for NY State from 1880 through 1995. Until about 1980, most of the landings came from the Hudson River and highest annual landings occurred in 1898. Landings dropped through the early 1980's and in 1990, when the Atlantic States Marine Fisheries Commission (ASMFC) adopted an interstate fishery management plan for Atlantic sturgeon. States with open fisheries began to monitor harvest and population modeling was conducted to determine acceptable levels of harvest from the Hudson River stock. In 1993 through 1995, NY regulated the Atlantic sturgeon fishery with size limits, seasons, and area closures, determining that the Hudson River stock was being overfished. A harvest moratorium was implemented in 1996 and NJ followed with a zero quota in the same year.

Conservation of the Atlantic sturgeon population in the Hudson River has benefitted from an intensive research program in the mid-1990s funded by the Hudson River Foundation for Science and Environmental Research, which covered reproductive physiology, genetics, age structure, habitat use, behavior, and fishery attributes (Bain et al. 2000). Peterson et al. (2000) conducted a mark-recapture study to estimate the age-1 juvenile cohort size in the Hudson River and found an 80% decline in cohort size had occurred since a similarly conducted population estimate was made in 1976. Dovel and Berggren (1983) marked immature fish from 1976-1978 and calculated a year class age-1 cohort as approximately 25,000 fish, whereas the estimate by Peterson et al. (2000) from their 1994 study indicated 4,314 fish were in the age-1 cohort for that year.

Although the Hudson River subpopulation is believed to be the largest remaining Atlantic sturgeon subpopulation (NRDC 2009), bycatch mortality exceeds those levels needed to provide for a stable population (ASMFC 1990). Haley et al. (1996) cites Hoff et al. (1988) and Geoghegan et al. (1992) as reporting collections of Atlantic sturgeon as bycatch in trawl surveys conducted in the Hudson River by utility companies (April through December) between the Mario Cuomo Bridge and Coxsackie, NY.

Sediment contamination in NY/NJ Harbor includes synthetic compounds used in herbicide and pesticide production, metals, and petroleum hydrocarbons. Sources of contamination include combined sewer discharges, urban runoff, stormwater runoff, industrial discharges, and maritime and industrial accidents. Sediment contamination and silt/clay content are negatively correlated with the density and diversity of benthic organisms throughout the Harbor (Cerrato and Bokuniewicz 1986), which may in turn affect prey availability for Atlantic sturgeon.

Atlantic sturgeon are exposed to variations in dissolved oxygen because of their life history characteristics of benthic feeding and bottom dwelling and because they occur in areas with industrial pollution and temperature changes. Kieffer et al. (2011) found that Atlantic sturgeon were relatively tolerant of exposure to short-term severe hypoxia and that their biological responses may be influenced by temperature. Adult and subadult Atlantic sturgeon life stages during migration to and from spawning grounds in the Hudson River and along the coast, and nearshore feeding will be included in this analyses. Since there is no spawning habitat in the action area and the water is saline, we do not expect any spawning or early life stages to occur in the action area.

4.2 Sea Turtles.

The federally listed turtle species that may occur in the project areas are: the threatened Northwest Atlantic Ocean DPS of the loggerhead turtle (*Caretta caretta*); the endangered Kemp's ridley turtle (*Lepidochelys kempi*); the threatened North Atlantic DPS of green turtle (*Chelonia mydas*); the endangered leatherback turtle (*Dermochelys coriacea*).

In general, listed sea turtles are seasonally distributed in coastal US Atlantic waters, migrating to and from habitats extending from Florida to New England, with overwintering concentrations in southern waters. As water temperatures rise in the spring, these turtles begin to move northward and reside in relatively shallow inshore waters of the north east to take advantage of abundant forage. As temperatures begin to decline rapidly in the fall, turtles in the north east Atlantic begin to migrate back to southern waters. Sea turtles can be expected to be migrating and opportunistically foraging in the vicinity of coastal waters when the water temperature surpasses 15° C (60° F) which generally coincides with June 1. However, the window of residence for the 4 listed species is considered to be May 1 through November 30 with the highest concentration of sea turtles present from June-October (Morreale 1999; Morreale 2003; Morreale and Standora 2005; Shoop and Kenney 1992). Southern migration begins when the water drops below 15° C. Turtles are migrating out of the NYB apex and coastal areas by the beginning of November. Future warming ocean trends may cause this window to be expanded.

Per the NMFS 2012 BO for the HDP, Ruben and Morreale (1999) completed an analysis/model of habitat suitability of the New York and New Jersey Harbor complex in order to assess the impacts of the then, proposed New York and New Jersey Harbor Complex Deepening Project. As described above, the New York and New Jersey Harbor complex is comprised of the Upper Bay, the Lower Bay, Raritan Bay, and Newark Bay, which all the channels under consideration for deepening are located. The model evaluated habitat suitability based on several environmental variables considered to be important for sea turtle foraging: depth, current velocity, prey density (crab~ and mollusks). It is thought that the availability of appropriate food and suitable nesting beaches are probably the two most important controlling factors of sea turtle distribution and abundance (Shoop and Kenney 1992). In the model, the likelihood a sea turtle would forage in a particular habitat dictated the designated suitability of the environmental variables. During the warmer months, most turtles in the Northeast appear to spend the majority of the time in waters between 16 and 49 feet. This depth was interpreted not to be as much an upper physiological depth limit for turtles, as a natural limiting depth where light and food are most suitable for foraging turtles (Morreale and Standora 1990). As the channels within the Harbor Complex are proposed to be deepened to depths between 50-53 feet, the harbor channels proposed for dredging are likely too deep to be considered suitable for sea turtle foraging. Turtles usually spend most their summer foraging time in slow moving or still waters. Most of the channels in the action area are subject to strong currents (> 1 knot) and are unsuitable for foraging juvenile turtles. The deeper main channels, such as the Kill van Kull, Anchorage Channel, and Ambrose Channel, were classified as unsuitable for turtles based on their swiftly moving velocities exceeding 2.0 knots in many areas. The model also evaluated densities of crab and mollusks, the preferred prey of loggerheads and Kemp's ridleys. The Ambrose Channel was the only location within the action area that contained a high density of crabs, while several small pockets of high and/or low mollusk densities were found in the upper Newark Bay (out of the proposed dredging area) portions of the Ambrose Channel, and the Upper New York Bay. Most of the proposed project area contained sandy substrate which is optimal for young foraging sea turtles. Taking into account the results of the above model, Ruben and Morreale (1999) concluded that approximately 35% of the available habitat in the Harbor Complex was found to be marginally to· highly suitable for sea turtles, with this percentage largely found in the Lower Bay of the Harbor Complex. The model did not categorize any of the upper portions of the Upper Bay or Newark Bay (e.g., Kill van Kull, Arthur Kill) as optimal or suitable habitat for turtles.

This finding is consistent with no documented occurrences of sea turtles within portions of the Harbor Complex located in Newark Bay, Arthur Kill, and the KVK, and the rare sightings of sea turtles in portions of the Harbor Complex located in the Upper New York Harbor. Based on this information, sea turtles are not expected to be present in the portions of the action area located in Newark Bay and KVK, and thus, the effects to sea turtles in those areas will not be considered further. However, based on the model predictions of suitable habitat, the Lower Bay of the Harbor Complex is the only portion of the action area in which marginal to suitable sea turtle foraging habitat may be present. As the Ambrose Channel is located within this portion of the Harbor Complex, effects to foraging sea turtles may occur within this portion of the action area and are considered below.

It is unlikely that turtles are found in the majority of the Harbor Complex, especially in the the highly congested and trafficked channels of the Newark Bay complex. Additionally, the physical habitat characteristics in the project area do not suggest that it would represent a concentration area of or for sea turtles.

An assessment of the effects in the Anchorage Channel, Ambrose Channel, and Upper and Lower Bay (Port Jersey Channel) is included, since this is the only part of the action area likely to see turtle utilization.

4.3 Whales.

North Atlantic right and fin whales are seasonally present in the waters off New York and New Jersey. These species use the nearshore, coastal waters of the Atlantic Ocean as they migrate to and from calving and foraging grounds.

Right whales in the NYB are primarily transiting the area on their way to more northerly feeding and concentration areas. During late winter and early spring, they begin moving north along the coast past Cape Hatteras and near the Long Island Coast. Individuals have been sighted along the south shore of Long Island, Block Island Sound, Gardiners Bay and south shore inlets and bays. They could be present in the action area year-round.

Fin whales occupy both deep and shallow waters and are probably the most abundant large cetacean in NY waters. They are most abundant in spring, summer, and fall, but do have some presence during the winter months. Therefore, fin whales could be present in the action area year-round.

An assessment of effects to whales in the Lower Bay (Ambrose Channel), only, is included, since this is the only part of the action area likely to see whale utilization.

5. Environmental Baseline

Environmental baselines for biological opinions refer to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR § 402.02). The environmental baseline for this project includes the consequences of several activities that may affect the survival and recovery of the listed species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: dredging operations, vessel and fishery operations, water quality/pollution, and recovery activities associated with reducing those impacts.

Federal Actions that have Undergone Formal or Informal Section 7 Consultation

NMFS has undertaken several ESA section 7 consultations to address the effects of actions authorized, funded or carried out by Federal agencies. Each of those consultations sought to develop ways of reducing the probability of adverse impacts of the action on listed species. Consultations are detailed below.

New York and New Jersey Harbor Deepening Project (HDP)

An Opinion regarding the HDP was issued by NMFS to the USACE on October 13, 2000. The Opinion included an Incidental Take Statement (ITS) exempting the incidental taking of two (2) loggerhead, one (1) green, one (1), Kemp's ridley, or one (1) leatherback for the duration (i.e., 3 years) of the deepening, via a hopper dredge, of the Ambrose Channel. Consultation was reinitiated in 2012 and an Opinion was issued on October 25, 2012. The Opinion included an ITS exempting the incidental taking of (1), Kemp's ridley, or one (1) leatherback, and (1) Atlantic sturgeon (any DPS) for the duration of the deepening, via a hopper dredge, of the Ambrose Channel. Construction for the HDP was completed in 2016. One take of Atlantic sturgeon occurred at the Ambrose Channel under the HDP over the 12-year construction period of the project.

Amboy Aggregate Mining of Ambrose Channel

On October 11, 2002 NMFS issued an Opinion that considered the effects of the USACE's proposed issuance of a permit to Amboy Aggregates, Inc. for sand mining activities in the Ambrose Channel, New Jersey. The permit authorizes sand mining activities every year for a period of ten years. NMFS concluded that the proposed action may adversely affect but would not likely jeopardize the continued existence of listed species of sea turtles. The 2002 Opinion included an ITS which exempted the take, via injury or mortality, of two (2) loggerhead, one (1) green, one (1) Kemp's ridley, or one (1) leatherback sea for the ten-year duration of the permit. On July 23, 2012, the USACE started coordination to reinitiate this consultation to re-authorize the project for another 10 years. On May 20, 2013, NMFS concluded that the re-authorization of the project was not likely to adversely affect ESA-listed species. Therefore, this project currently no longer has an ITS.

Federally Authorized Fisheries

NMFS authorizes the operation of several fisheries in the action area under the authority of the Magnuson-Stevens Fishery Conservation Act and through Fishery Management Plans (FMP) and their implementing regulations. Fisheries that operate in the action area that may affect ESA listed species include: American lobster, Atlantic bluefish, Atlantic herring, Atlantic mackerel/squid/butterfish, Atlantic sea scallop, monkfish, northeast multispecies, spiny dogfish, surf clam/ocean quahog and summer flounder/scup/black sea bass. Section 7 consultations have been completed on these fisheries to consider effects to ESA listed species. NMFS has reinitiated consultations that consider fisheries actions that may affect ESA listed species. Atlantic sturgeon are known to be captured and killed in fisheries operated in the action area; NMFS expects that interactions may occur in all of the fisheries noted above. Data in the NEFOP database (see NEFSC 2011) indicates that captures of Atlantic sturgeon in fishing gear has been reported in all months in NOAA Statistical Area 612. In 2011, the NEFSC prepared a bycatch estimate for Atlantic sturgeon captured in Federally managed commercial sink gillnet and otter trawl fisheries operated 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, a total of 391 Atlantic sturgeon were estimated to be killed annually in these fisheries that are prosecuted in the Greater Atlantic Region (NMFS NEFSC 2011). Nearshore and coastal waters of the U.S. Northeast and Mid-Atlantic states represent a fraction of the action area assessed and for which interactions of Atlantic sturgeon are anticipated in the previous consultations for these fisheries. Nonetheless, any Federal fisheries that use sink gillnets, otter trawls, or hook and line gear are likely to interact with Atlantic sturgeon and be an additional source of incidental take and mortality in the action area for this consultation. 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 ASMFC (2017) Atlantic Sturgeon Benchmark Stock Assessment 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 per 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) are substantially lower than those from 2006-2010 (approximately 1,074 fish per year for gillnets, 1,016 for trawls) (ASMFC 2017).

Non-Federally Regulated Fishery Operations

State fisheries do operate in the state waters of New York and New Jersey. Very little is known about the level of interactions with listed species in fisheries that operate strictly in state waters. Impacts on ESA listed species from state fisheries may be greater than those from federal activities in certain areas due to the distribution of these species in these waters. Depending on the fishery in question, however, many state permit holders also hold federal licenses; therefore, section 7 consultations on federal actions in those fisheries address some state-water activity. NMFS is actively participating in a cooperative effort with the Atlantic States Marine Fisheries Commission (ASMFC) and member states to standardize and/or implement programs to collect information on level of effort and bycatch of protected species in state fisheries. When this information becomes available, it can be used to refine take reduction plan measures in state waters.

Private and Commercial Vessel Operations

The New York/New Jersey Harbor complex is a major shipping port and center of commerce, there are numerous private and commercial vessels (*e.g.*, container ships, commuter ferries) that operate in the action area that have the potential to interact with listed species. On an annual basis more than 5,124 commercial vessels and approximately 5,292,020 container vessels, as well as numerous recreational vessels transit the New York Harbor complex.

Data shows that vessel traffic is a substantial cause of sea turtle mortality. Fifty to 500 loggerheads and five to 50 Kemp's ridley turtles are estimated to be killed by vessel traffic per year in the U.S. (NRC 1990). The report indicates that this estimate is highly uncertain and could be a large overestimate or underestimate. As described in the Recovery Plan for loggerhead sea turtles (NMFS and USFWS 2008), propeller and collision injuries from boats and ships are common in sea turtles. From 1997 to 2005, 14.9 percent of all stranded loggerheads in the U.S. Atlantic and Gulf of Mexico were documented as having sustained some type of propeller or collision injuries although it is not known what proportion of these injuries were post or ante-mortem. As noted from the National Research Council (1990), the regions of greatest concern for vessel strike are outside the action area and include areas with high concentrations of recreational-boat traffic such as the eastern Florida coast, the Florida Keys, and the shallow coastal bays in the Gulf of Mexico. In general, the risk of strike for sea turtles is considered to be greatest in areas with high densities of sea turtles and small, fast moving vessels such as recreational vessels or speed boats (NRC 1990).

In certain geographic areas, vessel strikes have been identified as a threat to Atlantic sturgeon. Although the exact number of Atlantic sturgeon killed as a result of being stuck by vessels is unknown, records of these interactions have been documented (Balazik 2018, Balazik *et al.* 2012c, Brown and Murphy 2010). Other commercial and private activities therefore, have the potential to result in lethal (boat strike) or non-lethal (through harassment) takes of listed species that could prevent or slow a species' recovery. As sea turtles and Atlantic sturgeon may be in the area where high vessel traffic occurs, the potential exists for collisions with vessels transiting from within and out of the action area.

An unknown number of private recreational boaters frequent coastal waters; some of these are engaged in whale watching or sport fishing activities. These activities have the potential to result in lethal (through entanglement or boat strike) or non-lethal (through harassment) takes of listed species. Effects of harassment or disturbance which may be caused by such vessel activities are currently unknown; however, no conclusive detrimental effects have been demonstrated.

Historic Area Remediation Site (HARS)

On August 21, 2012, EPA requested re-initiation-of consultation pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended, on the continued usage of the HARS, because of the listing of a new species (five distinct population segments (DPSs) of Atlantic sturgeon on February 6, 2012. On September 21, 2012, NMFS issued a letter to the EPA concurring with their determination that continued disposal operations, including transport of material from dredge sites to the HARS site, were not likely to adversely affect any listed species under our jurisdiction (i.e., NMFS listed species of sea turtles, Atlantic sturgeon, and whales). As Section 7 consultation has previously been conducted on the disposal operation and no new information is available which changes the previous conclusion, no further consultation regarding the disposal of material at the HARS is necessary and will not be considered further in this document; the September 21, 2012 consultation is incorporated here by reference (NMFS HDP BO 2012).

Artificial Reefs

Existing reefs are already permitted and are covered by ESA Section 7 consultations to receive rock from Federal Navigation projects. One of the most recent ESA consultations was completed on April 30, 2021, which determined that the effects of the continued use, expansion, and creation of the Rockaway, McAllister Grounds, Fire Island, Moriches, Shinnecock, Atlantic Beach, Hempstead, Sixteen Fathom, Twelve Mile, Yellowbar, Kismet, Matinecock, Huntington/Oyster Bay, Smithtown, Port Jefferson/Mount Sinai, and Mattituck artificial reefs are not likely to adversely affect ESA-listed species. Therefore the effects of artificial reef placement will not be considered further. If new reefs are proposed for use by the states, they will be similarly permitted, including all necessary compliance with all environmental Federal statutes including initiating an ESA consultation, in order to receive any rock from the proposed Federal action.

6. Potential Effects from the Federal Action

Examination of the potential direct and indirect impacts resulting from removal, modification or exclusion to protected species individuals, as a result of implementation of the Federal action, is presented in this section. Different aspects of the HDCI have the potential to potentially impact these species.

This section discusses the potential impacts to adult and subadult Atlantic sturgeon, sea turtles and whales resulting from implementation of the HDCI, specifically as pertains to in-water elements of construction utilizing both mechanical and hydraulic dredges and including blast barges. Table 4 summarizes these analyses.

6.1 Atlantic Sturgeon

Potential stressors to adult and subadult Atlantic sturgeon from all five DPS related to implementation of the project may include mortality or injury from dredging and blasting construction equipment, noise, turbidity, vessel traffic, and habitat modification. Transient migrating and foraging adult and subadult sturgeon are the life stages at most risk to construction operations.

Dredging Entrainment

Although the ASSRT (2007) reports that dredging activities indirectly impact sturgeon by disrupting spawning migrations, it does not clearly state what the cause and rationale are for this threat. In the case of the Upper and Lower Bays, dredging activities have been ongoing for at least 100 years, and still the Hudson River population of Atlantic sturgeon is considered one of the healthiest populations in the U.S. (ASSRT 2007). Therefore, it would appear that despite regular dredging activities, Atlantic sturgeon are still finding and utilizing pathways through the NY/NJ Harbor to reach spawning grounds in the Hudson River. This is likely because the waterways available for migration extending from the mouth of the Hudson River to the marine environment are sufficiently deep enough and wide enough to permit Atlantic sturgeon to avoid potential dredging-related disturbances, including active dredges. It is possible for Atlantic sturgeon to be directly impacted by being entrained in a dredge. Dickerson (2006, as cited by USACE 2011) summarized sturgeon takes from Atlantic and Gulf Coast dredging activities conducted by the USACE between 1990 and 2005, which documented takes of 24 sturgeons (2 – Gulf, 11- Shortnose, and 11-Atlantic). The majority of the interactions were with a hopper dredge: sixteen takes with a Hopper dredge; five takes with a cutterhead dredge; and three takes with a mechanical dredge. Fifteen of the sturgeons were reported as mortalities, eight as alive, and one as unknown. These documented takes occurred during dredging operations in rivers and harbors, mainly in waterways along the Eastern coast that, from the map in the report, appear to be narrower (i.e., Delaware River, Savannah Harbor, etc.) than the pathways available to Atlantic sturgeon in the NY/NJ Harbor. However, the risk still exists for Atlantic sturgeon to become entrained in dredges during HDCI construction. Physical contact with a hopper dredge's drag-arm and impeller pumps may pose a threat to sturgeon. A minimum of 0.6 sturgeon per year were estimated to be entrained by hopper dredges alone (ASSRT 2007).

Per the NMFS BO for HDP (2012), while Atlantic sturgeon are vulnerable to entrainment in hopper dredges, given the large size of adults (greater than 150cm) and the size of the openings on the draghead, adult Atlantic sturgeon are unlikely to be vulnerable to entrainment.

In general, entrainment of large mobile animals, such as sturgeon (or sea turtles), is relatively rare. Several factors are thought to contribute to the likelihood of entrainment. In areas where animals are present in high density, the risk of an interaction is greater because more animals are exposed to the potential for entrainment. It has also been suggested that the risk of entrainment is highest in areas where the movements of animals are restricted (e.g., in river channels) where there is limited opportunity for animals to move away from the dredge. Because hopper dredging will occur in a largely open environment (i.e., Port Jersey intersect at Anchorage, Anchorage and Ambrose Channels), the movements of Atlantic sturgeon will not be restricted, and we anticipate that most Atlantic sturgeon will be able to avoid the dredge. Hopper dredge draghead operate on the bottom and are typically at least partially buried in the sediment. Sturgeon are benthic feeders and are often found at or near the bottom while foraging or while moving within rivers. Atlantic sturgeon migrating in the marine environment do not move along the bottom but move further up in the water column. If Atlantic sturgeon are up off the bottom while in offshore areas, such as the Ambrose Channel, the potential for interactions with the dredge are further reduced.

Per the NMFS HDP 2012 and CSRM 2020 BOs, we will use information available for all channel deepening projects that have been undertaken in open estuarine environments in the mid-Atlantic for which cubic yards of material removed are available to calculate the number of Atlantic sturgeon likely to be entrained during dredging operations. Using this method NMFS has calculated an entrainment rate of one Atlantic sturgeon is likely to be injured or killed for approximately every 5.6 million cy of material removed during hopper dredging operations undertaken during the HDP, specifically the Ambrose Channel.

While the likelihood of an interaction of an Atlantic sturgeon with a hopper dredge operating under the HDCI is expected to be low, because we know that entrainment is possible and that not all mobile animals will be able to escape from the dredge (as evidenced by past entrainment of sea turtles and sturgeon), we anticipate that entrainment is still possible. Therefore, potential effects on sturgeon from dredging entrainment of a hopper dredge are likely to adversely affect sturgeon.

While entrainment of smaller sturgeon in cutterhead dredges has been observed (as evidenced by the presence of a few individual shortnose sturgeon at the Money Island Disposal Site in the Delaware River in 1996 and 1998), these instances are rare
and have been limited to dredging events that occur near sturgeon overwintering areas where sturgeon are known to form dense aggregations of lethargic sturgeon that are less likely to respond to disturbance. However, although sturgeon may be present in the action area year round, the action area is not a known overwintering area for Atlantic sturgeon. The risk of entrainment is also higher for small fish, including early life stages and small juveniles. Because these life stages are not present in the action area and the smallest sturgeon present would be at least 2.3 feet (the size at which we expect them to begin migrations from their natal river), the risk of entrainment is extremely unlikely in the action area. Increased risk factors (i.e.,

small fish, overwintering area) are not present in the action area, overall (NY CSRM BO 2020). Therefore, the effects of entrainment from a cutterhead dredge are discountable.

Mechanical dredges are projected to be used throughout some portions of the Newark Bay Complex to remove regulated fine-grained sediments and to rip or remove rock. Closed clamshell buckets are typically deployed in regulated fine-grained sediments, and hoist speeds are usually employed, including special conditions in permits that mandate deliberate, slow placement of the closed bucket, and then retrieval/removal of sediments and their placement in a barge, with no barge overflow, designed to reduce resuspension of regulated material. The very essence of removing heavy, heaving and often still-buried or otherwise contained rock is a slow and deliberate process so as to avoid damage to the equipment and to reduce noise and vibration in the area, which also reduces risk of sturgeon entrainment or harassment. These mechanical dredge operations pose little risk to sturgeon that could be transiting an area where there are few, rare documented individuals as there is no overwintering occurring in the action area. There is plenty of room in the waterway for sturgeon to swim to avoid the clamshell bucket. Therefore, the effects of entrainment from a mechanical dredge on Atlantic sturgeon are extremely unlikely, and are, thus, discountable.

Blasting

Several studies have demonstrated that underwater blasting can cause fish mortality. Weight of the charge and distance from detonation are the most important factors affecting extent of injury and mortality, although depth of water, substrate type, and size and species of fish are also important (Keevin and Hempen 1997, Wiley et al 1981, Teleki and Chamberlain 1978, as cited by USACE 2004a). Teleki and Chamberlain (1978, as cited by USACE 2011) monitored fish mortality of 13 species in blasting experiments in Nanticoke, Lake Erie and found that fish were killed in radii ranging from 65.6 to 164 feet (20-50 m) for 50 lbs (22.7 kg) per charge and from 147.6 to 360.9 feet (45-110 m) for 600.5 lbs (272.4 kg) per charge. Mortality differed by species at identical pressure. No sturgeon were tested. Common blast-induced injuries included swimbladder rupturing and hemorrhaging in the coelomic and pericardial cavities. In 2004, USACE conducted a blast monitoring study in KVK. The type of blasting activity for the 2004 study in KVK is similar to that anticipated for NB Complex contracts. A theoretical estimate of the pressure and impact of the “average” blast event monitored during the study would result in a pressure of about 90 psi with a kill radius of approximately 375 feet. The data also implies that the charges used in the KVK Blasting Program, which were confined, appeared to have less of an impact on fish than would equivalent open water charges. Using the results of the two referenced studies in this paragraph, it is reasonable to conclude that any potential blasting impacts in NB/KVK would not reach areas in which Atlantic sturgeon are known or expected to migrate through the NY/NJ Harbor (i.e. Ambrose and Anchorage Channels) to their spawning grounds. Blasting operations only involve the action of drilling holes and setting the charge deep within the bedrock substrate. Additionally, it is anticipated the dredging (incl blasting) within most portions of the NB Complex will be subject to seasonal restrictions by New Jersey Department of Environmental Protection (NJDEP) from Mar 1 to June 30 of any year so as to be protective of migrating anadromous fish under their CWA jurisdiction. A typical blast operation includes the deployment of one blast barge, with actual blasting occurring only during the daylight hours, and required to be within the local jurisdictions (i.e. NY and NJ) noise and vibration regulatory standard parameters to avoid adverse effects to the potentially affected communities, and the potentially-affected environment. During the months of the blasting (July-February), we expect most adult and sub-adult Atlantic sturgeon to be leaving the Hudson River to the offshore foraging and overwintering sites. The blasting area is outside of the pathway to the overwintering sites. Adult and subadult Atlantic sturgeon start to leave the river by end of July and do not return until mid-May (Breece et al. 2021). Therefore, while sturgeon can enter NB, it is not a known aggregation site. Because fish would be transient and only opportunistically using the area, the risk of interaction is extremely unlikely to occur.

Therefore, potential effects to sturgeon are extremely unlikely to occur and are therefore discountable.

Noise.

A noisy underwater environment is typical since dredging activities have been ongoing for over 100 years (e.g., for shore protection, navigation improvements), and constant large vessel ship traffic to and from the NY/NJ Harbor, and recreational and commercial vessels along the south shore of Long Island, is part of the ambient conditions within and near the project area.

Since the charges for blast operation are buried in deep drilled holes in the diabase rock, there is no noise above ambient levels associated with blasting and drilling operations. If there is any noise, any elevated levels of underwater noise/pressure produced within these channels will not extend into areas of the Harbor Complex (i.e., Upper New York Harbor) where these species may occur (i.e., the District estimates that elevated levels of underwater noise/pressure levels will extend no further than 375 feet from the area being blasted; Upper New York Harbor is approximately 4,560 feet from the area to be blasted). Therefore, potential effects to sturgeon are extremely unlikely to occur and are therefore discountable.

Water Quality

Studies of the effects of turbid water on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993).

High TSS levels can cause a reduction in DO levels. Atlantic sturgeon may become stressed when dissolved oxygen falls below certain levels. Jenkins et al. (1993) observed that younger shortnose sturgeon experienced high levels of mortality at low dissolved oxygen levels while older individuals tolerated those reduced levels for short periods of time. Tolerances may decline if chronic exposure to low dissolved oxygen levels occurs. Johnson (2018) recommends that sturgeon should not be exposed to TSS levels of 1,000 mg/L above ambient for longer than 14 days at a time to avoid behavioral and physiological effects. While the increase in suspended sediments may cause Atlantic sturgeon to alter their normal movements, these minor movements will be too small to be meaningfully measured or detected. TSS is most likely to affect sturgeon if a plume causes a barrier to normal behaviors. However, we expect sturgeon to swim through the plume to avoid the area with no adverse effects.

Hopper dredges re-suspend sediment when the suction draghead(s) make contact with the substrate and during release of overflow waters, which generally occurs through the bottom of the vessel's hull. Hopper dredges have a large range in capacities and different draghead configurations. Plumes generated during hopper dredging of sandy entrance channels will have very different spatial and temporal characteristics than those created in silt-laden harbors. Near-bottom plumes caused by hopper dredges may extend approximately 2,300 to 2,400 feet (701-731 meters) down-current from the dredge (ACOE 1983). According to Wilber and Clarke (2001), suspended sediment plumes can extend 3,937 ft (1,200 m). TSS concentrations may be as high as several hundred mg/L near the discharge port and as high as several tens of mg/L near the draghead. In a literature review conducted by Anchor Environmental (2003), near-field concentrations ranged from 80.0-475.0 mg/L. TSS and turbidity levels in the near-surface plume usually decrease exponentially with increasing time and distance from the active dredge due to settling and dispersion, quickly reaching ambient concentrations and turbidities. In almost all cases, the majority of re-suspended sediments resettle close to the dredge within one hour, although very fine particles may settle during slack tides only to be re-suspended by ensuing peak ebb or flood currents (Anchor Environmental 2003). The TSS levels expected for hopper dredging (up to 475.0 mg/L) are below those shown to have adverse effect on fish (typically up to 1,000.0 mg/L; see summary of scientific literature in Burton 1993; Wilber and Clarke 2001).

Cutterhead dredges use suction to entrain sediment for pumping through a pipeline to a designated discharge site. Production rates vary greatly based on pump capacities and the type (size and rotational speed) of cutter used, as well as distance between the cutterhead and the substrate. Sediments are re-suspended during lateral swinging of the cutterhead as the dredge progresses forward. Modeling results of cutterhead dredging indicated that TSS concentrations above background levels would be present throughout the bottom six feet (1.8 meters) of the water column for a distance of approximately 1,000 feet (305 meters) (USACE 1983). Elevated suspended sediment levels are expected to be present only within a 984.3 to 1,640.4 foot (300-500 meters) radius of the cutterhead dredge (USACE 1983; LaSalle 1990; Hayes et al. 2000, as reported in Wilber and Clarke 2001). TSS concentrations associated with cutterhead dredge sediment plumes typically range from 11.5 to 282.0 mg/L with the highest levels (550.0 mg/L) detected adjacent to the cutterhead dredge and concentrations decreasing with greater distance from the dredge (Nightingale and Simenstad 2001; USACE 2005, 2010b, 2015b). The TSS levels expected for cutterhead dredging (up to 550.0 mg/L) are below those shown to have adverse effect on fish (typically up to 1,000.0 mg/L; see summary of scientific literature in Burton 1993; Wilber and Clarke 2001).

Mechanical dredges include many different bucket designs (e.g., clamshell, closed versus open bucket, level-cut bucket) and backhoe dredges, representing a wide range of bucket sizes. TSS concentrations associated with mechanical clamshell bucket dredging operations have been shown to range from 105 mg/L in the middle of the water column to 445 mg/L near the bottom (210 mg/L, depth-averaged) (USACE 2001). Furthermore, a study by Burton (1993) measured TSS concentrations at distances of 500, 1,000, 2,000, and 3,300 feet (152, 305, 610, and 1006 meters) from dredge sites in the Delaware River and were able to detect concentrations between 15 mg/L and 191 mg/L up to 2,000 feet (610 meters) from the dredge site. In support of the New York/New Jersey Harbor Deepening Project, the U.S. Army Corps of Engineers conducted extensive monitoring of mechanical dredge plumes (USACE 2015a). The dredge sites included Arthur Kill, Kill Van Kull, Newark Bay, and Upper New York Bay. Although briefly addressed in the report, the effect of currents and tides on the dispersal of suspended sediment were not thoroughly examined or documented. Independent of bucket type or size, plumes dissipated to background levels within 600 feet (183 meters) of the source in the upper water column and 2,400 feet (732 meters) in the lower water column. Based on these studies, elevated suspended sediment concentrations at several hundreds of mg/L above background may be present in the immediate vicinity of the bucket, but would settle rapidly within a 2,400- foot (732 meter) radius of the dredge location. The TSS levels expected for mechanical dredging (up to 445.0 mg/L) are below those shown to have adverse effect on fish (typically up to 1,000.0 mg/L; see summary of scientific literature in Burton 1993; Wilber and Clarke 2001).

The TSS levels expected for all of the proposed activities for those areas where sturgeon are likely to occur (i.e., Ambrose and Anchorage Channels) are below those shown to have adverse effects on fish. We expect sturgeon to either swim through the temporary and localized plumes associated with the project or make small evasive movements to avoid them (NMFS BO USACE-NAN CSRM 2020). Therefore, potential effects to sturgeon are too small to be meaningfully measured or detected and are therefore insignificant.

Habitat Modification

Potential effects on food resources are likely to be temporary and minor due to the quick recovery (due to re-sedimentation) of benthic resources within the channels, as well as due to there being no effect to the vast benthos communities adjacent to the channels, and throughout the harbor. The HDP ABS Program included several years of benthic sampling and monitoring, the extensive results of which are located here: New York District Website > Missions > Navigation > New York & New Jersey Harbor > Harbor Program Reports (army.mil). In summary, benthic recovery, and resedimentation (*eg*. sediments overlaying shale, diabase rock, or over clay) occurs within approximately two years of the last dredging event in fine grained sediments, and in large-grained sediments (eg. sand, till). Also, the area to be affected is small compared to the available habitat within the action area.

Based on the best available information as presented above, we will not be able to meaningfully detect, evaluate, or measure the effects of habitat modification on sturgeon when added to baseline conditions. Therefore, we conclude that there will be insignificant effects on sturgeon habitat due to the Federal action.

Vessel Traffic

There have not been any reports of dredge and tug vessels colliding with listed species in the area, but contact injuries resulting from dredge movements could occur at or near the water surface and could therefore involve any of the listed species present in the action area. Because the dredge is unlikely to be moving at speeds greater than 2.5 to 3 knots during dredging operations, blunt trauma injuries resulting from contact with the hull are unlikely during dredging operations. It is more likely that contact injuries during actual dredging would involve the propeller of the vessel, which is more likely to occur when the dredge is moving from the dredging area to a disposal site or between dredge locations. While the distance between these areas is relatively short, the dredge in transit would be moving at faster speeds (i.e., up to 11 knots) than during dredging operations (i.e., 2.5 knots), particularly when empty and returning to the channel areas. The speed of the dredge while empty is not expected to exceed 11 knots.

The factors relevant to determining the risk to Atlantic sturgeon from vessel strikes are currently unknown, but based on what is known for other species, we expect they are 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 Atlantic sturgeon in the area (e.g., foraging, migrating, etc.). Geographic conditions (e.g. narrow channels, restrictions, etc.) may also be relevant risk factors. Large vessels have been typically implicated because of their deep draft relative to smaller vessels, which may increase the probability of vessel collision with demersal fishes like sturgeon, even in deep water (Brown and Murphy 2010). Larger vessels also draw more water through their propellers given their large size and therefore may be more likely to entrain sturgeon in the vicinity. However as documented below, sturgeon are also at risk from exposure to smaller vessels with shallower drafts, thus making vessel traffic analyses difficult. Sturgeon are known to breach the surface and are seen over foraging areas where sturgeon congregate. Atlantic sturgeon that ascend to the surface may be exposed to shallow draft vessels. It is believed that one of the reasons for this behavior is related to the fish needing to gulp air to fill their gas or swim bladder (Logan-Chesney et al. 2018, Watanabe et al. 2008). The need to inflate the swim bladder may be more pronounced and surfacing can occur more often at depths of ≤10 meters as the sharpest change in hydrostatic pressure with lateral movement occurs within this depth range. The number of surfacing events decreases substantially when at deeper depths, and the swim bladder may collapse at depths of 40 meters such that a sturgeon is negatively buoyant, remains near the bottom, and will have to swim actively to move off the bottom (Logan-Chesney et al. 2018, Watanabe et al. 2008). Since buoyancy is related to hydrostatic pressure, at depths of ≤10 meters, the need for regulating air in the swim bladder to control buoyancy may increase during flooding and ebbing tides when the hydrostatic pressure changes rapidly. Logan-Chesney et al. (2018) found in their study that about half of the recorded surfacing events occurred during flood tide, from mid-to high-tide, and the maximum number of breach events occurred between 23:00 and 03:00. Sturgeon actively swim when ascending and descending at swim speeds ranging from 0.17 to 3.17 m/s. Thus, the ability to avoid approaching vessels may be limited when ascending.

Atlantic sturgeon interactions with vessels have been documented in the James River (Balazik et al. 2012). The Balazik et al. (2012) study was conducted in the freshwater portion of the James River from 2007-2010 and 31 carcasses of adult Atlantic sturgeon were used in the study. Twenty-six of the carcasses had scars from propellers and five were too decomposed to determine the cause of death. Nearly all of the carcasses were recovered (84%) from a narrow reach of the river near Turkey Island (RM 75) that was modified to enhance shipping efficiency. Balazik et al. (2012) indicated that the vessel interactions were likely caused by deep draft vessels because of the benthic nature of Atlantic sturgeon based on the telemetry study. Balazik and Garman (2018) suggest that a high percentage of reports (unpublished) of dead Atlantic sturgeon may be interacting with vessels in the Thimble Shoals portion of the Chesapeake Bay which is one of the entrance channels into the James River. This area can support deep-draft vessels, and telemetry studies indicate that migrating sturgeon use the channel to enter the river system.

Miranda and Killgore (2013) estimated that the large towboats on the Mississippi River, which have a propeller diameter of eight feet, a draft of up to nine feet, and travel at approximately the same speed as tugboats (less than ten knots), kill a large number of fish by drawing them into the propellers. They indicated that shovelnose sturgeon (*Scaphirhynchus platorynchus*), a small sturgeon (~50-85 cm in length) with a similar life history to shortnose sturgeon, were being killed at a rate of 0.02 individuals per kilometer traveled by the towboats.

As the Mississippi River and the NY/NJ channels differ significantly, and as we do not have the data necessary to compare shovelnose sturgeon densities in the Mississippi to Atlantic sturgeon populations in NY/NJ waters, this estimate cannot directly be used for this analysis. We also cannot modify the rate for this analysis because we do not know (a) the difference in traffic on the Mississippi River and in NY/NJ waters; (b) the difference in density of shovelnose sturgeon and Atlantic sturgeon; and, (c) if there are risk factors that increase or decrease the likelihood of strike in the NY/NJ channels. However, this information does suggest that large vessel traffic can be a major source of sturgeon mortality. In larger water bodies like the NY/NJ channels, it is less likely that fish would be killed since they would have to be close to the propeller to be drawn in. In a relatively shallow or narrow area, a big vessel with a deep draft and a large propeller would leave little space for a nearby fish to maneuver.

Although smaller vessels have a shallower draft and entrain less water, they often operate at higher speeds, which is expected to limit a sturgeon's opportunity to avoid being struck. There is evidence to suggest that small fast vessels with shallow drafts are a source of vessel strike mortality on Atlantic sturgeon. On November 5, 2008, in the Kennebec River, Maine, Maine Department of Marine Resources (MEDMR) staff observed a small (<20 foot) boat transiting a known shortnose sturgeon overwintering area at high speeds. When MEDMR approached the area after the vessel had passed, a fresh dead shortnose sturgeon was discovered. The fish was collected for necropsy, which later confirmed that the mortality was the result of a propeller wound to the right side of the mouth and gills. In another case, a 35-foot recreational vessel travelling at 33 knots on the Hudson River was reported to have struck and killed a 5.5 foot long Atlantic sturgeon (NYSDEC sturgeon mortality database (9-15-14)). A tugboat moving at about 11 knots was observed striking and killing an adult Atlantic sturgeon female in the Delaware Bay in 2016 (Ian Park, DENRC, personal communication, June 2017). Additionally, Barber (2017) found correlations between channel morphology and vessel strike risk in the James River. Because risk varies depending on a number of factors, speed from smaller vessels may pose risk at similar levels as deep-draft vessels depending on the physical environment where the fish are found. Given these incidents, we conclude that interactions with vessels are not limited to large, deep draft vessels.

Although Atlantic sturgeon may be found foraging in the action area, Atlantic sturgeon are likely to be primarily using the action area as a migration path to and from spawning, overwintering, and/or foraging sites along the eastern coastline. Based on available information, it is believed that when migrating, Atlantic sturgeon are found primarily at mid-water depths (Cameron 2010) and while foraging, within the bottom meter of the water column. As depths within the portion of the action area that dredges will be operating (i.e., channel sites to disposal sites) will be 50 or more feet, there should be sufficient clearance between the underkeel of the dredge and the bottom that Atlantic sturgeon should be able to continue essential behaviors (e.g., migration, foraging) without an interaction with a dredge to occur. However, Atlantic sturgeon are not restricted to these depths, and on occasion, have been known to occur in the upper water column. Similar to sea turtles, it may be assumed that Atlantic sturgeon are more likely to avoid injury from slower-moving vessels since the sturgeon has more time to maneuver and avoid the vessel. The speed of the dredge is not expected to exceed 2.5 – 3.0 knots while dredging, 10 knots while transiting to the disposal sites, and no more than 11 knots while empty. As such, the 11· knot or less speed of the dredge vessel is likely to reduce the chances of collision with an Atlantic sturgeon. In addition, as noted above, locations that support large ports and have relatively narrow waterways seem to be more prone to ship strikes. Neither of these characteristics applies to the remaining channels of the HDCI where Atlantic sturgeon may be found (i.e., the Ambrose Channel).

These vessels do not have deep drafts, thus two of the majorly theorized risk factors (draft and speed) are not present. Only one channel is dredged at a time, so only six additional vessels, added to the baseline, would occur at a time at a rate of approximately 7-8 trips per day.

Because there are thousands of vessel trips occurring in the action area each year, the increase in vessel traffic from periodically used project vessels is extremely small (6 vessels per event). Additionally, these vessels are slow moving, and shallow draft vessels. Non- construction-related vessel speed will remain the same throughout the channels. Accordingly, the corresponding increase in the risk of strike is very small and cannot be meaningfully measured, detected, or evaluated and therefore, effects are insignificant.

Deepening of the Channels

The proposed HDCI improvements will not increase vessel traffic in the action area. These improvements will permit larger and cleaner vessels (ex. Triple-E Class Container Ship, Denmark (ship-technology.com) that are already accessing the port facilities to more safely do so due to the deeper and wider channels, reducing scouring, and will permit more efficiency, eliminating the need to ride the tides, which will reduce the risk of vessel strikes to prone aquatic species. The greater efficiency associated with permitting safe navigation for larger, newer and cleaner vessels is anticipated to reduce overall vessel calls to the port since demand for goods, which is disconnected with channel dimensions or vessel size, will not increase port calls by the larger, but will result fewer and more efficient vessels calling on the port. The baseline, pre-construction number of vessels is predicted to decrease post- construction since the improved channels will provide for safer and more efficient navigation by larger ships. To reiterate, port calls are driven by economics, not by channel depths.

The project is formulated, evaluated, and authorized by Congress based on the parameter that no tonnage will be induced or attracted to the port's facilities as a direct result of the proposed deepening of the channels. Increasing the depth of the channel will allow segments of the current container vessel fleets to carry more cargo as well as allowing the fleets to shift to more efficient sized vessels. Therefore, the new channel depth will improve the economic efficiency of ships moving through the New York and New Jersey ports, resulting in a reduction in total vessel trips. The number of vessel calls of the largest TEU ships is not anticipated to increase in the future; however, the number of smaller sized ships in the deep draft fleet (e.g., Panamax-size ships) may decrease due to the increased efficiency of cargo loading in the future. These vessels will continue to carry the same tonnage from the origin ports but will be able to operate more efficiently in the waterways with a deepened channel from reduced lightering. These factors will more efficiently apportion operating costs for the same amount of total tonnage and further reduce total vessel trips through the port. The effects of baseline (i.e., non-project related vessels) vessel traffic is included in the discussion of threats facing the species as addressed in the Environmental Baseline section of this biological assessment. Furthermore, the dredging of the existing navigation channel will not alter the vessel traffic pattern. Therefore, any use of the channel by vessels that operate independent of the action, will not create any additional pathways for effects. As such, we do not expect the channel deepening to result in any increase in risk of vessel strike beyond what is considered in the environmental baseline. Thus any effects of vessel traffic are too small to be measured or detected, and therefore insignificant. Accordingly, the increase in risk of a vessel strike from the larger cargo vessels, is so small it cannot be meaningfully measured, detected or evaluated and is, therefore, insignificant.

6.2 Sea Turtles

Dredging Entrainment.

Historically, hopper dredging in Ambrose channel has been identified as the location and dredging type of concern for entraining some sea turtles. With the exception of one green turtle entrained in a hopper dredge operating in Chesapeake Bay, all other sea turtles entrained in dredges operating in the USACE NAD have been loggerheads and Kemp's ridley.

The number of interactions between dredge equipment and sea turtles seems to be best associated with the volume of material removed, which is closely correlated to the length of time dredging takes, with a greater number of interactions associated with a greater volume of material removed and a longer duration of dredging. The number of interactions is also heavily influenced by the time of year dredging occurs (with more interactions correlated to times of year when more sea turtles are present in the action area) and the type of dredge plant used. The number of interactions may also be influenced by the terrain in the area being dredged, with interactions more likely when the draghead is moving up and off the bottom frequently. Interactions are also more likely at times and in areas when sea turtle forage items are concentrated in the area being dredged, as sea turtles are more likely to be spending time on the bottom while foraging.

It is assumed that hopper dredging within the existing Ambrose channel footprint, from the outer entrance channel to the Verrazano Bridge, will occur year-round. It is also assumed that turtles may seasonally be transiting or utilizing the area. There were no takes of turtles under the several years of dredging under the HDP, or during any O&M subsequent projects within the same HDP Ambrose channel footprint, therefore, we can conclude that there is a low risk of a take due to implementation of the HDCI project. BMPs, such a deployment of a turtle deflector on the draghead, NMFS-approved endangered species observers, screens, and the possibility of deploying a new technology (tickler chains), will all serve to reduce the already low risk to turtles. Technical specifics on hopper dredges and their typical operation can be located in the NMFS CRSM BO 2020.

NMFS has stated that it is reasonable to expect that one sea turtle is likely to be injured or killed for approximately every 2.6 million cy of material removed from the Ambrose, Anchorage, and Port Jersey Channels. Therefore, potential effects from hopper dredging operations are likely to adversely affect turtles.

As sea turtles are not known to be vulnerable to entrainment in cutterhead dredges, presumably because they are able to avoid the relatively small intake and low intake velocity, those channels/areas within the action area (e.g., Anchorage Channel and Port Jersey Channel) that will use this type of dredge are extremely not likely to injure or kill any sea turtle that may be present. Therefore, the effects dredging entrainment from cutterhead dredging on sea turtles is discountable.

Blasting.

Per the NMFS HDP BO 2012, as part of the HDCI, blasting of bedrock may also be required to within the NB- KVK complex. Blasting operations produce underwater pressure levels and/or underwater noise levels that may cause adverse effects to sea turtles; however, as noted above, sea turtles are not known to occur in the Newark Bay or the Kill van Kull. Additionally, elevated levels of underwater noise/pressure produced within these channels will not extend into areas of the Harbor Complex (i.e., Lower Bay) where turtles may occur. Based on this and the best available information, effects of blasting on sea turtles will not be considered further.

Noise.

A noisy underwater environment is typical since dredging activities have been ongoing for over 100 years (e.g., for shore protection and navigation maintenance and improvements), and constant large vessel ship traffic to and from the NY/NJ Harbor, and recreational and commercial vessels within the Port of New York and New Jersey and throughout the Bight, is part of the ambient (and baseline) conditions within and near the project area. Therefore, the effects of noise to turtles will not be considered further.

Habitat Modification.

If sea turtles are not directly harmed by dredging equipment, the main impact would most likely be the indirect effects of dredging activities on their food resources, namely crabs and mollusks (USACE 1999). The proposed action would not be expected to significantly alter the food resources available to sea turtles for many reasons: the dredging footprint represents a very small area within the action area, the disturbed area of accumulated sand that would be directly impacted by removal would retain the same sediment grain size characteristics post-construction, and it would be quickly colonized by nearby benthos, especially since scouring, which is more detrimental to establishing or maintaining the existing or recolonizing benthos, by vessels utilizing the channel would be eliminated. The proposed action temporary and short- term modification of the physical substrate would allow for long term community stability to be re-established at the site since scouring by vessels would be significantly reduced or eliminated. The potential effects of habitat modification are therefore determined to be too small to be meaningfully measured or detected and are insignificant.

Water Quality

No information is available on the effects of TSS on juvenile and adult sea turtles. While the increase in suspended sediments may cause sea turtles to alter their normal movements, these minor movements will be too small to be meaningfully measured or detected. Sea turtles breathe air and would be able to swim away from the turbidity plume and would not be adversely affected by passing through the temporary increase in TSS. TSS is most likely to affect sea turtles if a plume causes a barrier to normal behaviors. However, we expect sea turtles to swim through the plume to avoid the area with no adverse effects.

The potential effects to water quality are therefore determined to be insignificant.

Vessel Traffic.

Boat strikes and propeller hits are probably the greatest source of injury and mortality to sea turtles in coastal areas in the northeast. Most of these are due to the abundance of speeding recreational boats. 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 nine percent of living and dead stranded sea turtles had propeller or other vessel strike injuries (Lutcavage et al. 1997). According to the 2001 STSSN stranding data, at least 33 sea turtles (loggerhead, green, Kemp's ridley and leatherbacks) that stranded on beaches within the northeast (Maine through North Carolina) were struck by a vessel. This number underestimates the actual number of vessel strikes that occur since not every vessel 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 vessel. It should be noted, however, that it is not known whether all vessel strikes were the cause of death or whether they occurred post-mortem (NMFS 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 turtles are more likely to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel. The speed of the dredge is not expected to exceed 2.5 -3.0 knots while dredging, 10 knots while transiting to the disposal sites, and no more than 11 knots while empty. As such, the 11 knot or less speed of the dredge vessel is likely to reduce the chances of collision with a sea turtle. In addition, the risk of ship strike will be influenced by the amount of time the animal remains near the surface of the water. For the HDCI, the greatest risk of project-related vessel collision will occur during transit of the construction equipment (barge, tugs, tow boats) from the dredge site to the placement site(s). Sea turtles present in these shallower nearshore waters are most likely to be foraging along the bottom, thereby reducing the likelihood of interaction with a vessel as they will be found primarily on the bottom and away from the surface of the water column near the hull of the vessel. The presence of an experienced endangered species observer or lookout who can advise the vessel operator to slow the vessel or maneuver safely when sea turtles are spotted will further reduce the potential for interaction with vessels. Vessel speed will remain the same throughout the channels. Thus any effects of vessel traffic are too small to be measured or detected, and therefore insignificant.

Deepening of the Channels

The proposed HDCI improvements will not increase vessel traffic in the action area. These improvements will permit larger and cleaner vessels (ex. Triple-E Class Container Ship, Denmark (ship-technology.com) that are already accessing the port facilities to more safely do so due to the deeper and wider channels, reducing scouring, and will permit more efficiency, eliminating the need to ride the tides, which will reduce the risk of vessel strikes to prone aquatic species. The greater efficiency associated with permitting safe navigation for larger, newer and cleaner vessels is anticipated to reduce overall vessel calls to the port since demand for goods, which is disconnected with channel dimensions or vessel size, will not increase port calls by the larger, but will result fewer and, more efficient vessels calling on the port. The baseline, pre-construction number of vessels is predicted to decrease post- construction since the improved channels will provide for safer and more efficient navigation by larger ships.

There is no relationship, correlation or causation between the proposed channel improvements and the global ocean-going fleet forecast. The HDCI study proposed action is designed to facilitate safe and economic navigation for the vessel fleet that is already utilizing the port facilities, as well as that fleet that will use it in the foreseeable future. Economic evaluations conducted by the USACE Navigation Center of Expertise have concluded that the number of vessels utilizing port channels and calling on port facilities will likely decrease as the fleets' vessel size increase. Vessel size (globally) is increasing due to economic pressures, not due to port channel depths.

The project is formulated, evaluated, and authorized by Congress based on the parameter that no tonnage will be induced or attracted to the port's facilities as a direct result of the proposed deepening of the channels. Increasing the depth of the channel will allow segments of the current container vessel fleets to carry more cargo as well as allowing the fleets to shift to more efficient sized vessels. Therefore, the new channel depth will improve the economic efficiency of ships moving through the New York and New Jersey ports, resulting in a reduction in total vessel trips. The number of vessel calls of the largest TEU ships is not anticipated to increase in the future; however, the number of smaller sized ships in the deep draft fleet (e.g., Panamax-size ships) may decrease due to the increased efficiency of cargo loading in the future. These vessels will continue to carry the same tonnage from the origin ports but will be able to operate more efficiently in the waterways with a deepened channel from reduced lightering. These factors will more efficiently apportion operating costs for the same amount of total tonnage and further reduce total vessel trips through the port. The effects of baseline (i.e., non-project related vessels) vessel traffic is included in the discussion of threats facing the species as addressed in the Environmental Baseline sections of this biological assessment. Furthermore, the dredging of the existing navigation channel will not alter the vessel traffic pattern. Therefore, any use of the channel by vessels that operate independent of the action, will not create any additional pathways for effects. As such, we do not expect the channel deepening to result in any increase in risk of vessel strike beyond what is considered in the environmental baseline. Accordingly, the increase in risk of a vessel strike from the larger cargo vessels, is so small it cannot be meaningfully measured, detected or evaluated and is, therefore, insignificant.

6.3 Whales

ESA listed species of whales will not occur in the area north of the outer portions of the Ambrose Channel. Because whales forage upon pelagic prey items (e.g., krill, copepods), dredging at Ambrose and its secondary impacts on the benthic environment will not have any direct effects on whale prey/foraging items. As such, this section will only address the effects of vessel traffic and potential water quality impacts to whales at or near the Ambrose Channel.

Vessel Traffic.

Large whales, particularly right whales, are vulnerable to injury and mortality from ship strikes. Ship strike injuries to whales take two forms: (1) propeller wounds characterized by external gashes or severed tail stocks; and (2) blunt trauma injuries indicated by fractured skulls, jaws, and vertebrae, and massive bruises that sometimes lack external expression (Laist et al.2001). Collisions with smaller vessels may result in propeller wounds or no apparent injury, depending on the severity of the incident. Laist et al. (2001) reports that of 41 ship strike accounts that reported vessel speed, no lethal or severe injuries occurred at speeds below ten knots, and no collisions have been reported for vessels traveling less than six knots. Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003; Laist et al. 2001). An analysis by Vanderlaan and Taggart (2006) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death increases asymptotically to 100%. At speeds below 11.8 knots, the probability decreases to less than 50%, and at ten knots or less, the probability is further reduced to approximately 30%.

An analysis by Vanderlaan and Taggart (2006, as referenced in HDP BO) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death of a whale increases asymptotically to 100%. At speeds below 11.8 knots, the probability decreases to less than 50%, and at ten knots or less, the probability is further reduced to approximately 30%. Impacts to listed species of whales during sand mining are unlikely because the hopper dredge would move very slowly at < 2.6 knots, a speed at which whales can avoid contact with the dredge.

Collisions with a slowly transiting hopper might occur, but the suggested reduced speed (10 knots) during transit lessens the probability of a ship strike resulting in death. Although vessel strikes are acknowledged as being one of the primary known sources of whale mortality in the northeast, ship strikes remain relatively rare events and a small increase in vessel traffic within the project area does not necessarily translate into an increase in ship strike events (NMFS Consultation Letter to USACE, Daniel Marrone 1/20/2012). Onboard lookouts would also reduce the risk of vessel-whale collisions. If the lookout on board the hopper dredge observes a whale in the vicinity of the vessel during transit throughout the project area, maximum vessel speeds would be limited to 10 knots. If a Right Whale is observed, the vessel would maintain a 500-yard buffer from the whale. For all other whale species, a 100-yard buffer would be maintained.

The potential for adding a minimal number of project vessels to the existing baseline could increase risk to whales to such a small extent that the effect of the action cannot be meaningfully measured or detected. The increase or change in traffic associated with the proposed project is small. Channel deepening dredging operations typically add approximately 6 vessels to the action area. Dredging operations, similarly, exclude other non-dredging vessels from the action area as a result of the functioning of the dredging operation vessels presence in the action area. It is the Districts conclusion that there is a net gain of zero vessels added to the action area due to the dredging operations established exclusionary zones implementation as well as the mandatory reduced speed of those vessels (as opposed to non-project-related vessels). To be conservative, the District will assume an addition of 6 vessels to Ambrose channel. Once dredging is completed, the pre-project status quo of likely vessel numbers and vessel traffic patterns will likely decrease due to the deeper channels permitting greater efficiencies, such as fewer and larger and newer vessels accessing the terminals, and, thus, not permanently increase the risk of a vessel strike. Given that the action area associated with the greatest risk to whales is in a coastal environment where listed species are able to disperse widely, and due to the temporary and localized operation of the vessels associated with the Federal action, the risk of vessel strike is extremely unlikely. As a result, the effect of the action regarding the risk of a vessel strike in the action area is discountable.

Deepening of the Channels

The proposed HDCI improvements will not increase vessel traffic in the action area. These improvements will permit larger and cleaner vessels (ex. Triple-E Class Container Ship, Denmark: https://www.ship-technology.com/projects/triple-e-class-container-ship/) that are already accessing the port facilities (ex. *CMA CGM Marco Polo* to Port Elizabeth on 20 May 2021; dimensions are 1299’ LOA x 176’ Beam x 52.5’ draft with 16,000 nominal TEU capacity) to more safely do so due to the deeper and wider channels, reducing scouring, and will permit more efficiency, eliminating the need to ride the tides, which will reduce the risk of vessel strikes to prone aquatic species. The greater efficiency associated with permitting safe navigation for larger, newer and cleaner vessels is anticipated to reduce overall vessel calls to the port since demand for goods, which is disconnected with channel dimensions or vessel size, will not increase port calls by the larger, but will result in fewer and more efficient vessels calling on the port. The baseline, pre-construction number of vessels is predicted to decrease post- construction since the improved channels will provide for safer and more efficient navigation by larger ships. To reiterate, port calls are driven by economics, not by channel depths.

The project is formulated, evaluated, and authorized by Congress based on the parameter that no tonnage will be induced or attracted to the port's facilities as a direct result of the proposed deepening of the channels. Increasing the depth of the channel will allow segments of the current container vessel fleets to carry more cargo as well as allowing the fleets to shift to more efficient sized vessels. Therefore, the new channel depth will improve the economic efficiency of ships moving through the New York and New Jersey ports, resulting in a reduction in total vessel trips. The number of vessel calls of the largest TEU ships is not anticipated to increase in the future; however, the number of smaller sized ships in the deep draft fleet (e.g., Panamax-size ships) may decrease due to the increased efficiency of cargo loading in the future. These vessels will continue to carry the same tonnage from the origin ports but will be able to operate more efficiently in the waterways with a deepened channel from reduced lightering. These factors will more efficiently apportion operating costs for the same amount of total tonnage and further reduce total vessel trips through the port. The effects of baseline (i.e., non-project related vessels) vessel traffic is included in the discussion of threats facing the species as addressed in the Environmental Baseline sections of this biological assessment. Furthermore, the dredging of the existing navigation channel will not alter the vessel traffic pattern. Therefore, any use of the channel by vessels that operate independent of the action, will not create any additional pathways for effects. As such, we do not expect the project to result in any increase in risk of vessel strike beyond what is considered in the environmental baseline.

As a result, the effect of the action regarding the risk of a vessel strike in the action area is discountable.

Water Quality

Total Suspended Solids and turbidity are most likely to affect whales if a plume causes a barrier to normal behaviors. As whales breathe air and are highly mobile, they are likely to be able to avoid any sediment plume and any effect on their movements is likely to be insignificant. While the increase in suspended sediments, which is unlikely given the large grain size of the sand, may cause whales to alter their normal movements, any change in behavior is not able to be measured or detected, as it will only involve minor movements that alter their course out of any plume which will not disrupt any essential life behaviors. Additionally, for the same reason, there would be no measurable effects on whales prey. Based on this information, we believe the effects of suspended sediment on whales resulting from increased turbidity from dredging are too small to be meaningfully measured or detected and are insignificant.

Stressor	Atlantic Sturgeon	Sea Turtles	Whales

Dredging Entrainment	LAA	LAA	N/A
Blasting	NLAA	N/A	N/A
Vessel Traffic	NLAA	NLAA	NLAA
Habitat Modification	NLAA	NLAA	N/A
Noise	NLAA	NLAA	N/A
Water Quality	NLAA	NLAA	NLAA

Table 4. Impact Summary Table (Stressors vs Species)

NLAA- Is Not Likely to Adversely Affect - the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial.

- Beneficial effects are contemporaneous positive effects without any adverse effects to the species.
- Insignificant effects are effects that are too small to be meaningfully measured or detected.
- Discountable effects are those effects that are extremely unlikely to occur.

LAA- Is Likely to Adversely Affect

N/A - Not Applicable; the effects will not be considered further.

6.4 Cumulative Effects

Cumulative effects are defined in 50 CFR § 402.02 as 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.
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. Sources of human-induced mortality, injury, and/or harassment of sea turtles and Atlantic sturgeon in the action area that are reasonably certain to occur in the future include interactions in state-regulated and recreational fishing activities, vessel collisions, ingestion of plastic debris, pollution, global climate change, coastal development, and catastrophic events. Actions carried out or regulated within the action area also include the regulation of dredged material discharges through CWA Section 401-certification and point and non-point source pollution through the National Pollutant Discharge Elimination System. We are not aware of any local or private actions that are reasonably certain to occur in the action area that may affect listed species. It is important to note that the definition of "cumulative effects" in the section 7 regulations is not the same as the NEPA definition of cumulative effects.[1] While the combination of these activities may affect sea turtles and Atlantic sturgeon, preventing or

[1] Cumulative effects are defined for NEPA as "the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

slowing a species' recovery, the full magnitude of these consequences is not completely known. However, we have considered the best information available in our assessment of both effects from the proposed action as well as cumulative effects.

State Water Fisheries
Fishing activities are considered one of the most significant causes of death and serious injury for sea turtles. Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S.fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). Fishing gear in state waters, including bottom trawls, gillnets, trap/pot gear, and pound nets, interacts with sea turtles each year. NMFS is working with state agencies to address the bycatch of sea turtles in state water fisheries within the action area of this consultation where information exists to show that these fisheries capture sea turtles. Action has been taken by some states to reduce or remove the likelihood of sea turtle bycatch and/or the likelihood of serious injury or mortality in one or more gear types. However, given that state managed commercial and recreational fisheries along the U.S. Atlantic coast are reasonably certain to occur within the action area in the foreseeable future, additional interactions of sea turtles with these fisheries are anticipated. There is insufficient information to quantify the number of sea turtle interactions with state water fisheries as well as the number of sea turtles injured or killed as a result of these interactions. While actions have been taken to reduce sea turtle bycatch in some state water fisheries, the overall effect of these actions is not fully known, and the future effects of state water fisheries on sea turtles are presently difficult to quantify due to data and monitoring limitations.

Information on interactions with Atlantic sturgeon with state fisheries operating in the action area is not available, and it is not clear to what extent these future activities will affect listed species differently than the current activities.

Vessel Interactions
NMFS's STSSN data indicate that vessel interactions are responsible for a number of sea turtle strandings within the action area each year. In the U.S. Atlantic from 1997-2005, 14.9% of all stranded loggerheads were documented as having sustained some type of propeller or collision injuries (NMFS and USFWS 2007). The incidence of propeller wounds rose from approximately 10% in the late 1980s to a record high of 20.5% in 2004 (STSSN database). Such collisions are reasonably certain to continue into the future. Collisions with boats can stun, injure, or kill sea turtles, and many live-captured and stranded sea turtles have obvious propeller or collision marks (Dwyer *et al.* 2003). However, it is not always clear whether the collision occurred pre-or postmortem. NMFS believes that vessel interactions with sea turtles will continue in the future. An estimate of the number of sea turtles that will likely be killed by vessels is not available at

this time. Similarly, we are unable at this time to assess the risk that vessel operations in the action area pose to Atlantic sturgeon. While vessel strikes have been documented in several rivers, the extent that interactions occur in the marine environment is not fully known.

Pollution and Contaminants
Human activities in the action area causing pollution are reasonably certain to continue in the future, as are impacts from them on sea turtles and Atlantic sturgeon. However, the level of impacts cannot be projected. Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from coastal development, groundwater discharges, and industrial development. Chemical contamination may have effects on listed species' reproduction and survival. Excessive turbidity due to coastal development and/or construction sites could influence sea turtle or sturgeon foraging ability. Marine debris (*e.g.*, discarded fishing line or lines from boats, plastics) also has the potential to entangle ESA-listed species in the water or to be fed upon by them. Sea turtles commonly ingest plastic or mistake debris for food and sometimes this may lead to asphyxiation.

State NPDES Permits
New York has been delegated authority to issue NPDES permits by the EPA. These permits authorize the discharge of pollutants in the action area. Permittees include municipalities for sewage treatment plants and other industrial users. New York will continue to authorize the discharge of pollutants through the state issued permits. State standards are ultimately devised using EPA's techniques, which we anticipate to be insignificant and/or discountable to all listed species, so effects of discharges should also be insignificant and discountable.

Global Climate Change
In the future, global climate change is expected to continue and may impact listed species and their habitat in the action area. However, as noted in the Status of the Species and Environmental Baseline sections above, given the likely rate of change associated with climate impacts (*i.e.*, on a decadal to century scale), it is unlikely that climate related impacts will have a significant effect on the status of any listed species over the temporal scale of the proposed action (*i.e.*, over the next 19 years) or that in this time period, the abundance, distribution, or behavior of these species in the action area will significantly change as a result of climate change related impacts.

7. Conclusion

The intent of this analyses is to reinitiate the previous Navigation Program's analyses with any new and or relevant information pertaining to the Federal Action that could affect protected species, and to acquire a Biological Opinion (BO), including an updated Incidental Take Statement, from NMFS for this improvement project.

The District has incorporated Best Management Practices (BMPs) into our civil works programs, including abiding by seasonal restrictions designed to be protective of Federal, state and locally regulated and protected aquatic resources. Currently, there are seasonal restrictions to be protective of aquatic species that prohibit dredging operations throughout the HDCI study footprint. Specifically, to protect migratory finfish a seasonal no work restriction is assumed to be placed throughout the KVK channel (beginning at its junction with Anchorage Channel) and up through the Newark Bay Main Stem Channel March 1- June 30. Another seasonal no dredge restriction is placed at the outer portion (intersect with Anchorage Channel) of the PJ channel from January 15 through May 31.

Additionally, the District is currently requiring the use of a turtle excluder device (TED), in addition to UXO screens, and ESA Protected Species Observers (PSO) on Hopper dredges operating in the Ambrose channel.

Recommendations

Finally, the District has concluded the pilot study coordinated with NMFS Protected Resources Division (PRD) to determine the feasibility of deploying a new best management practice (BMP), a tickler chain apparatus designed to reduce the risk of dredging entrainment to protected species that could be dwelling at/near the bottom during hopper dredge operations. The pilot study was undertaken at 100% Federal cost so as to be responsive to Section 7(a)(1) of the ESA which places a responsibility on all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species." The HDP 2012 BO Conservation Recommendations included discretionary activities designed to minimize or avoid (mitigate) adverse effects of an action on listed species or critical habitat, to help implement recovery plans, or to develop information. Specifically, NMFS included the recommendation to USACE to coordinate with other districts and dredge operators regarding additional reasonable measures they may take to further reduce the likelihood of takes. The diamond-shaped pre-deflector, or other potentially promising pre-deflector designs such as tickler chains, water jets, sound generators, etc., should be developed and tested and used where conditions permit as a means of alerting sea turtles and sturgeon of approaching equipment. New technology or operational measures that would minimize the amount of time the dredge is spent off the bottom in conditions of uneven terrain should be explored. Pre-deflector use should be noted on observer daily log sheets, and annual reports to NMFS should note what progress has been made on deflector or pre-deflector technology and the benefits of, or problems associated with, their usage. The District has completed the field portion of the tickler chain pilot study, coordinated the draft report with the GARFO PRD, and is now preparing the final report for distribution, and eventually publication as a USACE-ERDC Technical Note.

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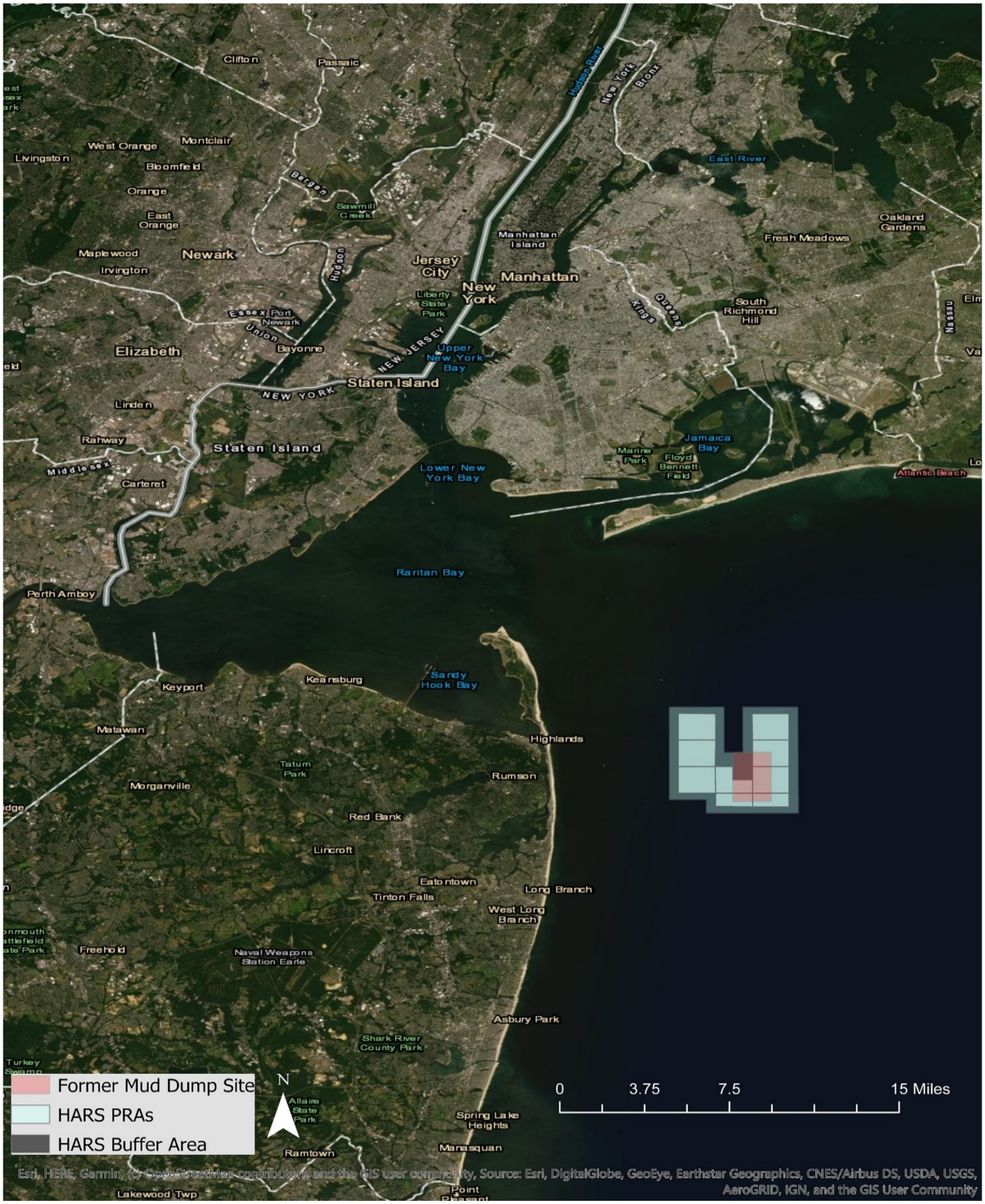
Appendix A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Appendix B

NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

Agency: Army Corps of Engineers (USACE), New York District

Activity: New York and New Jersey Harbor Deepening Channel Improvements (HDCI) Navigation Study

GARFO-2020-03300

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Conducted by: National Marine Fisheries Service
Greater Atlantic Regional Fisheries Office

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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 consequences of the U.S. Army Corp of Engineers' (USACE) proposed initial channel deepening to the already completed 50 Foot New York/New Jersey (NY/NJ) Harbor Deepening Project (HDP) under the newly authorized Harbor Deepening Channel Improvements (HDCI) study. This Opinion is based on the information provided in the Biological Assessment (BA) dated September 14, 2021, past consultations with the USACE New York District (District), and scientific papers and other sources of information as cited in this Opinion. We will keep a complete administrative record of this consultation at our NMFS Greater Atlantic Regional Fisheries Office. Formal consultation was initiated on September 14, 2021.

2.0 PROJECT HISTORY

2.1 Harbor Deepening Project (HDP)

The NY/NJ Harbor (Port) is a major shipping port and center of commerce. The key channels have to be dredged to meet the growing demands of the Port, which is the nation's third largest container port. The primary goal of the HDP has been to provide access to and accommodate the demand for international cargo through the NY and NJ region by deepening several navigation channels in the Port of NY and NJ to a depth of -50 feet below mean lower low water (MLLW). The HDP was authorized pursuant to the Water Resources Development Act of 2000 (Public Law No. 106-541, December 11, 2009). The original HDP involved the deepening and widening of Federal channels, as well as the management of the dredged material produced by these operations.

On June 14, 1999, you (USACE) began consulting informally with us (NMFS) under section 7 of the ESA regarding a proposal to deepen some of the major channels in the Harbor Complex (*i.e.*, Ambrose, Anchorage, Bay Ridge, Port Jersey, Kill van Kull, Arthur Kill, and Newark Bay). Several concerns were raised by us because endangered and threatened sea turtles have the potential to be in the project area. Informal consultation was subsequently determined as not able to adequately ensure that sea turtles would not be harmed by the project due to the type of dredge proposed in selected channels and the project time frame. Therefore, formal consultation was necessary.

On January 5, 2000, you sent us supplemental information and clarification on the BA and Final Environmental Impact Statement for the proposed project. In a January 21, 2000, letter to us, you requested formal consultation on this action. Before we agreed to initiate formal consultation, additional information was requested and supplied to us via a telephone conversation on February 15, 2000.

On February 18, 2000, consultation was initiated, with a Biological Opinion issued by us to you on October 13, 2000. The 2000 Opinion addressed the consequences of the initial deepening of the previously mentioned channels to 50 feet with 50 years of maintenance dredging. Maintenance dredging did not include the Ambrose Channel, which is the only location where hopper dredging has occurred. In this Opinion, we concluded that the HDP was likely to adversely affect but was not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, leatherback or green sea turtles. The Opinion included an Incidental Take Statement (ITS) exempting the incidental taking of two (2) loggerhead, one (1) green, one (1) Kemp's ridley, or one (1) leatherback for the duration (*i.e.*, 3 years) of the deepening, via a hopper dredge, of the Ambrose Channel. Due to the proposed method of dredging (*i.e.*, clamshell bucket dredge or hydraulic cutterhead dredge) and location which we considered to be unsuitable sea turtle habitat, dredging activities in Anchorage Channel, Bay Ridge Channel, Port Jersey Channel, Kill van Kull, Arthur Kill, and Newark Bay Channels were not expected to result in any lethal or non-lethal take of sea turtles. As such, no incidental take was designated for dredging activities in these channels.

On October 6, 2010, we published two proposed rules to list five distinct population segments (DPS) of Atlantic sturgeon under the ESA (*i.e.*, New York Bight, Chesapeake Bay, Carolina and South Atlantic (endangered); Gulf of Maine DPS (threatened); 75 FR 61872, 75 FR 61904). Once a species is proposed for listing, as either endangered or threatened, the conference provisions of the ESA may apply (see ESA section 7(a)(4) and 50 CFR 402.10). As stated at 50 CFR 402.10, "Federal agencies are required to confer with NMFS on any action which is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat."

Pursuant to the October 6, 2010 proposed rule, on May 17, 2011, you requested, via email, a meeting to discuss the need to conference on Atlantic sturgeon in relation to the ongoing HDP. On May 24, 2011, we held a conference call. After both agencies discussed the remaining work to be undertaken under the HDP, and the potential consequences the remaining work may have on Atlantic sturgeon, both agencies agreed that a conference was necessary, and that a BA would be written and provided to us. On October 19, 2011, we received, via email, the BA for the HDP. After review of the BA, we requested additional information and revisions to be made to the BA. On January 31, 2012, we received a revised BA; however, after review of the BA, additional questions remained, particularly in regard to the use of unexploded ordinance screens (UXO) on hopper dredges. We requested additional information on the consequences of using this screen on listed species, as well as how the use of these screens may impact observer ability to appropriately monitor potential take of listed species when these screens are in use. Discussions regarding this matter continued until May 4, 2012, when a meeting was held between both agencies. At the end of the teleconference, a resolution was reached and you agreed to provide us with a revised and final BA. On June 12, 2012, we received, via email, the final revised BA.

February 6, 2012, is the date we published two final rules listing five distinct population segments (DPSs) of Atlantic sturgeon (with an effective date of listing on April 6, 2012 (77 FR 5880; 77 FR 5914)). As we did not receive all the necessary information to complete a conference before February 6, 2012, a conference was never formally initiated. However, on June 15, 2012, you confirmed, via email, that the June 12, 2012, BA for the HDP, served as your official request for reinitiation of formal consultation on the HDP.

We issued the Biological Opinion on October 25, 2012. In this Opinion, we concluded that the HDP:

- is likely to adversely affect, but is not likely to jeopardize the continued existence of the Northwest Atlantic Ocean Distinct Population Segment (DPS) of loggerhead sea turtle; Kemp's ridley sea turtles; and the Gulf of Maine (GOM), New York Bight (NYB), Chesapeake Bay (CB), Carolina, or South Atlantic (SA) DPSs of Atlantic sturgeon;
- is not likely to adversely affect leatherback or green sea turtles or North Atlantic right, humpback or fin whales; and
- will not affect shortnose sturgeon or hawksbill sea turtles.

The 2012 Opinion included an Incidental Take Statement (ITS) exempting the incidental take of no more than one sea turtle for approximately every 2.6 million cubic yards (CY) of material removed from the channel areas via a hopper dredge, which over the remaining life of the project (*i.e.*, through 2014), exempted the take of one sea turtle, with this sea turtle being a loggerhead or a Kemp's ridley. In addition, the ITS exempted the incidental taking of no more than one Atlantic sturgeon for approximately every 5.6 million cubic yards (CY) of material removed from the channel areas via a hopper dredge, which over the remaining life of the project, exempted the take of one Atlantic sturgeon. This Atlantic sturgeon could have come from any DPS. No incidental take was issued for dredging operations involving clamshell or hydraulic cutterhead dredges.

Fifty years of maintenance dredging was planned as part of the HDP to maintain the channels and would occur as needed and as funding permitted. As a result, we strongly recommended to you that maintenance dredging and its consequences on listed species and their habitat be considered in the 2012 BA and therefore, within the 2012 Opinion. Correspondence with you on September 12, 2011, indicated that you were not going to assess and include the impacts of maintenance dredging operations within the BA as the Division of the USACE responsible for the initial deepening being undertaken by the HDP (*i.e.*, Planning Division) was not responsible for future maintenance of the channels (pers. comm., Ann Marie Dilorenzo, New York District USACE, September 12, 2011; USACE 2012 BA). Additionally, you informed us, if and when you receive appropriations for maintenance dredging, and such dredging is required, the planning division would reinitiate consultation.

Based on this information, and at your request, the 2012 Biological Opinion did not assess the impacts associated with Operation and Management of the HDP as this was a feature authorized under the Civil Works program, not the Planning Division, which is the division of the USACE responsible for the HDP, the federal action under consideration for 2012 Opinion. At the time, any maintenance of the Federal channels would have been conducted under separate authority and coordinated with us as such. Therefore, at the time, you did not wish to address maintenance dredging under the 2012 correspondence.

In 2013, only one contract (*i.e.*, channel) of the HDP remained to be deepened (*i.e.*, Arthur Kill contract). Additionally, recent surveys taken by the District indicated that shoaling rates, exacerbated by Hurricane Sandy, had accelerated in some Upper Bay (*i.e.*, Port Jersey, Eastern

Kill Van Kull, Anchorage (utility corridor)) and Newark Bay (*i.e.*, Middle Newark Bay, and Western Kill Van Kull/Southern Newark Bay) channels that were previously deepened and thus, removal of these shoals was necessary for safe navigation, as well as for the purposes of transitioning the Civil Works deepening project to the Operations and Maintenance Program within the District. As a result, a new contract to the HDP (*i.e.*, the Shoal Removal and Utility Contract (SRUC)) was needed to remove the resulting shoals from the affected reaches of the Upper Bay and Newark Bay channels.

On April 16, 2013, you sent us a letter regarding the newly proposed NY and NJ HDP SRUC. In our May 6, 2013, response letter, we concurred with the your determination that the proposed SRUC did not trigger the need to reinitiate formal consultation pursuant to section 7 of the ESA, as amended, as the newly proposed action did not differ significantly from the actions we considered in the 2012 HDP Opinion.

The construction of the HDP was completed in 2016. The project improved navigational safety to accommodate larger, deeper-draft vessels that were accessing the port facilities.

In March 2018, an Initial Appraisal Report, per compliance with Section 216 of WRDA 1970, was completed to determine if there is potential federal interest to undertake modifications to the existing 50-foot federal navigation project. The Initial Appraisal Report states that the accelerating expansion of the volume of trade that has taken place since the existing 50-foot federal navigation project was authorized has led to the existing project's dimensions, based on the design vessel, the *Regina Maersk*, as recommended in the 1999 Study, being superseded in use in the Port of New York and New Jersey much sooner than anticipated in the 1999 Study. This fact has a material effect on the economics and engineering design of the 50-foot federal navigation project. The Initial Appraisal Report made the recommendation to "investigate and determine if there is a Federal interest in continuing the project with the preparation of cost-shared feasibility report for analyzing alternatives to address the identified problems though possible modifications of the project." As an outcome of the Initial Appraisal Report, the resulting study is called the New York and New Jersey Harbor Deepening Channel Improvements, Navigation Feasibility Study (HDCI Study). Water Resources Development Act 1970 Section 216 limits the analysis of the NY/NJ HDCI Study to the constructed 50-foot federal navigation project.

You submitted a BA, along with a request to reinitiate consultation on the proposed channel improvements to the HDP, as recommended under the HDCI authorization, on November 9, 2020. This proposal is consistent with the HDCI Navigation Study (draft Integrated Feasibility Report and Environmental Assessment published on October 2020). On November 10, 2020, we requested additional information that was necessary prior to initiation of consultation. You provided us with a final revised BA on September 14, 2021. On October 19, 2021, we sent you a letter stating that all information required to initiate formal section 7 consultation was included in your September 14, 2021 letter and BA, or is otherwise accessible for our consideration and reference; therefore, the date of the September 14, 2021 correspondence will serve as the commencement of the formal consultation process. In the initiation letter, we also clarified that because the HDP was completed in 2016, the HDCI study is considered to be a new action and did not meet the triggers for reinitiation. The ESA and the section 7 regulations (50 CFR§402.14) require that formal consultation be concluded within 90 calendar days of initiation (*i.e.*, December 13, 2021), and that a biological opinion be completed within 45 days after the conclusion of formal consultation (*i.e.*, January 27, 2022), unless we mutually agree on an extension.

As the study, conducted under SMART, moves through the authorization process to the Pre-Engineering and Design (PED) and Construction (CO) phases of a project, if there are any significant changes to the proposed action, or to the action area, you will reinitiate consultation with us, as is required under ESA, and under USACE implementing regulations.

3.0 DESCRIPTION OF THE PROPOSED ACTION

The national economic development (NED) plan is the Tentatively Selected Plan (TSP) identified for this study. This includes the additional width required for structural stability and for the navigation of a Triple E Class vessel to transit from sea to Port Elizabeth and Port Jersey. Channel configurations were designed to avoid and minimize environmental and cultural resource impacts while still meeting navigation safety requirements. This Opinion considers the consequences of the TSP which involves initial deepening of the following waterways by five feet (Figure 1):

- Ambrose Channel (Amb),
- Anchorage Channel (Anch),
- Port Jersey Channel (PJ),
- Kill Van Kull (KVK),
- Newark Bay Channel (NB),
- South Elizabeth Channel (SE), and
- Port Elizabeth Channel (PE)

Figure 1. Tentatively Selected Plan Overview for HDCI.

The major channels under study in the HDCI will provide access to three main existing container terminals: The Port Newark Terminal and Elizabeth Marine Terminal in Newark Bay and the Global Marine Terminal on the Port Jersey Peninsula (Figure 2).

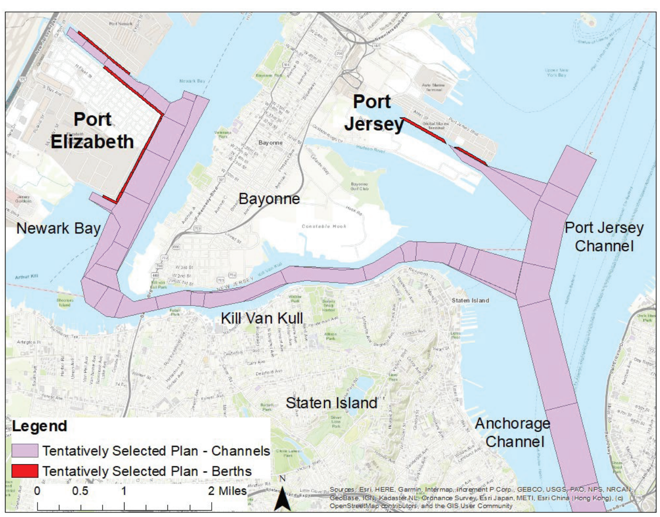

Figure 2. TSP/RP Channel Configurations. Note: Berth Deepening is included in the TSP as an Associated Cost, only, per USACE regulations. Berths, which are proposed for deepening

regardless of the HDCI implementation will not be deepened under the HDCI Project, and therefore, will have its own separate consultation.

The TSP is anticipated to become the Recommend Plan (RP) upon the Action Agency's determination of the Finding of No Significant Impact, per National Environmental Policy Act (NEPA) requirements. If there are changes or revisions to the TSP or RP that would warrant reinitiation of consultation with us, you would reinitiate consultation according to ESA statutory requirements. The initial dredging and blasting events are expected to occur from 2025 through 2039 (January 1, 2025 to December 31, 2039).

3.1 Deepening

Table 1 describes the current TSP dimensions and characteristics. Contract designations in the footnotes from the HDP are used for illustrative purpose, only. The HDCI study has not yet identified each construction contract. According to the Distict, it is impossible to calculate exact volumes of material to be dredged at this time of the study. Any significant changes to the proposed action that are not addressed in this BA that changes the level of consequences will be cause for reinitiation of formal consultation with us. You also indicate that we will be apprised of any changes to the proposed project over the course of the 15-year project, as is required.

Table 1. TSP/RP Channel Dimensions and Characteristics

	Proposed Maintained Channel Level[a] [ft MLLW]	Proposed Authorized Channel Level[b] [ft MLLW]	Total Depth[c] [ft MLLW]	Length of Improve-ment [ft]	Quantity to be Dredged (CY)	Channel Bottom Width	Predominant Side Slope	Predominant Channel Bottom Material Type
Ambrose Channel	-58	-58	-59	90,000	6,389,000	2,000	3:1	Sand
Anchorage Channel	-55	-55	-56.5	31,000	3,800,000	2,000	3:1	Sand
Port Jersey Channel	-55	-57	-58.5	6,000	3,003,000	450 to 2,313	3:1/1:1 against berths	Sand/sediment
Kill Van Kull	-55	-57	-58.5	28,000	4,451,000	800 to 2,313	3:1/1:1 through rock	HARS[d] suitable material & moderately hard rock and till
Newark Bay	-55	-57	-58.5	13,000	14,148,000	1,740 to 2,008	3:1/1:1 through rock & against berths	Non-HARS suitable material & moderately hard rock and till
South Elizabeth Channel	-55	-57	-58.5	2,000	423,000	500 to 640	3:1/1:1 through rock & against berths	Non-HARS suitable material & moderately

	Proposed Maintained Channel Level[a] [ft MLLW]	Proposed Authorized Channel Level[b] [ft MLLW]	Total Depth[c] [ft MLLW]	Length of Improve-ment [ft]	Quantity to be Dredged (CY)	Channel Bottom Width	Predominant Side Slope	Predominant Channel Bottom Material Type
								hard rock and till
Port Elizabeth Channel	-55	-57	-58.5	8,000	1,024,000	500 to 750	3:1/1:1 through rock & against berths	Non-HARS suitable material & moderately hard rock and till

[a]Maintained channel level includes the summer salt water draft, squat, salinity, wave motion, and safety clearance. The channels will be maintained at this depth.
[b]The authorized channel level includes additional safety clearance needed for hard bottom.
[c]The total depth includes an additional dredging tolerance (paid overdepth). This is the sum of the depths and specific to each plan.
[d] HARS = Historic Area Remediation Site

Table 2 includes a summary of the presumed operations. All volume projections are subject to change.

Table 2. Summary Table of Proposed Federal Action Operations.

Contract Area	Sediment Type	Volume (CY)	Equipment	# Vessels	Trips/Day (to ocean/offshore placement site)	Placement Site	Dredge Window
Amb	Sand	6,389,000	*Hydaulic	3	4	HARS	Year-round
Anch	Sand/Silt	3,800,000	**Hydaulic	3	3	HARS/ Non-HARS	Year-round
PJ	Sand/Silt	3,003,000	**Hydaulic	3	3	HARS/ Non-HARS	June 1 – January 14
KVK	Silt/Rock	4,451,000	Mechanical/Blast	3	3	HARS /Non-HARS	July 1 – February 28
NB	Silt/Rock	14,148,000	Mechanical/Blast	3	3	HARS /Non-HARS	July 1 – February 28
SE	Silt/Rock	423,000	Mechanical/Blast	3	3	Upland/ Reef	July 1 – February 28
PE	Silt/Rock	1,024,000	Mechanical/Blast	3	3	Upland/ Reef	July 1 – February 28

Total Hydraulic Volume: 13,192,000
Total Mechanical Volume: 20,046,000
Total Volume: 33,238,000
* = Assumes hopper, only
** = Assumes hopper and cutterhead

3.1.1 Dredging

Dredging equipment comprises mid to large hopper dredges, cutterhead dredges, and open and closed clamshell dredges (Table 2). Hoppers are assumed to be deployed in sandy and unconsolidated till areas assessed as suitable for placement at the Historic Area Remediation Site

(HARS), such as is present in the Ambrose (as they were under the HDP), Anchorage, and Port Jersey Channels. The mechanical and cutterhead dredges are assumed to be deployed in areas with soft substrate that is unsuitable for HARS placement. Cutterhead dredges may, specifically, be used in the Anchorage and Port Jersey Channels. The mechanical dredge and blast barges are also assumed to be deployed in areas with harder material suitable for HARS or reef placement (*i.e.*, Kill Van Kull, Newark Bay, South Elizabeth, and Port Elizabeth Channels). All dredged material will be placed at permitted sites that are already covered under ESA consultation or where an ESA consultation is not necessary (*i.e.*, upland). Therefore, the consequences of placement will not be considered further.

3.1.2 Blasting

A blast barge may be utilized in areas where unfractured rock is determined to remain, notably in the Newark Bay-Kill Van Kull complex area. Blasting operations, which will be required to abide by state and local noise and vibration regulations, will include one blast barge and at least one tender vessel. Typically, they are staged in the highly restricted and United States Coast Guard (USCG)-monitored target area according to well-established overall safety protocols. These protocols can be unique to each individual blasting operation. A blast monitoring program conducted under the HDP (then known as the Kill Van Kull Deepening Project) that included voluntary fish monitoring describes a typical operation (USACE 2004). Typical Best Management Practices (BMPs) for a blast operation include time of day restrictions (daylight, only), property distance offsets, adherence to local noise and vibration thresholds, and adherence to all state and NMFS-mandated seasonal restrictions. Until the blasting plan for the HDCI is determined, it is assumed that the plan will be similar to what was done for the HDP (as described in the Kill Van Kull Blast Monitoring Program (USACE 2004) and the 2002 Blast Plan (Bean Stuyvesant 2002)). The Kill Van Kull blasting protocol (USACE 2004) attempted to optimize production and reduce environmental consequences as defined by Keevin and Hempen (1997). Optimized blasting (Keevin and Hempen 1997) is accomplished by:

- reducing the weight of explosive by accounting for the characteristics of the media, blasting pattern, and the properties of the blasting material,
- use of water gel explosives,
- increasing the number of delays to progressively displace material, and
- stemming boreholes to prevent pre-mature venting of explosive gases and dampen the pressure shock wave.

You will coordinate an appropriate monitoring program with us after blast plans are developed, and prior to the award of blasting contracts. A site-specific blasting plan will be submitted to us up to 14 days prior to the conduct of the work for review and input as pertains specifically to our trust resources. Our comments will be due to you as soon as possible upon our receipt of the blast plan. You will incorporate only those resource protective BMPs that are determined to be feasible, per your Environmental Operating Principles and per your obligations under the ESA, so as not to adversely affect the construction schedule. The blast plan will establish the expected pressure levels, proposed timing, and minimization measures.

According to the Kill Van Kull blasting monitoring program (USACE 2004), the blasting process entails the use of barge-mounted drill towers to bore a series of holes into the bedrock. For the HDP specifically, the 4.5-in. diameter holes were 10- to 15-feet deep into bedrock and arranged approximately 12 feet apart in a row configuration referred to as a range. Each range typically consisted of six holes in a line. Each blast event (shot) had up to five parallel ranges separated by 10 feet with boreholes staggered between adjacent ranges. The arrangement of holes varied among shots, depending on factors such as location, thickness of rock to be removed, and specific objective of the shot. Each hole was packed with water gel ammonium nitrate derivative high explosive, and stemmed with coarse gravel at the top of the hole to confine and direct the blast energy into the rock. A detonation cord runs from the barge to a booster at each hole. Delays were used for detonation of each shot, *i.e.*, the charges in individual holes were detonated in sequence with a detonation delay of 25 m-seconds between holes.

The main blasting agent used in October 2003 by the Joint Venture was EL957C, a water gel emulsion, manufactured by ETI Canada Ltd. The emulsion is not cap sensitive. The emulsion has a specific gravity of 1.30 and a detonation velocity of 20,000 feet/second (fps). The blasting agent was packaged in 2.75-inch (in) diameter polythene sleeves, each weighing 4.23 pounds (lb). Typically charges ranged between 25 and 29 lb per shot hole, depending on the height of rock relative to the dredge depth of 53.5 feet (ft). Larger emulsion weights were often used in one or more holes for each shot.

The initiation system was comprised of a Detaline dual path, precision delay, non-electric initiation cord and components. By using a non-electric initiating system the shot was safely initiated and connected without concern for radio silence. Radios can initiate electric systems. The system utilizes a fine extruded detonating cord with a PETN explosive core of 2.4 grains per ft. The timing and delay sequence to the shot holes were achieved with “Detaslide Delays” detonators. The detonators were used in each booster and were connected via Detaline to “Detaline Surface Delays.” The surface delays were connected to a dual trunk of Detaline.

All the shot holes were drilled, loaded and connected to the dual trunk line. The shot was initiated using a “Noiseless Lead-in-Line.” An instantaneous detonator was attached to a 500-ft length of hollow shock tube that contained explosive dust. The entire shot was initiated by a simple shot-shell primer, which was fired into the shock tube connected to the trunk line delay system to the individual shot holes.

Upon initiating the blast, each cord carries the detonation to its shot hole. In doing so, the cord itself sets up a “tubular” pressure front that forms around the cord along its entire length. How the pressure from the multitude of Detalines affected the recorded blast pressures or how the lines may impact fish (if separate from the confined blasts) is unknown at this time. It can only be assumed that these “other” pressures were incorporated into recorded values.

The delay sequence was resolved by a predetermined evaluation plan and placed by the number of holes drilled in each range and the number of ranges for the particular shot. Thus the actual delay timing deployed was a process of both the plan and the actual holes that were found above the pay grade.

In your email dated December 1, 2021, you recommended not specifying the maximum underwater noise, maximum underwater overpressure, or a maximum charge weight per delay at this time because a test blast program will be conducted to collect site specific monitoring data prior to production blasting and dredging. Based upon past operations, it is assumed that the blasting may occur during daylight hours only, Monday through Saturday, and will occur only from July 1 through February 28 of any year, in discreet locations within the NB/KVK complex, only. Blast operations are very site specific, as there are new or different considerations with each blast proposal at each site requiring blasting. As it is currently unknown exactly where, or if, blasting will occur, we can only assume at this time that some parts of the NB Complex (South Elizabeth and Port Elizabeth Channels), especially near the KVK intersection, might require blasting. It is unknown whether fish monitoring will be a requirement for this project so it will not be considered further at this time. If fish monitoring does become a requirement and changes the consequences of the action, it may require further analysis and a reinitiation of consultation.

3.2 Maintenance Dredging

Per the request of the District, the 2012 HDP Opinion only covered the initial deepening and Civil Works has since not requested formal consultation on any maintenance deepening. As we did for the 2012 HDP Opinion, we strongly recommended to the District that maintenance dredging and its consequences on listed species and their habitat be considered in their BA and therefore, within the current Opinion. Correspondence with the District on August 4, 2021, and September 29, 2021, indicated that they were not going to assess and include impacts of maintenance dredging operations within their BA as the division of the USACE responsible for the initial deepening being undertaken by the HDCI study (*i.e.*, Planning Division) is not responsible for future maintenance of the channels (pers. comm., Jenine Gallo, New York District USACE, August 4, 2021; pers comm., Peter Weppler, New York District USACE, September 29, 2021; (USACE 2021)). According to the District, the Navigation Operation and Maintenance (O&M) Program is a separately authorized and funded program from the Civil Works program and are considered two distinct and separate federal actions. The HDCI Study is authorized and funded as a stand-alone study that does not include the O&M projects. Additionally, the District informed us, if and when the District received appropriations for maintenance dredging, and such dredging is required, the District will reinitiate consultation.

Based on this information, and at the request of the District, this Opinion will not assess the impacts associated with O&M of the HDCI study as this is a feature authorized under the Civil Works program, not the Planning Division, which is the division of the USACE responsible for the HDCI study, the federal action under consideration for the current Opinion. Any maintenance of the federal channels would be conducted under separate authority and coordinated with us as such. To date, there is no information on the funding availability and thus, potential timeframe under which maintenance dredging will be undertaken and therefore, at this time, the District does not wish to address maintenance dredging under this correspondence (USACE 2021).

3.3 Vessels

3.3.1 Project Vessels

To be conservative, you will assume the temporary addition of six vessels to the action area during construction as part of the Federal action. The addition of these project-related vessels will be intermittent and temporary (7-8 trips per day during construction from 2025-2039) and restricted to a small portion of the overall action area on any day dredging occurs. The dredge in transit would be moving at faster speeds (*i.e.*, up to 11 knots) than during dredging operations (*i.e.*, 2.5-3.0 knots), particularly when empty and returning to the channel areas. The speed of the dredge while empty is not expected to exceed 11 knots.

3.3.2 Vessels Associated with the HDCI Study

In March 2018, an Initial Appraisal Report, per compliance with Section 216 of WRDA 1970, was completed to determine if there is potential federal interest to undertake modifications to the existing 50-foot federal navigation project. The Initial Appraisal Report states that the accelerating expansion of the volume of trade that has taken place since the existing 50-foot federal navigation project was authorized has led to the existing project's dimensions, based on the design vessel, the *Regina Maersk* (Figure 3), as recommended in the 1999 Study, being superseded in use in the Port of New York and New Jersey much sooner than anticipated in the 1999 Study.

According to the District, the proposed HDCI improvements will not increase vessel traffic (USACE 2020b). According to the Environmental Assessment (USACE 2020c), without-project condition (*i.e.*, if the HDCI action did not occur) the future fleet is still expected to contain ships such as the *Maersk Triple E* Ultra Large Container Vessel (ULCV) Class (Triple E) (Figure 3). In this scenario, a Triple E vessel would have to transit the channel light-loaded so as to not exceed the 49-foot draft limit (USACE 2020c). While your BA indicates that the proposed HDCI improvements permit larger and cleaner vessels that are already accessing the port facilities to more safely do so, the Economic Analysis for the HDCI study (USACE 2020b) assumes that the channel deepening will lead to the lifting of the 49-foot draft restriction for container vessels to the Port Jersey and Elizabeth channels and expects the largest vessels to use the deepened channels will have a maximum draft of 52.5 feet. The HDCI study is anticipating the use of Post-Panamax Generation 4 (PPX4) vessels in the future and is expected to be the largest, most frequently calling vessel during the study period (USACE 2020b). The specifications for the vessel class are as follows:

- 1,308.0 feet length overall (LOA)
- 193.5 feet beam
- 52.5 feet design draft
- 18,000 TEU capacity

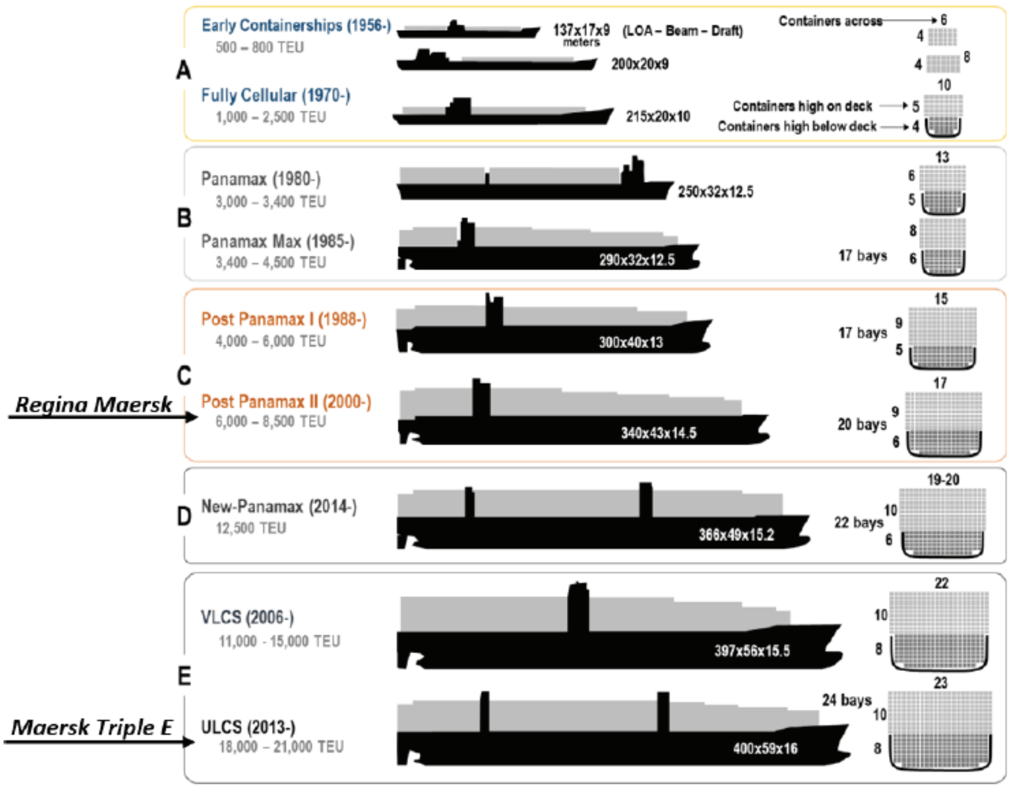

Figure 3. Containership size comparison; Source: The Geography of Transport Systems (USACE 2020c).

You have maintained that the HDCI deepening will improve the economic efficiency of ships moving through the NY/NJ ports, resulting in a reduction in total vessel trips. These improvements will permit larger and cleaner vessels (*i.e.*, Triple-E Class Container Ship, Denmark and CMA CGM Marco Polo to Port Elizabeth on 20 May 2021; dimensions are 1299' LOA x 176' Beam x 52.5' draft with from 16,000 and possibly up to 18,000 nominal twenty-foot equivalent units (TEU) capacity) to safely access the port facilities due to the deeper and wider channels, and will result in reduced scouring, permit more efficiency, and eliminate the need to ride the tides. The greater efficiency associated with permitting safe navigation for larger, newer and cleaner vessels is anticipated to reduce overall vessel calls to the port since the demand for goods, which is disconnected with channel dimensions or vessel size, will not increase port calls by the larger, but will result in fewer, more efficient vessels calling on the port. Because some smaller vessels have been retired in recent years and replaced by larger vessels that may be used more diversely and efficiently (*i.e.*, options to carry large loads or smaller capacity loads when needed), the increase in larger vessel usage may not be related to a greater need for deeper draft tankers, but rather indicative of versatile usage of available vessels to transport goods. Thus, deeper sailing drafts may lead to higher cargo volumes per transit and less required vessel calls (USACE 2020b). The continued deepening is not expected to increase vessel usage of the channel above baseline levels for the duration of the action (until 2039).

Major container terminals included in this study are Elizabeth Port Authority Marine Terminal

(EPAMT), Port Jersey Port Authority Marine Terminal (PJPAMT), and Port Newark (Figure 4). Using the HarborSym Modeling Suite of Tools' (HMST) Container Loading Tool (CLT) algorithm, a vessel call list for the EPAMT (Table 3) and PJPAMT (Table 4) was generated by pairing the Port of NYNJ's commodity forecast for a given year with the expected fleet distribution and loading practices for that year, factoring in changes in vessel operations caused by channel improvements (USACE 2020b). As described in the Economic Analysis appendix of the Environmental Assessment, Table 3 and Table 4 show that without the HDCI study (Future Without Project Condition (FWOP); *i.e.*, Environmental Baseline) the vessel calls are projected to increase over time and be much higher in numbers than they would be if the deepening brings the channel depths to -55 or -57 feet MLLW. Vessels will access the terminal from the federal navigation channel.

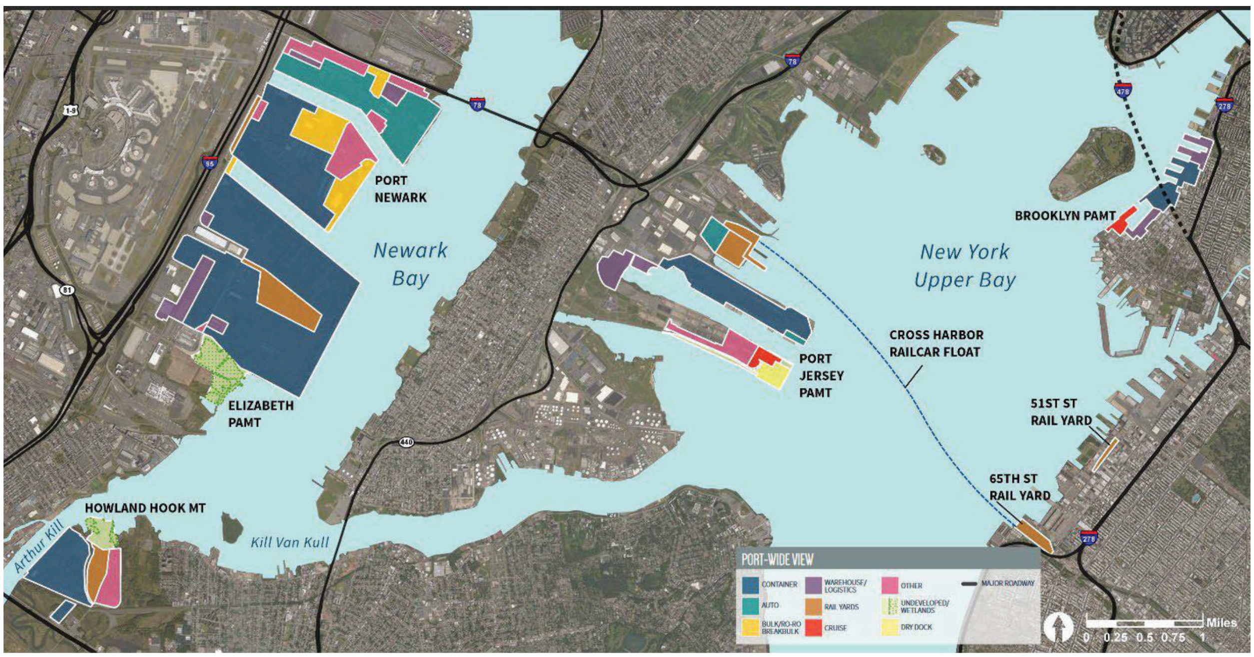

Figure 4. NY/NJ Harbor Container Ports.

Table 3. Elizabeth Port Authority Marine Terminal (EPAMT) projected average annual vessel calls by vessel class and channel depth (30 iterations) from 2030-2050 (USACE 2020b).

Vessel Class	FWOP*	-52FT	-54FT	-55FT	-57FT
2030					
Panamax Containership	150	150	150	150	150
PPX Gen1 Containership	326	224	153	151	151
PPX Gen2 Containership	620	620	613	613	613
PPX Gen3 Containership	610	610	610	610	610
PPX Gen4 Containership	39	39	39	39	39
Total	**1,745**	**1,643**	**1,565**	**1,563**	**1,563**
2040					

Vessel Class	FWOP*	-52FT	-54FT	-55FT	-57FT
Panamax Containership	125	125	125	125	125
PPX Gen1 Containership	318	215	146	142	142
PPX Gen2 Containership	688	640	603	601	601
PPX Gen3 Containership	890	890	890	890	890
PPX Gen4 Containership	78	78	78	78	78
Total	**2,099**	**1,948**	**1,842**	**1,836**	**1,836**
2050					
Panamax Containership	90	90	90	90	90
PPX Gen1 Containership	373	261	178	178	178
PPX Gen2 Containership	830	790	736	729	729
PPX Gen3 Containership	1,155	1,155	1,155	1,155	1,155
PPX Gen4 Containership	117	117	117	117	117
Total	**2,565**	**2,413**	**2,276**	**2,269**	**2,269**

* FWOP = Future Without Project Condition

Table 4. Port Jersey Port Authority Marine Terminal (PJPAMT) projected average annual vessel calls by vessel class and channel depth (30 iterations) from 2030-2050 (USACE 2020b).

Vessel Class	FWOP*	-52FT	-54FT	-55FT	-57FT
2030					
Panamax Containership	5	5	5	5	5
PPX Gen1 Containership	35	22	13	12	12
PPX Gen2 Containership	93	88	84	84	84
PPX Gen3 Containership	155	155	155	155	155
PPX Gen4 Containership	13	13	13	13	13
Total	**301**	**283**	**270**	**269**	**269**
2040					
Panamax Containership	5	5	5	5	5
PPX Gen1 Containership	35	27	13	11	11
PPX Gen2 Containership	67	60	54	54	54
PPX Gen3 Containership	242	242	242	242	242
PPX Gen4 Containership	26	26	26	26	26
Total	**375**	**360**	**340**	**338**	**338**
2050					
Panamax Containership	5	5	5	5	5
PPX Gen1 Containership	44	23	4	2	2
PPX Gen2 Containership	79	70	63	63	63
PPX Gen3 Containership	309	309	309	309	309
PPX Gen4 Containership	39	39	39	39	39
Total	**476**	**446**	**420**	**418**	**418**

* FWOP = Future Without Project Condition

The speed at which vessels operate in the harbor, by vessel class both loaded and light loaded, were determined by the District for each channel segment by evaluating pilot logs and port records and verifying the data with the pilots (USACE 2020b) (Table 5).

Table 5. Vessel speed in channels for containerships (USACE 2020b).

Reach	Speed (knots)
Ambrose Channel	9
Anchorage Channel	10
Kill Van Kull	7
Newark Bay	7

3.4 Best Management Practices

3.4.1 Time of Year Restrictions

You have incorporated Best Management Practices (BMPs) into your civil works programs, including abiding by seasonal restrictions designed to be protective of Federal, state and locally regulated and protected aquatic resources. Currently, there are seasonal restrictions to be protective of aquatic species that prohibit dredging operations throughout the HDCI study footprint:

- To protect migratory finfish, a seasonal no dredge/blasting restriction is placed throughout the KVK channel (beginning at its junction with Anchorage Channel) and up through the Newark Bay Main Stem Channel (continuing up river to Hackensack and Passaic Rivers) from March 1- June 30.
- A seasonal no dredge restriction is placed at the outer portion (intersect with Anchorage Channel) of the PJ channel from January 15 through May 31.

3.4.2 Hopper Dredging

- Additionally, at this time, you are requiring the use of a turtle excluder device (TED), in addition to UXO screens, and ESA Protected Species Observers (PSO) on Hopper dredges operating in the Ambrose channel only.
- If the bridge lookout on board the hopper dredge observes a whale in the vicinity of the vessel during transit throughout the project area, maximum vessel speeds would be limited to 10 knots. If a right whale is observed, the vessel would maintain a 500-yard buffer from the whale. For all other whale species, a 100-yard buffer would be maintained.

3.4.3 Blasting

In a follow-up email dated October 26, 2021, you confirmed that the underwater overpressure and noise will be minimized in confined blasting by:

- using clean, crushed, stone stemming at the top of the blasthole,
- using timed delays of at least 25 milliseconds between blastholes, and
- using timed delays greater than 25 milliseconds between rows of blastholes.

The stemming will minimize the blast energy entering the water column. The timed delays will limit the underwater overpressure by effectively reducing the size of the blast to the size of an individual blasthole.

During a follow-up call on November 23, 2021, and an email dated December 1, 2021, you proposed additional measures to avoid and minimize consequences from the use of explosives. Multiple options may be implemented to reduce the presence of fish, including as example:

- Use of fish and mammal observers with side scan sonar to image fish in the blast area prior to blasting,
- Use of an acoustic fish startle system to move fish from the blast area prior to blasting,
- Use of a series of small scare charges[1] detonated in the water column at one-minute intervals prior to each blast, and
- Use of fish and mammal observers to document potential fish take after each blast.

You stated in an email dated December 20, 2021, that you are committed to developing a Biological Aquatic Monitoring Program (BAMP) in partnership with us to identify additional site-specific BMPs (such as the potential blasting BMPs listed above), as may be feasible and effective in further reducing risk to protected resources within your Area of Responsibility. Currently, you have specified in dredge contracts that upon sighting of protected species, all operations that could cause harm are to cease until such time it is determined that it is safe to resume operations and not risk harm to the animal. As data from the BAMP are reviewed and analyzed, these BMPs could be revised. Because we will be recommending these BMPs during our coordination with you, we will assume for the analysis that they will be employed. If there is a BMP that is employed or if any BMPs listed above are not employed which introduces new consequences or take that was not considered in this Opinion, reinitiation may be necessary.

3.5 Action area

The action area 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). For this project, the action area includes New York and New Jersey Harbor, specifically those areas of the Harbor located in the Upper Bay, the Lower Bay, and Newark Bay, where initial dredging/blasting events will be completed (*i.e.*, Ambrose Channel, Kill van Kull, Anchorage, Port Jersey, South Elizabeth, Elizabeth, and Newark Bay Channels) (Figures 1 and 2). In addition, the action area also includes all routes traveled by the project vessels (between the homeports (location currently unknown), dredge sites, and HARS or other beneficial use sites). The 20 square mile HARS is located approximately 20 miles south from the channels to be deepened in the Upper Bay of the

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[1] A scare charge is a small charge of explosives detonated immediately prior to a blast for the purpose of scaring aquatic organisms away from the location of an impending blast without producing so much pressure or noise that they could be injured or killed.

Harbor (*i.e.*, Kill van Kull and Newark Bay Channels) and approximately 3 miles south from the channel to be deepened in the Lower Bay of the Harbor (*i.e.*, Ambrose Channel) (Figure 5). The action area also includes vessels using the channels as a result of the action (*i.e.*, containerships). Last, the action area includes the underwater areas where the consequences of dredging and blasting (*i.e.*, increases in suspended sediment, etc.) could be experienced.

Based on this information, the action area consists of the project footprint channels that will be dredged and blasted, up to a 1,200 meter radius around the deepening sites, and all routes traveled by the project and commercial vessels as a result of the HDCI study.

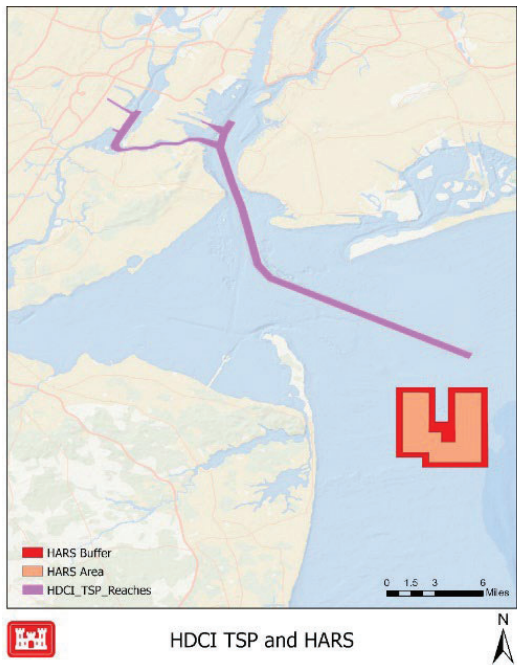

Figure 5. Harbor Deepening Channel Improvements (HDCI) and Historic Area Remediation Site (HARS)

3.5.1 Habitat in the Action Area

According to the Draft Integrated Feasibility Report and Environmental Assessment (USACE 2020c), the action area, which consists of numerous bays, rivers, and channels of complex shape that are connected to the Hudson River, is underlain by both bedrock and unconsolidated materials (Table 1). Additionally, the average current throughout the action area is at or exceeds 1 knot/1 nm/hr.

Throughout the Kill Van Kull (including the Constable Hook Reach, Bergen Point East Reach, and Bergen Point West Reach), previously blasted, fractured, or moderately weathered bedrock underlies the channel. Dense to very dense sand underlies the Kill Van Kull east of the Bayonne Bridge and through the Bergen Point East Reach (Lyttle and Epstein 1987, Drake Jr *et al.* 1997). The pre-HDP dredging benthic community in the Kill Van Kull was dominated by nematodes, blue mussels, and polychaetes. Following dredging, annelids dominated the benthos, primarily due to high densities of *Sabellaria vulgaris*.

Sediments within Newark Bay tend to be a fine-grained combination of bedrock, silts, clays, and sands, with larger-grained materials present in the southern end of the bay due to materials introduced by tidal activity (USACE 2020c).

Sediments in Upper New York Bay vary from coarse sands and gravels in high-energy areas to fine-grained silts and clays in low-energy areas. Lower New York Bay sediments in the area just south of the Narrows are characterized by gravelly sands underlying the main channel, with finer-grained sands, clays, and silts to the east and west of the channel. Extensive deposits of sand characterize the northern part of Lower New York Bay (USACE 2020c).

Baseline benthic sampling in Anchorage Channel revealed a similar community composition to that of Ambrose Channel prior to dredging with blue mussels also being dominant. Amphipods (*Ampeliscidae*), northern dwarf tellin (*Tellina agilis*), and the annelid species (*Spio setosa*) comprised dominant taxa in the benthic assemblage in this area. A much higher percentage of pollution tolerant taxa (29 percent) was present following dredging in 2009 compared to pre-dredging (10 percent) and blue mussels were absent post-dredging. The pre-dredging benthic community dredging, annelids dominated the benthos, primarily due to high densities of *Sabellaria vulgaris*. In an email dated December 20, 2021, you confirmed that post-dredging, the area was recolonized by the original benthic species that were present. There was also an abundance of opportunistic colonizing species that also happened to be pollution tolerant (USACE 2020a).

In the Ambrose Channel, there is medium to fine sand, with little or no organic content predominates, with gravel in some places (USACE 2020c). In Ambrose Channel prior to HDP dredging, the benthos was dominated by annelids, arthropods, and mollusks, with a prevalence of blue mussels (*Mytilus edulis*). In 2009, following dredging, the benthic community was dominated by annelids *Magelona sp*. and no blue mussels were collected. Investigations at the entrance of Ambrose Channel (*i.e.*, apex of NYB) were also conducted September 2009 (USACE 2010a). Water depth at the obstruction is approximately 53 feet at MLW while nearby water depths range from 72 to 80 feet. Benthic prey resources in this area are similar to that described in previous investigations by Cerrato (2006) and are dominated by the annelid *Polygordius sp.* and *Polydora ligni* with nematodes, the arthropods *Unciola sp.* and *Ampelisca abdita*, the blue mussel (*Mytilus edulis*) and two gastropod species as well.

There is no documented submerged aquatic vegetation within the project area (USACE 2020c).

4.0 STATUS OF LISTED SPECIES IN THE ACTION AREA

We have determined that the action being considered in this biological opinion may affect the following endangered or threatened species under our jurisdiction (Table 6):

Table 6. ESA-listed species in the action area

ESA-Listed Species	Latin Name	Distinct Population Segment (DPS)	Federal Register (FR) Citation	Recovery Plan
North Atlantic Right Whale	*Eubalaena glacialis*	Range-wide	73 FR 12024	(NMFS 2005)
Fin Whale	*Balaenoptera physalus*	Range-wide	35 FR 18319	(NMFS 2010)
Loggerhead Turtle	*Caretta caretta*	Northwest Atlantic	76 FR 58868	(NMFS and U.S. FWS 2008)
Leatherback Turtle	*Dermochelys coriacea*	Range-wide	35 FR 8491	(NMFS and U.S. FWS 1992)
Green Turtle	*Chelonia mydas*	North Atlantic	81 FR 20057	(NMFS and U.S. FWS 1991)
Kemp's Ridley Turtle	*Lepidochelys kempii*	Range-wide	35 FR 18319	(NMFS *et al.* 2011)
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	Gulf of Maine; New York Bight; Chesapeake Bay; Carolina; South Atlantic	77 FR 5880 and 77 FR 5914	N/A
Shortnose Sturgeon	*Acipenser brevirostrum*	Range-wide	32 FR 4001	(NMFS 1998a)

There is no designated critical habitat present in the action area for any of these species.

This section will focus on the status of the various species within the action area, summarizing the information necessary to establish the environmental baseline and to assess the consequences of the proposed action.

4.1 Species Not Likely to be Adversely Affected by the Proposed Action

4.1.1 Whales

Federally endangered North Atlantic right whales and fin whales are expected to occur in New York nearshore and coastal waters of the action area. Fin and right whales use the nearshore coastal waters of the Atlantic Ocean as they migrate to and from calving and foraging grounds.

Right whales in the New York Bight are primarily transiting the area on their way to northern feeding and aggregation areas. During late winter and early spring, they begin moving north along the coast past Cape Hatteras and near the Long Island coast. Individuals have been sighted along the south shore of Long Island, Block Island Sound, Gardiners Bay and south shore inlets and bays. They could be present in the action area year-round.

Finback whales occupy both deep and shallow waters and are likely the most abundant large cetacean in New York waters. They are most abundant in spring, summer, and fall, but do have some presence during the winter months. Therefore, fin whales could be present in the action area year-round.

Sightings and satellite tracking data along the east coast indicate that endangered large whales such as right and fin whales rarely venture into bays, harbors, or inlets (Southall and Scholik-Schlomer 2007). As such, we do not expect that any of these species would be present along dredge transit routes through Upper New York Harbor, Kill Van Kull, Newark Bay or within the Anchorage Channel. However, the portion of the Ambrose Channel to be deepened is located within a designated seasonal management area for right whales.[2] In addition, the HARS is located 3.5 miles east (offshore) of Sandy Hook, New Jersey.[3] Right and fin whales may be present at these sites and along the offshore portion of the dredge transit routes to these areas.

4.1.1.1 Consequences of the Proposed Action on Whales

ESA listed species of whales will not occur in the shallow areas where blasting will occur and, thus, will not be exposed to any consequences of blasting activities. ESA listed species of whales may be present within the Ambrose Channel where dredging will occur. Because whales forage upon pelagic prey items (*e.g.*, krill, copepods), dredging and its impacts on the benthic environment will not have any direct consequences on whale prey/foraging items. As dredging occurs at speeds at or less than 3.0 knots in the open waters of the Atlantic ocean with ample space for whales to move around the dredge, migratory behaviors of ESA listed whales will also not be affected, nor will whales be exposed to any direct consequences of interactions with dredge heads as whales are not vulnerable to entrainment due to their large size. As such, this section will only address the consequences of vessel traffic and sedimentation/turbidity to whales at the Ambrose Channel, while transiting back and forth from the Ambrose Channel, and at the placement sites.

Sedimentation and Turbidity

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the water, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column further from the dredge site. The nature, degree, and extent of sediment suspension around a dredging operation are controlled by many factors including: the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, discharge/cutter configuration, discharge rate, and solids concentration of the slurry; operational procedures used; and the characteristics of the hydraulic regime in the vicinity of the operation, including water composition, temperature and hydrodynamic forces (*i.e.*, waves, currents, etc.) causing vertical and horizontal mixing (USACE 1983).

[2] From November 1 to April 30 of any year, NMFS has designated this area as a seasonal management area (78 FR 73726) for right whales.

[3] The HARS is overseen by the USACE and the U.S. Environmental Protection Agency (EPA).

Hopper dredges re-suspend sediment when the suction draghead(s) make contact with the substrate and during release of overflow waters, which generally occurs through the bottom of the vessel's hull. Hopper dredges have a large range in capacities and different draghead configurations. Plumes generated during hopper dredging of sandy entrance channels will have very different spatial and temporal characteristics than those created in silt-laden harbors. Near-bottom plumes caused by hopper dredges may extend approximately 2,300 to 2,400 feet (701-731 meters) down-current from the dredge (USACE 1983). According to Wilber and Clarke (2001), suspended sediment plumes can extend 3,937 feet (1,200 m). Total Suspended Sediment (TSS) concentrations may be as high as several hundred mg/L near the discharge port and as high as several tens of mg/L near the draghead. In a literature review conducted by Anchor Environmental (2003), near-field concentrations ranged from 80.0-475.0 mg/L. TSS and turbidity levels in the near-surface plume usually decrease exponentially with increasing time and distance from the active dredge due to settling and dispersion, quickly reaching ambient concentrations and turbidities. In almost all cases, the majority of re-suspended sediments resettle close to the dredge within one hour, although very fine particles may settle during slack tides only to be re-suspended by ensuing peak ebb or flood currents (Anchor Environmental 2003). If those re-suspended sediments do resuspend in the ebb/flood tides, it becomes part of the normal tidal cycle and represents "ambient" conditions.

TSS is most likely to affect whales if a plume causes a barrier to normal behaviors or if elevated levels of suspended sediment affects prey. Whales may be exposed to consequences of TSS or other water quality factors through the uptake of water when they feed. Even if whales ingested the transient plumes, it would be brief and low in frequency. As whales breathe air and are highly mobile, they are likely to be able to avoid any sediment plume and any consequence on their movements is likely to be insignificant. While the increase in suspended sediments may cause whales to alter their normal movements, any change in behavior is not able to be measured or detected, as it will only involve minor movements that alter their course out of the way of the sediment plume, which will not disrupt any essential life behaviors. The whales that may be present in the action area feed on krill and small schooling fish. The TSS levels expected for dredging (up to 550.0 mg/L) are below those shown to have adverse consequences on fish (580.0 mg/L for most sensitive species, with 1,000.0 mg/L being more typical) (Burton 1993, Wilber and Clarke 2001). Because of this and the fact that these species live pelagically and are highly mobile, no impacts to these forage fish are likely to result from exposure to increased suspended sediment from these dredges during dredging operations. Based on this information, we believe the consequences of suspended sediment on whales resulting from increased turbidity from dredging are too small to be meaningfully measured or detected and are insignificant.

<u>Vessel Traffic</u>

Injuries and mortalities from vessel strikes are a threat to North Atlantic right and fin 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 for fin whales (Hayes *et al.* 2019). Ship strike injuries to whales occur in two ways: (1) propeller wounds characterized by external gashes or severed tail stocks; and (2) blunt trauma injuries indicated by fractured skulls, jaws, and vertebrae, and massive bruises that sometimes lack external expression (Laist *et al.* 2001). Collisions with smaller vessels may result in propeller wounds or no apparent injury, depending on the severity of the incident. Laist *et al.* (2001) reports that of 41 ship strike accounts that reported vessel speed, no lethal or severe injuries occurred at speeds below ten knots, and no collisions have been reported for vessels traveling less than six knots. Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Laist *et al.* 2001, Jensen and Silber 2003).

Impacts to listed species of whales during dredging are unlikely because hopper dredges move very slowly at < 3.0 knots, a speed at which whales can avoid interaction with the dredge. On the other hand, collisions with a transiting hopper dredge between the Ambrose Channel and the placement sites could occur. An analysis by Vanderlaan and Taggart (2007) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death of a whale increases asymptotically to 100 percent. At speeds below 11.8 knots, the probability decreases to less than 50 percent, and at 10 knots or less, the probability is further reduced to approximately 30 percent.

As noted above, the speed of the dredge is not expected to exceed 2.5-3.0 knots while dredging, 10 knots while transiting to the disposal sites, and no more than 11 knots while empty. Collisions with a slowly transiting hopper could occur, but the speed (up to 11 knots) during transit lessens the probability of a ship strike resulting in lethal or serious injuries. Onboard lookouts also may further reduce the risk of vessel-whale collisions. Having an onboard lookout is standard protocol and you have agreed to adhere to this. If the lookout on board the hopper dredge observes a whale in the vicinity of the vessel during transit throughout the project area, maximum vessel speeds would be limited to 10 knots. If a right whale is observed, the vessel would maintain a 500 yard buffer from the whale. For all other whale species, a 100 yard buffer would be maintained.

The potential for adding a minimal number of project vessels to the existing baseline increases vessel strike risk to whales, but it is to such a small extent that the increase in risk of a potential strike cannot be meaningfully measured or detected. The increase or change in traffic associated with this proposed project is small. Dredging operations typically add approximately six vessels to the action area. Dredging operations, similarly, exclude other vessels unrelated to the project from the action area while dredging is underway in the action area. While it is your conclusion that there is a net gain of zero vessels added to the action area, due to the dredging operations established exclusionary zones implementation as well as the mandatory reduced speed of those vessels (as opposed to non-project-related vessels), to be conservative, we will assume an addition of six vessels to the action area resulting from the Federal action. The addition of these project-related vessels will be temporary (four trips per day during planned dredging cycles, until 2039), and restricted to a small portion of the overall action area on any day dredging occurs. Once dredging is completed, the pre-project status quo of likely vessel numbers and vessel traffic patterns will likely decrease due to the deeper channels permitting greater efficiencies, such as fewer and larger and newer vessels accessing the terminals, and, thus, not permanently increase the risk of a vessel strike. Therefore, the consequences of the action regarding the risk of a vessel strike in the action area are extremely unlikely to occur.

Whales are most likely to be hit by vessels traveling at speeds of 10 knots or more (Laist *et al.* 2001, Pace and Silber 2005, Vanderlaan and Taggart 2007). Therefore, we established Seasonal Management Areas (SMAs) in 2008 to reduce the likelihood of death and serious injuries to endangered right whales that result from collisions with ships (50 CFR 224.105). The areas are defined as the waters within a 20-nm area with an epicenter located at the midpoint of the COLREG demarcation line crossing the entry into the designated ports or bays. A mid-Atlantic SMA is located at the Ambrose Channel and is active from November 1 through April 30 of any given year. Vessels 65 feet or longer are required to operate at speeds of 10 knots or less when traveling through the SMA. In addition, federal regulations, as specified in 50 CFR 222.32, require that a vessel steer a course away from a right whale and immediately leave the area at a slow safe speed if a whale is observed within 500 yards (460 m) of the vessel. Thus, measures to avoid vessel strike are already in place and will be applicable to the PPX4 class vessels.

Given the rarity of vessel strikes when considering that the increase in risk posed by the addition to the baseline of the project vessels and that there are regulations in place to reduce the risk of vessel strike to whales, the increase in risk of vessel strike is so small as to not be meaningfully detected.

4.1.2 Shortnose sturgeon

Shortnose sturgeon are benthic fish that occur in large coastal rivers of eastern North America. They range from as far south as the St. Johns River, Florida (possibly extirpated from this system) to as far north as the Minas Basin in Nova Scotia, Canada (Vladykov and Greeley 1963, Dadswell *et al.* 2013). Shortnose sturgeon are a diadromous fish species and one of only two sturgeon species that occur in marine waters and estuaries from Canada to Florida. More recent research has demonstrated that shortnose sturgeon leave their natal estuaries, undergo coastal migrations, and use other river systems to a greater extent than previously thought. Within the Gulf of Maine, a portion of adults make seasonal migrations along the coast, traveling between the Penobscot, Kennebec and Merrimack rivers and making short stops in smaller coastal rivers along this route (SSSRT 2010, Zydlewski *et al.* 2011, Wippelhauser and Squiers 2015). Outside the Gulf of Maine, marine migrations have only rarely been documented. Some shortnose sturgeon captured and/or tagged in the Connecticut River have been recaptured, detected, or were previously tagged in the Housatonic River (T. Savoy, CT DEP, pers. comm. 2015), the Hudson River (Savoy 2004), and the Merrimack River (M. Kieffer, USGS, pers. comm. 2015). Two shortnose sturgeon adults tagged in the Hudson River have been recaptured in the Connecticut River which indicates that shortnose sturgeon might be using the East River and Long Island Sound to swim between these rivers (Savoy 2004). However, even in the Northeast where these coastal migrations have been documented, shortnose sturgeon do not appear to spend significant time in the marine environment and generally stay close to shore (SSSRT 2010, NMFS, unpublished data).

A population of the federally endangered shortnose sturgeon (*Acipenser brevirostrum*) occurs in the Hudson River. Shortnose sturgeon have been documented in the entire Hudson River up to the Troy Dam (rkm 246). The habitat characteristics of the lower Hudson (*i.e.*, Manhattan to the confluence of New York Harbor) and the Upper New York Harbor, in general, consist of deep channel habitat and salinity levels that range from 11-30 ppt. Due to high salinity levels, post yolk-sac larvae and young-of-the-year shortnose sturgeon are not expected to occur in the action area and, due to the distance from the spawning grounds in the Hudson River (*i.e.*, approximately 154 miles away), shortnose sturgeon eggs or yolk-sac larvae, whose occurrence is limited to the waters near the spawning grounds (*i.e.*, Hudson River, below the Federal Dam at Troy to about Coxsackie, NY (rkm 246-190) (Dovel *et al.* 1992, Bain 1997, Kazyak *et al.* 2020)), are also not likely to occur in this area. We also do not expect that juveniles would be present due to the action area being outside of the Hudson River, their natal river, which juveniles are not known to leave.

The New York/New Jersey Harbor Complex located in the Lower New York Bay, Newark Bay, and the Kill van Kull is data poor when it comes to shortnose sturgeon presence. According to the Blast Monitoring Program for the Kill Van Kull Deepening Project (USACE 2004), no shortnose sturgeon were collected in the New York/New Jersey Harbor Complex during various studies that occurred from 1986 to 1999. Adult shortnose sturgeon have been documented in the Upper New York Bay during the HDP Aquatic Biological Survey (ABS) program (USACE 2021) (Table 7) and the Hudson River Utilities winter trawl survey from 2003-2017 (unpublished data). Six shortnose sturgeon total were identified in the ABS program which occurred from 1998-2011 (Table 7)[4]. The data/samples collected by Hudson River Utilities were collected in their Hudson River Biological Monitoring Program which are donated to and curated by the Stony Brook University. From that program, only 19 shortnose sturgeon total were detected in Upper New York Bay during the winters of 2003-2017[5] (Hudson River Utilities winter trawl survey, unpublished data). Based on the best available information, it is believed that only rare transient adult shortnose sturgeon are likely to be present within the action area, and further, the action area does not serve as any type of aggregation or overwintering area, from what can be understood from existing data.

Table 7. Harbor Deepening Project (HDP) Aquatic Biological Survey (ABS) Shortnose sturgeon observations in and around the HDP area (1998-2011) (USACE 2021).

Date	**Location**	**Length (mm)**	**Data Source/Comments**
June 2003	Upper NY Bay (near Statue of Liberty)	780	HDP ABS program
June 2003	Upper NY Bay (near Statue of Liberty)	690	HDP ABS program
June 2005	Port Jersey (east of Liberty Golf Course)	1250	HDP ABS program
June 2005	Port Jersey (east of Liberty	840	HDP ABS

[4] There were also three unidentified sturgeon that were caught in the ABS program that may have been either Atlantic or shortnose sturgeon.
[5] Trawl data from winters 2011/2012 and 2012/2013 was missing and is not included in these numbers.

Date	Location	Length (mm)	Data Source/Comments
	Golf Course)		program
May 2008	Port Jersey (east of Liberty Golf Course)	900	HDP ABS program
May 2009	Port Jersey (east of Liberty Golf Course)	910	HDP ABS program

In your September 14, 2021, BA, you state that the consequences to shortnose sturgeon will not be considered futher, because they are not expected to occur in the action area. While their presence in the action area has not been well documented, shortnose sturgeon have been detected in the Upper New York Bay, and there are no barriers preventing them from entering the action area. Therefore, we will analyze the consequences of the proposed action on transient and opportunistically foraging adult shortnose sturgeon that could be present in the action area year-round.

4.1.2.1 Consequences of the Proposed Action on Shortnose Sturgeon

Sedimentation and Turbidity

The HDCI project involves the use of a mechanical, cutterhead, and hopper dredge. Mechanical dredges include many different bucket designs (*e.g.*, clamshell, closed versus open bucket, level-cut bucket) and backhoe dredges, representing a wide range of bucket sizes. TSS concentrations associated with mechanical clamshell bucket dredging operations have been shown to range from 105 mg/L in the middle of the water column to 445 mg/L near the bottom (210 mg/L, depth-averaged) (USACE 2001). Furthermore, a study by Burton (1993) measured TSS concentrations at distances of 500, 1,000, 2,000, and 3,300 feet (152, 305, 610, and 1006 meters) from dredge sites in the Delaware River and were able to detect concentrations between 15 mg/L and 191 mg/L up to 2,000 feet (610 meters) from the dredge site. In support of the New York/New Jersey Harbor Deepening Project, the U.S. Army Corps of Engineers conducted extensive monitoring of mechanical dredge plumes (USACE 2015a). The dredge sites included Arthur Kill, Kill Van Kull, Newark Bay, and Upper New York Bay. Although briefly addressed in the report, the consequences of currents and tides on the dispersal of suspended sediment were not thoroughly examined or documented. Independent of bucket type or size, plumes dissipated to background levels within 600 feet (183 meters) of the source in the upper water column and 2,400 feet (732 meters) in the lower water column. Based on these studies, elevated suspended sediment concentrations at several hundreds of mg/L above background may be present in the immediate vicinity of the bucket, but would settle rapidly within a 2,400- foot (732 meter) radius of the dredge location. The TSS levels expected for mechanical dredging (up to 445.0 mg/L) are below those shown to have adverse consequences on fish (typically up to 1,000.0 mg/L; (see summary of scientific literature in Burton 1993, Wilber and Clarke 2001)).

Cutterhead dredges use suction to entrain sediment for pumping through a pipeline to a designated discharge site. Production rates vary greatly based on pump capacities and the type (size and rotational speed) of cutter used, as well as distance between the cutterhead and the substrate. Sediments are re-suspended during lateral swinging of the cutterhead as the dredge progresses forward. Modeling results of cutterhead dredging indicated that TSS concentrations above background levels would be present throughout the bottom six feet (1.8 meters) of the water column for a distance of approximately 1,000 feet (305 meters) (USACE 1983). Elevated suspended sediment levels are expected to be present only within a 984.3 to 1,640.4 foot (300-500 meters) radius of the cutterhead dredge (USACE 1983, LaSalle 1990, Hayes *et al.* 2000, as reported in Wilber and Clarke 2001). TSS concentrations associated with cutterhead dredge sediment plumes typically range from 11.5 to 282.0 mg/L with the highest levels (550.0 mg/L) detected adjacent to the cutterhead dredge and concentrations decreasing with greater distance from the dredge (Nightingale and Simenstad 2001, USACE 2005, 2010b, 2015b). The TSS levels expected for cutterhead dredging (up to 550.0 mg/L) are below those shown to have adverse consequences on fish (typically up to 1,000.0 mg/L; (see summary of scientific literature in Burton 1993, Wilber and Clarke 2001)).

Hopper dredges re-suspend sediment when the suction draghead(s) make contact with the substrate and during release of overflow waters, which generally occurs through the bottom of the vessel's hull. Hopper dredges have a large range in capacities and different draghead configurations. Plumes generated during hopper dredging of sandy entrance channels will have very different spatial and temporal characteristics than those created in silt-laden harbors. Near-bottom plumes caused by hopper dredges may extend approximately 2,300 to 2,400 feet (701-731 meters) down-current from the dredge (USACE 1983). According to Wilber and Clarke (2001), suspended sediment plumes can extend 3,937 ft (1,200 m). TSS concentrations may be as high as several hundred mg/L near the discharge port and as high as several tens of mg/L near the draghead. In a literature review conducted by Anchor Environmental (2003), near-field concentrations ranged from 80.0-475.0 mg/L. TSS and turbidity levels in the near-surface plume usually decrease exponentially with increasing time and distance from the active dredge due to settling and dispersion, quickly reaching ambient concentrations and turbidities. In almost all cases, the majority of re-suspended sediments resettle close to the dredge within one hour, although very fine particles may settle during slack tides only to be re-suspended by ensuing peak ebb or flood currents (Anchor Environmental 2003). The TSS levels expected for hopper dredging (up to 475.0 mg/L) are below those shown to have adverse consequences on fish (typically up to 1,000.0 mg/L; (see summary of scientific literature in Burton 1993, Wilber and Clarke 2001)).

TSS is most likely to affect shortnose sturgeon if a plume causes a barrier to normal behaviors. However, we expect shortnose sturgeon to either swim through the plume or temporarily avoid the plume with no adverse consequences. Therefore, the consequences of sedimentation and turbidity on shortnose sturgeon are too small to be meaningfully measured or detected, and are insignificant.

<u>Habitat Modification</u>
Shortnose sturgeon generally feed when the water temperature exceeds 10°C and in general, foraging is heavy immediately after spawning in the spring and during the summer and fall, with lighter to no foraging during the winter (NMFS 1996, Kynard *et al.* 2016). Given the lack of data

regarding their presence in the Kill Van Kull/Newark Bay area, the likelihood that shortnose sturgeon are actively foraging in the area where blasting will occur is extremely unlikely. Few benthic invertebrates are present in the rocky area where blasting will occur. As previously mentioned in the *Action Area* section, annelids have dominated the benthos area at Kill van Kull following past dredging events. The area immediately surrounding the blast zone would be void of preferred shortnose sturgeon prey such as crustaceans and molluscs (Bain 1997) and thus, sturgeon would not be likely to forage in this area.

While some temporary loss and consequences to benthic foraging habitat may occur, no permanent changes in habitat type are expected, and only a small portion of benthic habitat will be disturbed at any one time and only in areas where dredging/blasting is needed. It is expected that the bottom will be recolonized by pre-dredging benthic species and opportunistic colonizing polychaetes (Bain 1997). Few motile organisms will be affected by the proposed dredging and recolonization of the benthic community will be rapid. The area to be affected is also small compared to the available opportunistic foraging habitat that may occur within the action area (which includes the underwater areas experiencing the consequences of the deepening, and all routes traveled by project vessels and vessels using the waterway as a result of the project). As such, any consequences to shortnose sturgeon by way of habitat modification will be too small to be meaningfully detected and all consequences are insignificant.

Vessel Traffic

The proposed project vessels do not have deep drafts, and only one channel is dredged at a time, so only six additional vessels would occur at a time at a rate of approximately 7-8 trips per day. The speed of the dredge is not expected to exceed 2.5 – 3.0 knots while dredging, 10 knots while transiting to the disposal sites, and no more than 11 knots while empty. As such, the 11 knot or less speed of the dredge vessel is likely to reduce the chances of collision with a shortnose sturgeon.

In our analysis we considered three elements: (1) the existing baseline conditions, (2) the action and what it adds to existing baseline conditions, and (3) new baseline conditions (the existing baseline conditions and the action together). We have determined that vessel traffic added to baseline conditions as a result of the proposed project is not likely to adversely affect shortnose sturgeon for the following reasons.

Adding project vessels to the existing baseline will not increase the risk that any vessel in the area will strike an individual, or will increase it to such a small extent that the consequence of the action (*i.e.*, any increase in risk of a strike caused by the project) cannot be meaningfully measured or detected. The baseline risk of a vessel strike within the NY/NJ channels is unknown. According to the 2013 to 2020 reported-but-not-salvaged carcass data collected by the New York State Department of Environemental Conservation (NYSDEC), no shortnose sturgeon carcasses have been reported in the vicinity of the NY/NJ channels.

The increase in traffic associated with the proposed project is extremely small. During the project activities, six project vessels will be added to the baseline. The addition of project vessels will also be intermittent, temporary, and restricted to a small portion of the overall action area on any given day. As such, any increased risk of a vessel strike caused by the project will be too small to be meaningfully measured or detected. As a result, the consequence of the action on the increased risk of a vessel strike in the action area is insignificant.

As discussed above, the HDCI study is anticipating the use of PPX4 vessels in the future and is expected to be the largest, most frequently calling vessel during the study period (USACE 2020b). Based on the largest draft vessel expected to use the waterway (52.5 feet) and the depth to be dredged in the channels (approximately -55 feet with possible overdredge), vessels maneuvering within the berth would have a minimum of a 2.5 foot (0.7m) clearance from the bottom surface. The actual clearance may be greater, depending on the draft of a particular vessel and the depth of the channel. This is an increase of the current 1 foot clearance for 49' draft vessels that are using the -50 foot channels.

Given we expect that the presence of shortnose sturgeon is limited to rare opportunistically foraging transients, that fewer vessels will be using the channels, and the increase in draft clearance from the bottom as a result of the project, the consequences of the action regarding the risk of a vessel strike in the action area are too small to be meaningfully measured or detected and are, therefore, insignificant.

<u>Blasting</u>

Several studies have demonstrated that underwater blasting can cause fish mortality. Weight of the charge and distance from detonation are the most important factors affecting extent of injury and mortality, although depth of water, substrate type, and size and species of fish are also important (Teleki and Chamberlain 1978 as cited by USACE 2004, Wiley *et al.* 1981, Keevin and Hempen 1997). Teleki and Chamberlain (1978) monitored fish mortality of 13 species in blasting experiments in Nanticoke, Lake Erie and found that fish were killed in radii ranging from 65.6 to 164 feet (20-50 m) for 50 lbs (22.7 kg) per charge and from 147.6 to 360.9 feet (45-110 m) for 600.5 lbs (272.4 kg) per charge. Mortality differed by species at identical pressure. No sturgeon were tested. Common blast-induced injuries included swimbladder rupturing and hemorrhaging in the coelomic and pericardial cavities.

As discussed above, in 2004, USACE conducted a blast monitoring study in Kill Van Kull (USACE 2004). The type of blasting activity for the 2004 study in Kill Van Kull is similar to that anticipated for the potential HDCI contracts in Kill Van Kull and Newark Bay. A theoretical estimate of the pressure and impact of the "average" blast event monitored during the study would result in a pressure of about 90 psi with a kill radius of approximately 375 feet. The data also suggests that the charges used in the Kill Van Kull Blasting Program, which were confined, appeared to have less of an impact on fish than would equivalent open water charges. This is because the radiation of the wave energy into the rock reduces the available energy reaching the water column. The pressures entering the water column were well below those pressures that typically propogate away from open-water (unconfined by solid media that may radiate the energy away with less harm) charges relative to charge weight per delay (USACE 2004). However, the District states that without completion of a caged fish study, quantitative estimates and/or calculations of mortality radii may not be made. Additionally, it is anticipated the blasting within most portions of the Newark Bay Complex will be subject to seasonal restrictions by the New Jersey Department of Environmental Protection (NJDEP) from March 1 to June 30 of any year so as to be protective of migrating anadromous fish under their Clearn Water Act (CWA) jurisdiction. Blasting operations involve the action of drilling holes and setting the charge deep within the bedrock substrate. A typical blast operation includes the deployment of one blast barge, with actual blasting occurring only during the daylight hours, and required to be within the local jurisdictions (*i.e.*, NY and NJ) noise and vibration regulatory standard parameters to avoid adverse consequences to the potentially affected communities, and the potentially-affected environment.

During the months of the blasting (July-February), we expect most adult shortnose sturgeon sturgeon to be migrating to the overwintering sites in the Hudson River. Based on these results, it is reasonable to conclude that any potential blasting impacts in Newark Bay/ Kill Van Kull would not reach areas in which shortnose sturgeon are known or expected to migrate through the NY/NJ Harbor (*i.e.*, Port Jersey Channels) to their spawning or overwintering grounds. Based on the best available information, shortnose sturgeon have currently not been observed in the Kill Van Kull/Newark Bay area which is also not known to be an aggregation site for shortnose sturgeon. The blasting area is outside of the migratory pathway to the overwintering sites. Because of this and the fact that the area does not have the preferred foraging habitat for shortnose sturgeon, the risk of interaction is extremely unlikely.

Therefore, given the potential for interaction is extremely unlikely because of the low probability of fish using the action area, any consequences of blasting to shortnose sturgeon are extremely unlikely to occur.

<u>Dredge Entrainment and Entrapment</u>

The direct impact to adult shortnose sturgeon from mechanical dredging is possible but expected to be less than for other types of dredges such as hopper dredges. Most mobile organisms, including adult sturgeon, are able to avoid mechanical dredge buckets. For a bucket dredge to capture a sturgeon, the sturgeon has to be immediately below the bucket and remain stationary as the bucket jaw closes. The slow movement of the dredge bucket through the water column and the relatively small area of bottom impacted by each pass of the bucket makes the likelihood of interaction between a dredge bucket and an individual fish extremely low. Additionally, the dredging area is not a known aggregation area where shortnose sturgeon would be stationary, and any sturgeon that are present would be expected to swim away from the dredging equipment. Based on all available evidence, the risk that a mechanical dredge will capture a sturgeon is extremely unlikely. Because of this, the consequences of mechanical dredge entrainment and entrapment are extremely unlikely to occur.

If transient adult shortnose sturgeon are present during dredging activities, they are not subject to impingement or entrainment in cutterhead dredges, because similar to adult Atlantic sturgeon and sea turtles (both discussed later in this Opinion), their size and swimming ability allow them to escape the intake velocity of cutterhead dredges (Clarke 2011). Because of this, the consequences of cutterhead dredge entrainment and entrapment are extremely unlikely to occur.

With the use of a hopper dredge, dredged material is raised by dredge pumps through dragarms connected to dragheads in contact with the channel bottom and discharged into hoppers built in the vessel. Hopper dredges are equipped with large centrifugal pumps similar to those employed by other hydraulic dredges. Suction pipes (dragarms) are hinged on each side of the vessel with the intake (drag) extending downward toward the stern of the vessel. The drag head is moved along the bottom as the vessel moves forward at speeds up to three knots. The dredged material is sucked up the pipe and deposited and stored in the hoppers of the vessel.

Most sturgeon are able to escape from the oncoming draghead due to the slow speed that the draghead advances (up to 3 mph or 4.4 feet/second). Interactions with a hopper dredge result primarily from crushing when the draghead is placed on the bottom, or when an animal is unable to escape from the suction of the dredge and becomes stuck on the draghead (*i.e.*, impingement). Entrainment occurs when organisms are sucked through the draghead into the hopper. Mortality most often occurs when animals are sucked into the dredge draghead, pumped through the intake pipe and then killed as they cycle through the centrifugal pump and into the hopper.

Sturgeon are vulnerable to interactions with hopper dredges. The risk of interactions is related to both the amount of time sturgeon spend on the bottom and the behavior the fish are engaged in (*i.e.*, whether the fish are overwintering, foraging, resting or migrating), as well as the intake velocity and swimming abilities of sturgeon in the area (Clarke 2011). Intake velocities at a typical large self-propelled hopper dredge are 11 feet per second.

In general, entrainment of large mobile animals, such as the sturgeon, is relatively rare. Several factors are thought to contribute to the likelihood of entrainment. One factor influencing potential entrainment is the swimming stamina and size of the individual fish at risk (Boysen and Hoover 2009). Swimming stamina is positively correlated with total fish length. Entrainment of larger sturgeon, such as adults that may occur in the action area, is less likely due to the increased swimming performance by the fish. The estimated minimum size for adult shortnose sturgeon that out-migrate from their natal river is approximately 450 mm (Dadswell *et al.* 1984); therefore, that is the minimum size of shortnose sturgeon anticipated in the action area.

In areas where animals are present in high density, the risk of an interaction is greater because more animals are exposed to the potential for entrainment. The hopper dredge draghead operates on the bottom and is typically at least partially buried in the sediment. Sturgeon are benthic feeders and are often found at or near the bottom while foraging or while moving within rivers. Sturgeon at or near the bottom could be vulnerable to entrainment if they were unable to swim away from the draghead. Sturgeon that are migrating in the marine environment generally do not move along the bottom but move further up in the water column. If sturgeon are up off the bottom while in marine areas, such as Upper New York Bay, the potential for interactions with the dredge are further reduced. We expect the occurrence of shortnose sturgeon in the dredging area to be limited to rare transients. Given the rarity of shortnose sturgeon in the action area and the action area is not a known aggregation site, an interaction of a shortnose sturgeon with a hopper dredge in the action area is extremely unlikely.

4.2 Species Likely to be Adversely Affected by the Action

4.2.1 Sea Turtles

Kemp's ridley and leatherback sea turtles are currently listed under the ESA at the species level; green and loggerhead sea turtles are listed at the DPS level. Therefore, we include information on the range-wide status of Kemp's ridley and leatherback sea turtles to provide the overall status of each species. Information on the status of loggerhead and green sea turtles is for the DPS affected by this action. Additional background information on the range-wide 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, Hirth 1997, TEWG 1998, 2000, 2007, Conant *et al.* 2009, TEWG 2009, Seminoff *et al.* 2015), and recovery plans and five-year reviews for the loggerhead sea turtle (NMFS and U.S. FWS 2008, 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, 1998a, 2013).

2010 BP Deepwater Horizon Oil Spill

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 that 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; 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 turtles were sighted, 574 of which were captured and examined for oiling (Stacy 2012). Of the turtles captured during these operations, greater than 80 percent were visibly oiled (DWH NRDA Trustees 2016). Most of the rescued turtles were taken to rehabilitation facilities; more than 90 percent of the 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. Approximately 14,000 hatchlings were released off the Atlantic coast of Florida, with most of them being 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 consequences of oil on turtles obtained by at-sea captures, sightings, and strandings represent a fraction of the scope of the injury. As such, the Deep Water Horizon (DWH) National Resource Damage Assessment (NRDA) Trustees used expert opinion, surface oiling maps, and statistical approaches to apply the directly observed adverse consequences of oil exposure to turtles in areas and at times that could not be surveyed. The Trustees estimated that between 4,900 and up to 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, green turtles, 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 green turtles) 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 consequences. 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 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 percent of all oceanic 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 consequences 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.* 2014). While the consequences 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) conclude 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 consequences of the spill and impacts of the associated response activities are likely to remain unknown for some period into the future.

4.2.1.1 Green Sea Turtle (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 hardshell marine turtles, growing to a weight of approximately 350 lbs (159 kg) and a straight carapace length of greater than 3.3 ft (1 m). 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 green turtle is found in the North Atlantic Ocean and Gulf of Mexico (Figure 6) and is listed as threatened. Green turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5° N, 77° W) in the south, throughout the Caribbean, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48° N, 77° W) in the north. The range of the DPS then extends due east along latitudes 48° N and 19° N to the western coasts of Europe and Africa.

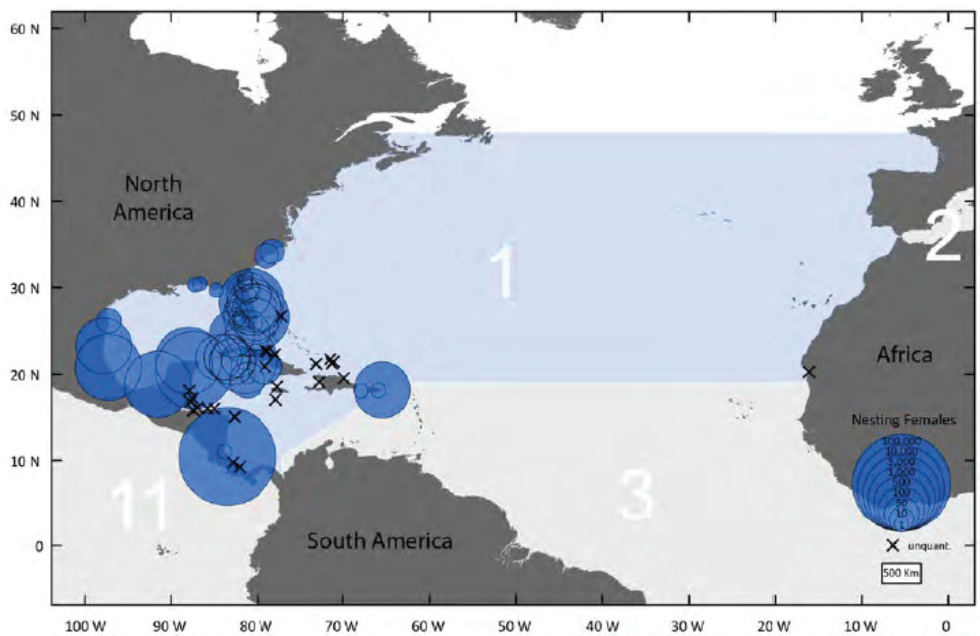

Figure 6. Range of the North Atlantic distinct population segment of green turtle with location and abundance of nesting females (Seminoff et al. 2015).

We used information available in the 2015 Status Review (Seminoff *et al.* 2015), 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
Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, Quintana Roo), United States (Florida) and Cuba (Figure 6) 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 percent of nesting females for the DPS (Seminoff *et al.* 2015). In the southeastern United States, 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 summer months.

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 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 (15–19 years) turtles from the Cayman Islands (Bell *et al.* 2005) and Caribbean Mexico (12–20 years) (Zurita *et al.* 2012). A study of green turtles that use waters of the southeastern United States as developmental habitat found the age at sexual maturity likely ranges from 30 to 44 years (Goshe *et al.* 2010). Green turtles in the Northwestern Atlantic mature at 2.8-33+ ft (85–100+ cm) straight carapace lengths (SCL) (Avens and Snover 2013).

Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat 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 indicate 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 10 years of data collection in the North

Atlantic DPS. The results were variable with some sites showing no trend and others increasing. However, all major nesting populations (using data through 2011-2012) demonstrated increases in abundance (Seminoff *et al.* 2015).

More recent data is available for the southeastern United States. The FWRI monitors sea turtle nesting through the Statewide Nesting Beach Survey (SNBS) and Index Nesting Beach Survey (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 is presented for green, loggerhead, and leatherback sea turtles. The index counts represent 27 core index beaches. The index nest counts represent approximately 70 percent 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. The nest numbers show a mostly biennial pattern of fluctuation (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/; Figure 7). 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 2011, 2013, 2015, 2017, and 2019. In 2020, green sea turtle nest counts on the 27 core index beaches reached more than 20,000 nests recorded, which was also high considering the above-mentioned cycles (FFWCC 2021). This recent nesting data over the past decade suggests a potentially strong increasing trend in 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.

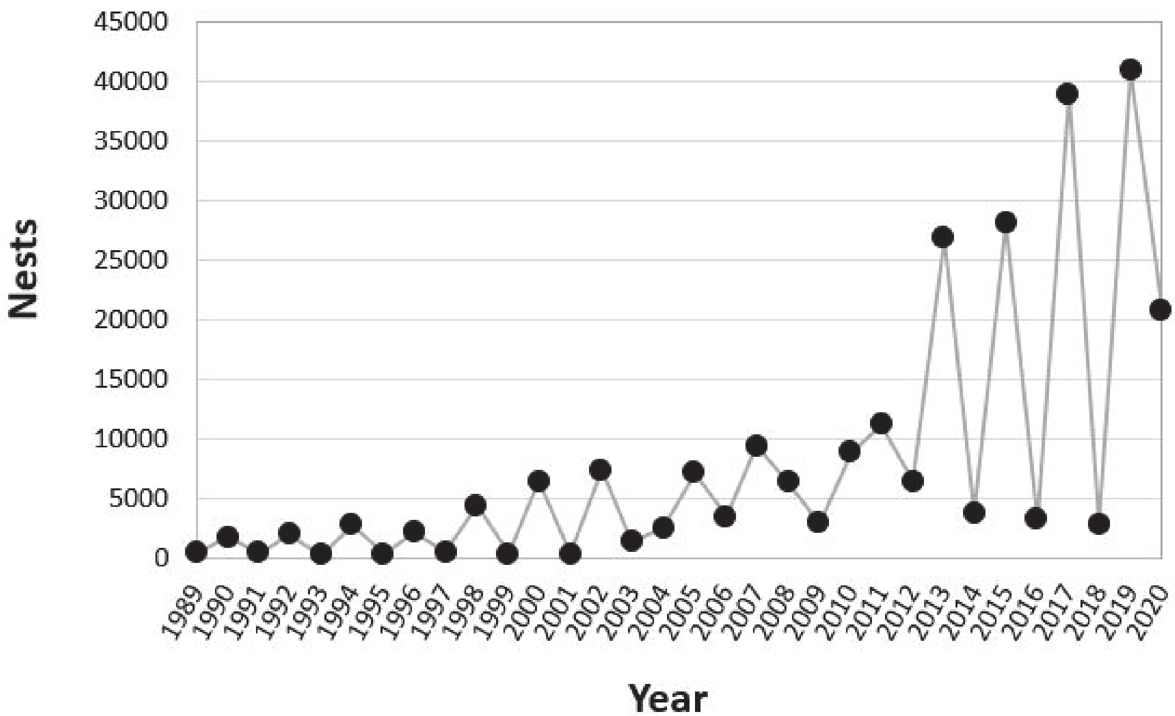

Figure 7. Number of green sea turtle nests counted on core index beaches in Florida from 1989-2020 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/).

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 is in effect for the North Atlantic DPS of 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 percent (105 km) of available nesting beaches is in public ownership and encompasses greater than 50 percent 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 percent 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.

4.2.1.2 Kemp's Ridley Sea Turtle

Species Description

The range of Kemp's ridley sea turtles extends from the Gulf of Mexico to the Atlantic coast (Figure 8). 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.

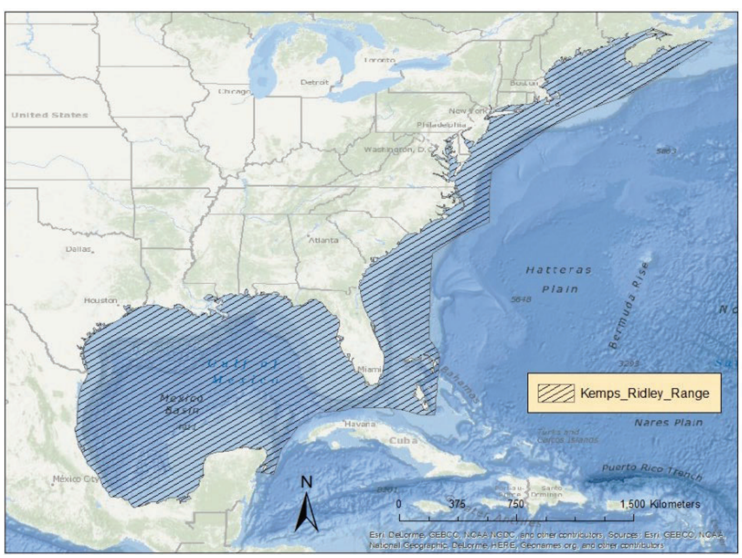

Figure 8. Range of the Kemp's ridley sea turtle.

We used information available in the revised recovery plan (NMFS *et al.* 2011) and 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 percent of the global population's nesting activity occurs on a 146 km stretch of beach that includes Rancho Nuevo in Mexico (Wibbels and Bevan 2019). In the United States, 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 turtles are likely distributed throughout the Gulf of Mexico into the northwestern Atlantic (Putman *et al.* 2013). Kemp's ridley 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), and 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 Northeast Fisheries Science Center (NEFSC) caught a juvenile Kemp's ridley during a recent research 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 turtles 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, jellyfish, mollusks, and tunicates (NMFS *et al.* 2011).

Population Dynamics

Of the sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased at 15 percent annually (Heppell *et al.* 2005). However, due to recent declines in nest counts, decreased survival of immature and adult sea turtles, and updated population modeling, this rate is not expected to continue 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 percent decrease from 2018 and a 54.89 percent decrease from 2017, which had the highest number (24,587) of nests (Figure 9; unpublished data). The reason for this recent decline is uncertain.

Using the standard International Union for Conservation of Nature (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 2 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, 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 turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton *et al.* 2006).

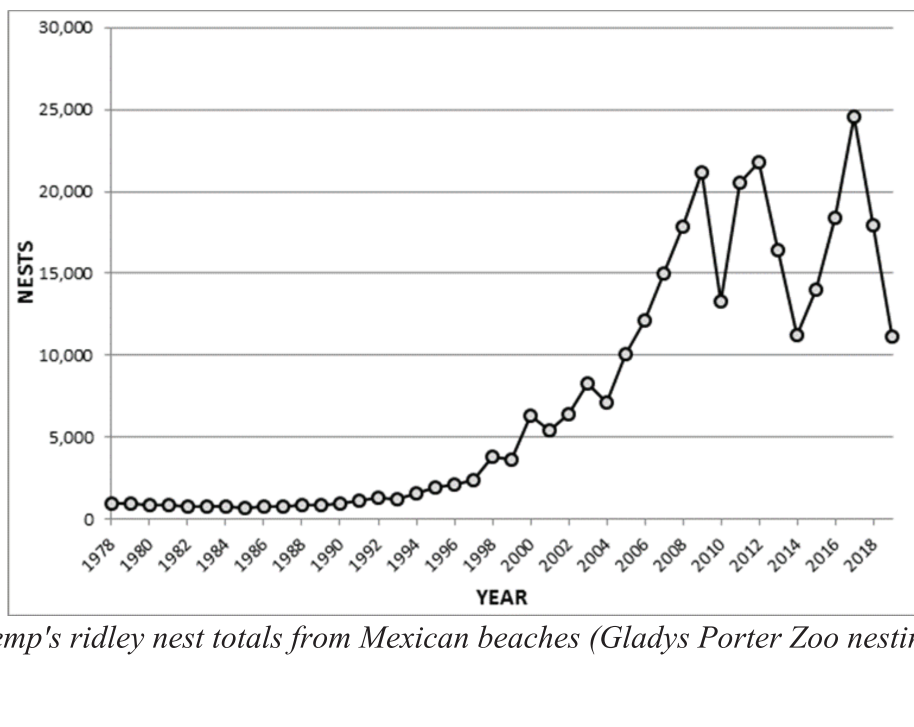

Figure 9. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2019).

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 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, 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 6-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 Sea Turtle Stranding and Salvage Network (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 Loggerhead Sea Turtle (Northwest Atlantic Ocean DPS)

Loggerhead sea turtles are circumglobal, and are found in the temperate and tropical regions of the Indian, Pacific and Atlantic Oceans. The loggerhead sea turtle is distinguished from other turtles by its reddish-brown carapace, large head and powerful jaws. The species was first listed as threatened under the Endangered Species Act in 1978 (43 FR 32800, July 28, 1978). On September 22, 2011, the NMFS and U.S. FWS designated nine distinct population segments of loggerhead sea turtles, with the Northwest Atlantic Ocean DPS listed as threatened (76 FR 58868). The Northwest Atlantic Ocean DPS of loggerheads is found along eastern North America, Central America, and northern South America (Figure 10).

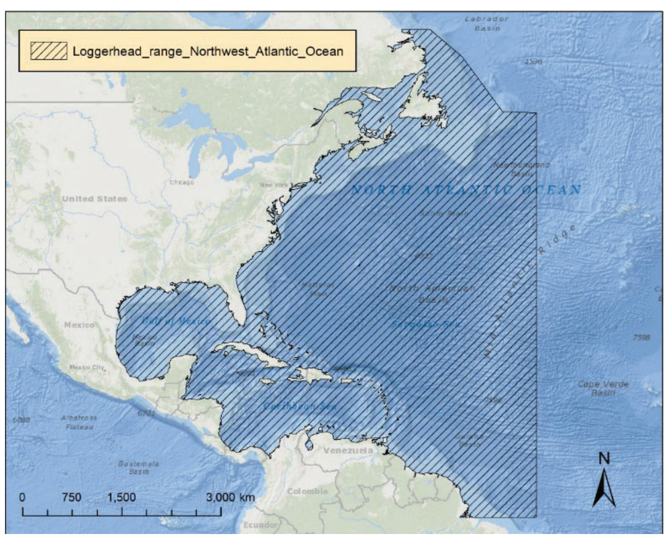

Figure 10. Map identifying the range of the Northwest Atlantic Ocean DPS of loggerhead sea turtles.

We used information available in the 2009 Status Review (Conant *et al.* 2009), the final listing rule (76 FR 58868, September 22, 2011), the relevant literature, and recent nesting data from the 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 an average of five clutches per year. The annual average clutch size is 115 eggs per nest. Females do not nest every year. The average remigration interval is three years. There is a 54 percent emergence success rate (Conant *et al.* 2009). As with other sea turtles, temperature determines the sex of the turtle during the middle of the incubation period. Turtles spend the post-hatchling stage in pelagic waters. The juvenile stage is spent first in the oceanic zone and later in 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 to 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 percent-88 percent) 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 United States and, in particular, Florida. They found that nearly all loggerheads caught in the NED came from the Northwest Atlantic DPS (mean = 99.2 percent), 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 (including 24 turtles caught during fisheries research) turtles 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 (≤ 2 ft (63 cm) SCL) and large (> 2 ft (63 cm) SCL) loggerheads north and south of Cape Hatteras, North Carolina. North of Cape Hatteras, large turtles came mainly from southeast Florida (44 percent±15 percent) and the northern United States management units (33 percent ± 16 percent); small turtles came from central east Florida (64 percent ± 14 percent). South of Cape Hatteras, large turtles came mainly from central east Florida (52 percent ± 20 percent) and southeast Florida (41 percent ± 20 percent); small turtles came from southeast Florida (56 percent ± 25 percent). 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, NMFS SEFSC 2001, Heppell *et al.* 2005, Conant *et al.* 2009, NMFS SEFSC 2009, TEWG 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 Northwest Atlantic Ocean DPS is divided into five recovery units: Northern, Peninsular Florida, Dry Tortugas, Northern Gulf of Mexico, and Greater Caribbean (Conant *et al.* 2009). A more recent analysis using expanded 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 Northwest Atlantic Ocean DPS should be considered as ten management units: (1) South Carolina and Georgia, (2) central eastern Florida, (3) southeastern Florida, (4) Cay Sal, Bahamas, (5) Dry Tortugas, Florida, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin *et al.* 2012).

The Northwest Atlantic Ocean's loggerhead nesting aggregation is considered the largest in the world (Casale and Tucker 2017). Using data from 2004-2008, the adult female population size of the DPS was estimated at 20,000 to 40,000 females (NMFS SEFSC 2009). More recently, Ceriani and Meylan (2017) reported a 5-year average (2009-2013) of more than 83,717 nests per year in the southeast United States and Mexico (excluding Cancun, Quintana Roo, Mexico; approximately 3.7 percent of nests in Quintana Roo). These estimates included sites without long-term (≥10 years) datasets. When they used data from 86 index sites (representing 63.4 percent of the estimated nests for the whole DPS with long-term datasets, they reported 53,043 nests per year. 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 Northwest Atlantic DPS was positive (+2 percent) (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 5-year average annual nest counts. However, the authors concluded that the subpopulation is well monitored and the data evaluated represents 63.4 percent of the total estimated annual nests of the subpopulation and, therefore, are representative of the overall trend (Ceriani and Meylan 2017).

About 80 percent of loggerhead nesting in the southeast United States occurs in six Florida counties (NMFS and U.S. FWS 2008). The Peninsula Florida Recovery Unit and the Northern Recovery Unit represent approximately 87 percent and 10 percent, respectively of all nesting effort in the Northwest Atlantic DPS (NMFS and U.S. FWS 2008, Ceriani and Meylan 2017). As described above, FWRI's INBS collects standardized nesting data. The index nest counts for loggerheads represent approximately 53 percent of known nesting in Florida. There have been three distinct intervals observed: increasing (1989-1998), decreasing (1998-2007), and increasing (2007-2020) (Figure 11). 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 2019 and 2020, more than 53,000 nests were documented (Figure 11). The nest counts in Figure 12 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 an upward trend since 2010 (Figure 12).

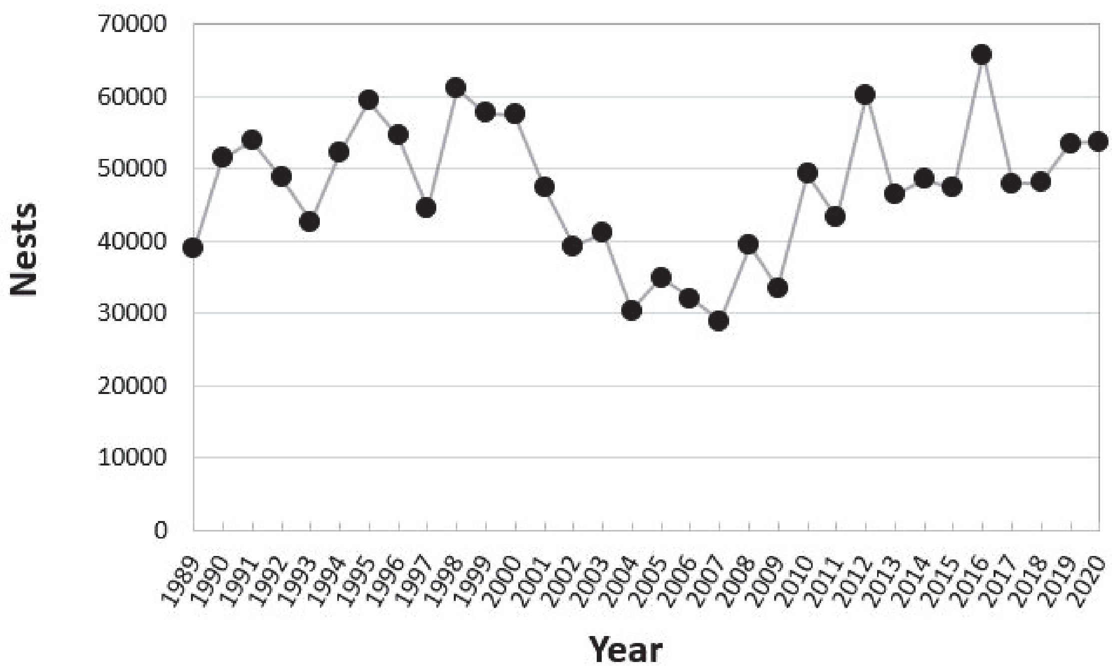

Figure 11. Annual total nest counts of loggerhead sea turtles on Florida core index beaches in peninsular Florida, 1989-2020 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/).

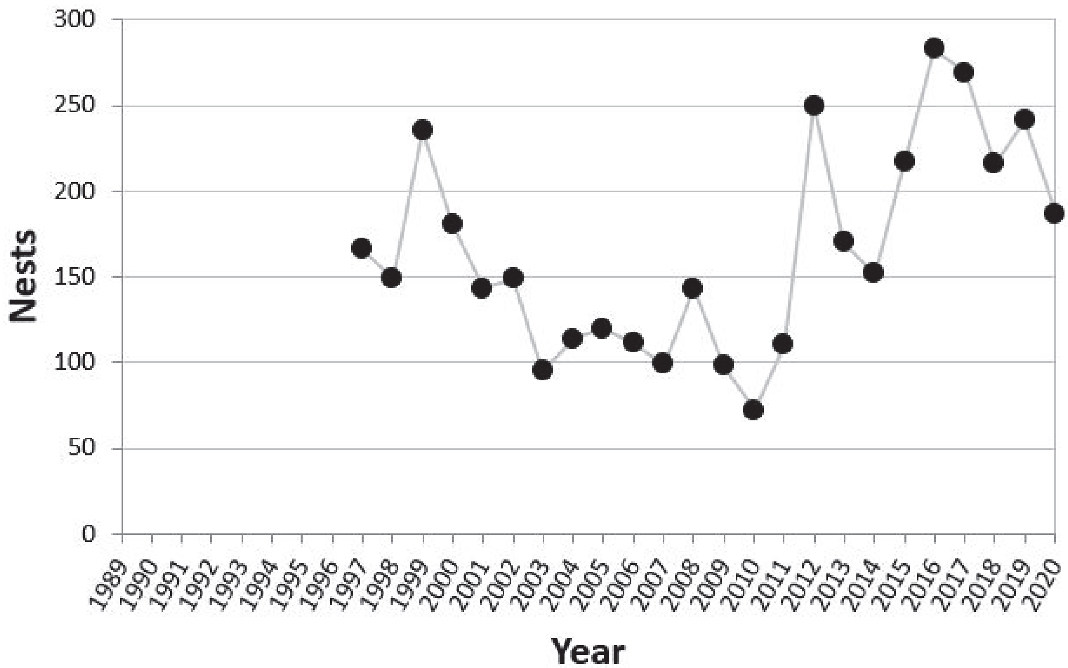

Figure 12. Annual nest counts of loggerhead sea turtles on index beaches in the Florida Panhandle, 1997-2020 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/).

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 2020 ranged from a low of 28,876 in 2007 to a high of 65,807 in 2016 (Bolten *et al.* 2019, FFWCC 2021). An increase in the number of loggerhead nests in the PFRU has been observed since 2007 and long-term nesting data from 1989-2020 reveal a complex pattern with three distinct phases: increasing (1989- 1998), decreasing (1998-2007), and increasing (2007-2020) (FFWCC 2021). 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), 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 percent annually from 1983 to 2005 (NMFS and U.S. FWS 2008). Recently, the trend has been increasing. Ceriani and Meylan (2017) reported a 35 percent 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 percent (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, Ceriani *et al.* 2019), which accounts for less than 1 percent of the Northwest Atlantic 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 km 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 index nesting beach survey 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) (see https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). In the 2009-2013 trend analysis by Ceriani and Meylan (2017), a one percent 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 percent (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 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 one hundred 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 percent increase for this Recovery Unit was reported from 2009 through 2013.

Status

Fisheries bycatch is the highest threat to the Northwest Atlantic 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 Northwest Atlantic Ocean DPS are variable. Overall, short-term trends have shown increases, however, over the long-term the DPS is considered stable.

Critical Habitat
Critical habitat is in effect for the Northwest Atlantic DPS of loggerhead sea turtles surrounds southeastern United States (79 FR 29755, July 10, 2014; 79 FR 39856, July 10, 2014), which is outside the action area.

Recovery Goals
The recovery goal for the Northwest Atlantic loggerhead 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 percent resulting in at least 14,000 nests annually for the Northern Recovery Unit; greater than or equal to 1 percent resulting in 106,100 nests annually for the Peninsular Florida Recovery Unit; greater than or equal to 3 percent resulting in at least 1,100 nests for the Dry Tortugas Recovery unit; and greater than or equal to 3 percent 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.

4.2.1.4 Leatherback Sea Turtle
The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (Figure 13).

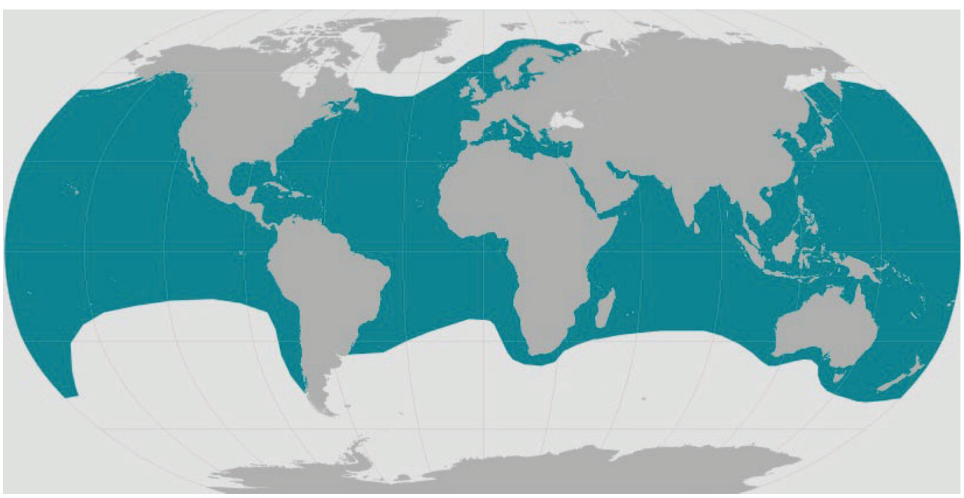

Figure 13. Range of the leatherback sea turtle (https://www.fisheries.noaa.gov/species/leatherback-turtle).

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 populations that met the discreteness and significance criteria of the DPS were identified (NMFS and U.S. FWS 2020). The subpopulation found within the action is area is the Northwest Atlantic DPS (Figure 14). NMFS and U.S. FWS concluded that the seven populations, which met the criteria for DPSs, all met the definition of an endangered species. However, NMFS and U.S. FWS 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 Florida FWRI to summarize the life history, population dynamics and status of the species, as follows.

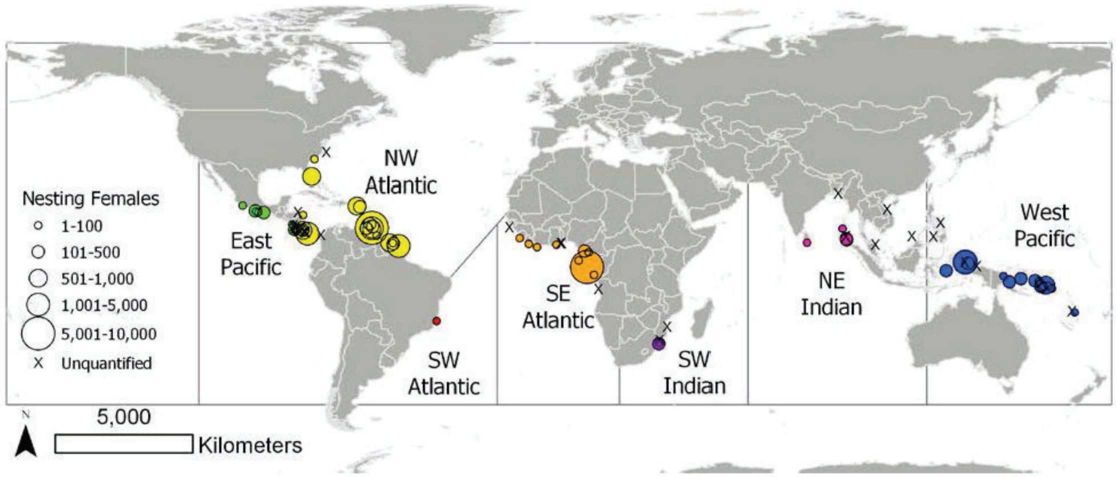

Figure 14. Leatherback sea turtle DPSs and nesting beaches (NMFS and U.S. FWS 2020).

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, Eckert *et al.* 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 3 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 percent worldwide (Eckert *et al.* 2012).

Age at sexual maturity has been challenging to obtain given the species physiology and habitat use (Avens *et al.* 2019). Past estimates ranged from 5-29 years (Spotila *et al.* 1996, Avens *et al.* 2009). More recently, Avens *et al.* (2019) 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 4.2 ft (129.2 cm) curved carapace length (CCL) (range 3.7-5 ft (112.8-153.8 cm)). In the Pacific, the mean age at sexual maturity was 17 years (range 12-28) and the mean size at sexual maturity was 4.2 ft (129.3 cm) CCL (range 3.6- 5 ft (110.7-152.3 cm)) (Avens *et al.* 2019).

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 percent more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James *et al.* 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, 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 (DO)) 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 Pacific, Atlantic, 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 regional management units (RMU) or subpopulations: Northwest Atlantic, Southeast Atlantic, Southwest Atlantic, Northwest Indian, Southwest Indian, East Pacific, and West Pacific (Wallace *et al.* 2010). The status review concluded that the RMUs identified by Wallace *et al.* (2010) are discrete populations and, then, evaluated whether any other populations exhibit this level of genetic discontinuity (NMFS and U.S. FWS 2020).

To evaluate the RMUs 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 these studies detected fine-scale genetic differentiation in the Northwest, Southwest, and Southeast Atlantic populations, the status review team determined that none indicated that the genetic differences were sufficient 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 3-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.* 2013b). 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 a 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 turtles. The Working Group discussed entanglement in vertical line fisheries off New England and Canada as potentially important mortality 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/yr) (Lum 2006, Eckert 2013, Northwest Atlantic Leatherback Working Group 2018).

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).

Leatherback sea turtles nest in the southeastern United States. From 1989-2020, leatherback nests at core index beaches in Florida have varied from a minimum of 30 nests in 1990 to a maximum of 657 in 2014 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). Leatherback nesting declined from 2014 to 2017. Although slight increases were seen in 2018, 2019, and 2020, nest counts remain low compared to the numbers documented from 2008-2015 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/) (Figure 15). The status review found that the median trend for Florida from 2008-2017 was a decrease of 2.1

percent annually (NMFS and U.S. FWS 2020).

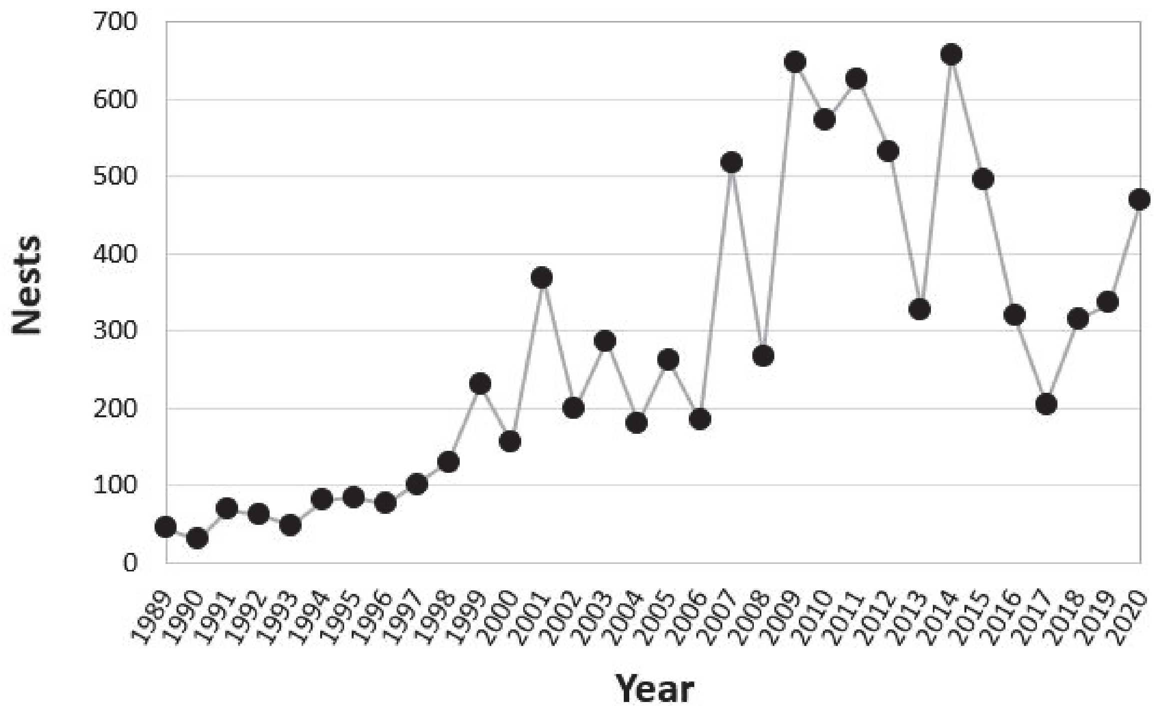

Figure 15. Number of leatherback sea turtle nests counted on core index beaches in Florida from 1989-2020. (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/).

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. 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). The Southeast DPS exhibits a declining nest trend (NMFS and U.S. FWS 2020).

Populations in the Pacific have shown dramatic declines at many nesting sites (Santidrián-Tomillo *et al.* 2007, Sarti Martínez *et al.* 2007, Tapilatu *et al.* 2013, Mazaris *et al.* 2017, Santidrián-Tomillo *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.* 2013a). 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.* 2013a). Counts of leatherbacks at nesting beaches in the western Pacific indicate that the subpopulation declined at a rate of almost 6 percent 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 percent 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 10 females nest per year from 1994 to 2004, and about 296 nests per year were 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 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.* 2013a) and there have been range-wide reductions in population abundance. The species' resilience to additional perturbation both within the Noirthwest 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 1998a) 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 include:

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, U.S. Virgin Islands; and the east coast of Florida.
2. Nesting habitat encompassing at least 75 percent of nesting activity in the U.S. Virgin Islands, 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 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 developed for these species to identify immediate, targeted efforts vital to stabilizing the population and preventing 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

4.2.2 Atlantic Sturgeon

An estuarine-dependent anadromous species, Atlantic sturgeon occupy ocean and estuarine waters including sounds, bays, and tidal-affected rivers from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (ASSRT 2007) (Figure 16). On February 6, 2012, NMFS listed five DPSs of Atlantic sturgeon under the ESA: Gulf of Maine (GOM), New York Bight (NYB), Chesapeake Bay (CB), Carolina, and South Atlantic (77 FR 5880 and 77 FR 5914). The Gulf of Maine DPS is listed as threatened, and the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered.

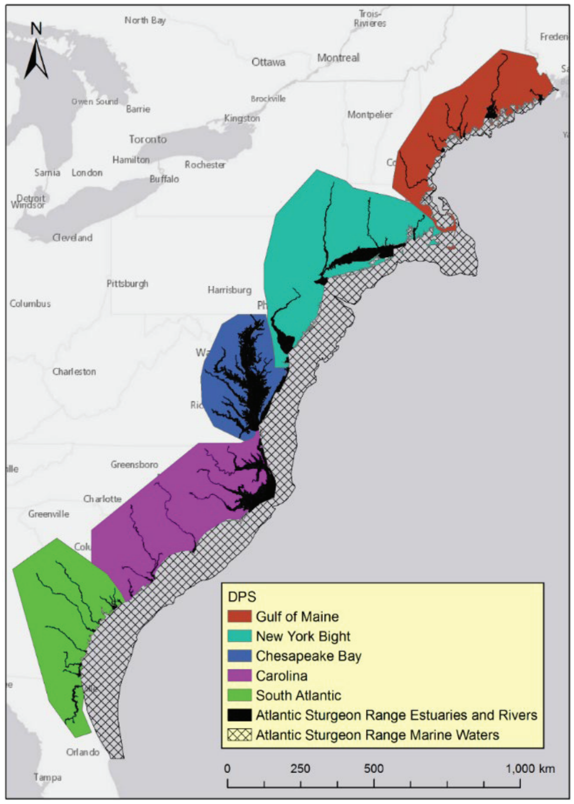

Figure 16. U.S. range of Atlantic sturgeon DPSs.

Information available from the 2007 Atlantic sturgeon status review (ASSRT 2007), 2017 Atlantic States Marine Fisheries Commission (ASMFC) benchmark stock assessment (ASMFC 2017), final listing rules (77 FR 5880 and 77 FR 5914; February 6, 2012), and material supporting the designation of Atlantic sturgeon critical habitat (NMFS 2017c), were used to summarize the life history, population dynamics, and status of the species.

Life history

Atlantic sturgeon are a late maturing, anadromous species (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 2017c).

Atlantic sturgeon spawn in freshwater habitats (ASSRT 2007, NMFS 2017c) 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.* 2012c). 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). Based on tagging records, Atlantic sturgeon return to their natal rivers to spawn (ASSRT 2007), with spawning intervals ranging from one to five years in males (Smith 1985, Collins *et al.* 2000b, Caron *et al.*

2002) and two to five years for 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). Some Atlantic sturgeon river populations may have up to two spawning seasons comprised of different spawning adults (Collins *et al.* 2000b, Balazik and Musick 2015), although the majority likely just have just one, either in the spring or fall.[6] There is evidence of spring and fall spawning for the South Atlantic DPS (77 FR 5914, February 6, 2012) (NMFS and U.S. FWS 1998b, Collins *et al.* 2000b); spring spawning for the Gulf of Maine and New York Bight DPSs (NMFS 2017c), and fall spawning for the Chesapeake Bay and Carolina DPSs (Smith *et al.* 1984, Balazik *et al.* 2012a). While spawning has not been confirmed in the James River (Chesapeake Bay DPS), telemetry and empirical data suggest that there may be two potential spawning runs: a spring run from late March to early May and a fall run around September after an extended staging period in the lower river (Balazik *et al.* 2012a, Balazik and Musick 2015).

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.* 2012a, 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.* 2012a, Breece *et al.* 2013, NMFS 2017c). 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-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.* 2000a, 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 subadult phase, individuals enter the marine environment, mixing with adults and subadults from other river systems (Dovel and Berggren 1983, Bain 1997, Hatin *et al.* 2007, McCord *et al.* 2007). Once subadult Atlantic sturgeon have reached maturity (*i.e.*, adult stage), they will remain in marine or estuarine waters, only returning far upstream to the spawning areas when they are 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 up into seven general categories as described in Table 8 below (adapted from ASMFC 2007).

[6] 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).

Table 8. Descriptions of Atlantic sturgeon life history stages.

Age Class	Size	Duration	Description
Egg	~2 mm – 3 mm diameter (Van Eenennaam *et al.* 1996); p. 773)	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); pp. 714-715)	8-12 days post hatch (ASSRT 2007); p. 4)	Negative photo-taxic, nourished by yolk sac
Post yolk-sac larvae (PYSL)	~14mm – 37mm (Bath *et al.* 1981); pp. 714-715)	12-40 days post hatch	Free swimming; feeding; Silt/sand bottom, deep channel; fresh water
Young of Year (YOY)	0.3 grams <410mm TL	From 40 days to 1 year	Fish that are > 40 days and < 1 year; capable of capturing and consuming live food
Juveniles	>410mm and <760mm TL	1 year to time at which first coastal migration is made	Fish that are at least age 1 and are not sexually mature and do not make coastal migrations.
Subadults	>760 mm and <1500 mm TL	From first coastal migration to sexual maturity	Fish that are not sexually mature but make coastal migrations
Adults	>1500 mm TL	Post-maturation	Sexually mature fish

Population dynamics

A population estimate was derived from the Northeast Area Monitoring and Assessment Program (NEAMAP) trawl surveys (Kocik *et al.* 2013).[7] For this Opinion, we are relying on the population estimates derived from the NEAMAP swept area biomass assuming a 50 percent 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

[7] 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.

Atlantic sturgeon are present. We also consider 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 percent catchability (NMFS 2013b). The 50 percent 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 believe 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 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 9). Given the proportion of adults to subadults in the NMFS NEFSC observer data (approximate ratio of 1:3), we have also estimated the number of adults and subadults originating from each DPS. However, this cannot be considered an estimate of the total number of subadults, because it only considers those subadults that are of a size that are present and vulnerable to capture in commercial trawl and gillnet gear in the marine environment.

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 no risk from the proposed action since they are absent within the action area. The NEAMAP surveys are conducted in waters that include the preferred depth ranges of subadult 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 subadults in marine waters is a minimum count because it only considers those subadults 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 subadults. 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.

Table 9. Calculated population estimates based upon the NEAMAP survey swept area model, assuming 50 percent efficiency.

DPS	Estimated Ocean Population Abundance	Estimated Ocean Population of Adults	Estimated Ocean Population of Subadults (of size vulnerable to capture in fisheries)
GOM	7,455	1,864	5,591
NYB	34,567	8,642	25,925
CB	8,811	2,203	6,608
Carolina	1,356	339	1,017
SA	14,911	3,728	11,183
Canada	679	170	509

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 percent to 4.9 percent (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. We decided to not use the most recent published mixed stock analysis from (Kazyak *et al.* 2021), because the percentages were based on genetic sampling of Atlantic sturgeon that were encountered across the U.S. Atlantic coast. Instead, we use the percentages from O'Leary *et al.* (2014) because their sampling area is more consistent in habitat and geography to the action area defined in this Opinion. Based on a recent mixed stock analysis done by O'Leary *et al.* (2014), we expect Atlantic sturgeon throughout the action area originate from the five DPSs at the following frequencies: NYB 87%; CB 8%; SA 3%; and GOM and Carolina (combined) 2%. These percentages are based on genetic sampling of all individuals (n=460) captured during trawl surveys in the mid-Atlantic Bight as described in Dunton *et al.* (2010), (2012). Individuals were captured at coastal aggregation sites for Atlantic sturgeon off the coast of Rockaway Peninsula, New York in May/June 2010, May 2011, October/November 2011, and May 2012. The genetic assignments have corresponding confidence intervals; however, for purposes of this Opinion, we are using the reported values without their associated confidence intervals. The reported values, which approximate the mid-point of the range, are a reasonable indication of the likely genetic makeup of Atlantic sturgeon in the action area. These assignments and the data from which they are derived are described in detail in O'Leary *et al.* (2014).

Depending on life stage, sturgeon may be present in marine and estuarine ecosystems. The action area for this Opinion occurs in saline waters; therefore, this section will focus only on the distribution of Atlantic sturgeon life stages (subadult and adult) in saline waters; it will not discuss the distribution of Atlantic sturgeon life stages (eggs, larvae, juvenile, subadult, adult) in freshwater ecosystems, specifically, their movements into/out of natal river systems. For 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 2017d); 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.* 2004b, Dadswell 2006, ASSRT 2007, Laney *et al.* 2007, Dunton *et al.* 2010, Erickson *et al.* 2011, Dunton *et al.* 2012, Wirgin *et al.* 2012, Waldman *et al.* 2013, O'Leary *et al.* 2014, Dunton *et al.* 2015, Wirgin *et al.* 2015a, 2015b, 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, b, Laney *et al.* 2007, Dunton *et al.* 2010, Erickson *et al.* 2011, Dunton *et al.* 2012, 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 m) continental shelf waters have been documented (Timoshkin 1968, Collins and Smith 1997, Colette and Klein-MacPhee 2002, Stein *et al.* 2004b, Dunton *et al.* 2010, 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 m, 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.* 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.* 2004b, 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). There are currently 39 rivers and two creeks that are specific occupied areas designated as critical habitat for Atlantic sturgeon (NMFS 2017d). 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 in some states. Based on management recommendations in the interstate fishery management plan (ISFMP), adopted by the Commission in 1990, commercial harvest in Atlantic coastal states was severely restricted and ultimately eliminated from all states (ASMFC 1998a). In 1998, the Commission placed a 20-40 year moratorium on all Atlantic sturgeon fisheries until the spawning stock could be restored to a level where 20 subsequent year classes of adult females were protected (ASMFC 1998a, ASMFC 1998b). In 1999, NMFS closed the Exclusive Economic Zone to Atlantic sturgeon retention, pursuant to the Atlantic Coastal Act (64 FR 9449; February 26, 1999). However, all state fisheries for sturgeon were closed prior to this.

The most significant threats to Atlantic sturgeon are habitat changes, impeded access to historical habitat by dams and reservoirs, degraded water quality, reduced water quantity, vessel strikes, and bycatch in commercial fisheries. A first-of-its-kind climate vulnerability assessment, conducted on 82 fish and invertebrate species in the Northeast U.S. Shelf, concluded that Atlantic sturgeon from all five DPSs were among the most vulnerable species to global climate change (Hare *et al.* 2016).

The ASMFC completed an Atlantic sturgeon benchmark stock assessment in 2017 that considered the status of each DPS individually, as well as all five DPSs collectively as a single unit (ASMFC 2017). The assessment concluded all five DPSs of Atlantic sturgeon, as well as each individual DPS remain depleted relative to historic abundance (Table 10). The assessment also concluded that the population of all five DPSs together appears to be recovering slowly since implementation of a complete moratorium in 1998. However, there were only two individual DPSs, the New York Bight DPS and Carolina DPS, for which there was a relatively high probability that abundance of the DPS has increased since the implementation of the 1998 fishing moratorium. In addition, there was a relatively high probability that mortality for animals of the Gulf of Maine DPS and the Carolina DPS exceeded the mortality threshold used for the assessment. Therefore, while Atlantic sturgeon populations are showing signs of slow recovery when all five DPSs are considered collectively, these trends are not necessarily reflected with individual DPSs (ASMFC 2017).

Table 10. Stock status determination for the coastwide stock and DPSs (recreated from the Commission'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)

*EPR= eggs per recruit. The EPR analysis was used to find the value of total mortality (Z) that resulted in an EPR that was 50 percent of the EPR at the unfished state for ages 4-21 ($Z_{50\%}$).

**For indices that started after 1998, the first year of the index was used as the reference value. The terminal year of a given survey was compared to the fitted abundance index from 1998 (the year the Commission's moratorium for Atlantic sturgeon was implemented).

Critical Habitat
Critical habitat has been designated for the five DPSs of Atlantic sturgeon (82 FR 39160, August 17, 2017) in rivers of the eastern United States. These areas are outside 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.

4.2.2.1 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, MA. 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 the Cocheco and Salmon Falls rivers) rivers. Spawning has been documented in the Kennebec River. During the study period of 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 (NMFS 2018b).

Studies are on-going to determine whether Atlantic sturgeon are spawning in these rivers. Atlantic sturgeons that are spawned elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT 2007). 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).

Bigelow and Schroeder (1953) surmised that Atlantic sturgeon likely spawned in Gulf of Maine Rivers in May-July. More recent captures of Atlantic sturgeon in spawning condition within the Kennebec River suggest that spawning more likely occurs in June-July (ASMFC 1998b, NMFS and U.S. FWS 1998b, 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, ME (NMFS and U.S. FWS 1998b, ASMFC 2007); and (4) the capture of three Atlantic sturgeon larvae between rkm 72 and rkm 75 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.

Several 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 17th 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. Nevertheless, mortalities associated with bycatch in fisheries occurring in state and federal waters still occurs. 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). Subadults and adults are killed as a result of bycatch in fisheries authorized under Northeast Fishery Management Plans (FMPs). 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. Habitat disturbance and direct mortality from anthropogenic sources are the primary concerns.

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.

Connectivity is disrupted by the presence of dams on some rivers in the Gulf of Maine region, including the Penobscot and Merrimack Rivers. While there are also dams on the Kennebec, Androscoggin, and Saco 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 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, Wippelhauser *et al.* 2017). The Essex Dam on the Merrimack River blocks access to approximately 58 percent 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[8], 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 is known to occur in two rivers (Kennebec and Androscoggin). Spawning may be occurring in other rivers, such as the Penobscot, but has not been confirmed. In the Stock Assessment, ASMFC concluded that the abundance of the Gulf of Maine DPS is "depleted" relative to historical levels and there is a 51 percent probability that abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium (ASMFC 2017). 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. Detections of acoustically-tagged sturgeon indicate that both adult and subadult Atlantic sturgeon use the area for foraging and come back to the area year after year (Little 2013, Novak *et al.* 2017). 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 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

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

River and Bay (Novak *et al.* 2017, Wippelhauser *et al.* 2017).

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 as a result 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 (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 percent (*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 percent originated from the Gulf of Maine DPS (Wirgin *et al.* 2012). Thus, a significant number of the GOM 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 cm, but the majority (72.5 percent) were less than 150 cm 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).

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.

4.2.2.2 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, MA 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 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). 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).

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 cm 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: it is the closest of the known spawning rivers to the Connecticut; the most robust of all of the spawning populations; and, 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 percent 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 percent) were full siblings which means that relatively few adults contributed to this cohort. 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.

There are no abundance estimates for the entire New York Bight DPS or for the entirety of the (*i.e.*, all age classes) the Hudson River or Delaware River populations. There are, however, some estimates for specific life stages (*e.g.*, natal juvenile abundance, spawning run abundance, and effective population size). Using side scan sonar technology in conjunction with detections of previously tagged Atlantic sturgeon, Kazyak *et al.* (2020) estimated the 2014 Hudson River spawning run size to be 466 sturgeon (95 percent CRI = 310-745). Based on genetic analyses of two different life stages, effective population size for the Hudson River spawning population has been estimated to be 198 (95 percent CI=171.7-230.7; (O'Leary *et al.* 2014)) based on sampling of subadults[9] captured off of Long Island across multiple years, and 156 (95 percent CI=138.3-176.1; (Waldman *et al.* 2019)) based on sampling of natal juveniles in multiple years. It has also been estimated at 144.2 (95 percent CI=82.9-286.6) based on samples from a combination of

[9] O'Leary et al. refer to the sampled fish as juveniles. However, we use the term "subadult" for immature Atlantic sturgeon that have emigrated from the natal river, and the term "juvenile" for immature fish that have not yet emigrated from the natal river.

juveniles and adults (ASMFC 2017). Estimates for the Delaware River spawning population from the same studies were 108.7 (95 percent CI=74.7-186.1; (O'Leary *et al.* 2014)), 40 (95 percent CI=34.7-46.2; (Waldman *et al.* 2019)), and 56.7 (95 percent CI=42.5-77.0) (ASMFC 2017). 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, Wirgin *et al.* 2015b, Kazyak *et al.* 2021). Waldman et al.'s 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 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.

As described above, the CT DEEP determined that very few adults contributed to the juveniles found in the Connecticut River in 2014. Based on the genetic analysis of 45 of the captured juveniles, the effective population size for the Connecticut River was estimated to be 2.4 sturgeon (Savoy *et al.* 2017). As noted above, the CT DEEP is further investigating the presence of and origins for a spawning population in the Connecticut River.

For 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 concluded that subadult and adult abundance of the New York Bight DPS was 34,566 sturgeon (NMFS 2013b). 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.* 2012b, 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.

The ASMFC 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 percent) that the New York Bight DPS abundance has increased since the implementation of the 1998 fishing moratorium, and a 31 percent probability that mortality for the New York Bight DPS exceeds the mortality threshold used for the assessment (ASMFC 2017). The ASMFC did not estimate abundance of the New York Bight DPS or otherwise quantify the trend in abundance because of the limited available information.

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. In the

Hudson River, sources of potential mortality include vessel strikes and entrainment in dredges. Individuals are also exposed to consequences of bridge construction (including the replacement of the Tappan Zee Bridge). Impingement at water intakes, including the Danskammer, Roseton and Indian Point 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 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. A dredged navigation channel extends from Trenton seaward through the tidal river (Brundage and O'Herron 2009), and the river receives significant shipping traffic. Vessel strikes have been identified as a threat in the Hudson and Delaware Rivers; however, at this time, we do not have information to quantify this threat or its impact to the population or the New York Bight DPS. Similar to the Hudson River, there is currently not enough information to determine a trend for the Delaware River population.

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, Waldman *et al.* 2013, Wirgin *et al.* 2015a, 2015b, 2018). These findings support the conclusion of Wirgin *et al.* (2015b) 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 also 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 1 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[10] 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 the genetic analyses, including in waters off of 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

[10] 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.

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, the available information suggests that the straying rate is high between these rivers. There are no indications of increasing abundance for the New York Bight DPS (Greene *et al.* 2009, ASMFC 2010a). Some of the impact 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 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. 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. 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). Currently available estimates indicate that at least 4 percent of adults may be killed as a result of bycatch in fisheries authorized under Northeast FMPs. Based on mixed stock analysis results presented by Wirgin and King (2011), over 40 percent 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 percent 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.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also 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). 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 exposure to contaminants.

Vessel strikes occur in the Delaware River. Twenty-nine mortalities believed to be the result of vessel strikes were documented in the Delaware River from 2004 to 2008, and at least 13 of these fish were large adults. 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 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, 138 sturgeon carcasses were observed on the Hudson River and reported to the NYSDEC between 2007 and

2015. Of these, 69 are suspected of having been killed by vessel strike. 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.

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 and Murphy 2010). There are no empirical abundance estimates of the number of Atlantic sturgeon in the New York Bight DPS. We determined that the New York Bight 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.

4.2.2.3 Chesapeake Bay DPS of Atlantic sturgeon

The Chesapeake Bay (CB) 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 CB DPS extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the CB DPS and the adjacent portion of the marine range are shown in Figure 16. 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 percent 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, Kahn *et al.* 2014, Richardson and Secor 2016, Secor *et al.* 2021). 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, Balazik and Musick 2015, Balazik *et al.* 2017b). 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 CB 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). Therefore, age at maturity for Atlantic sturgeon of the CB DPS likely falls within these values.

Several threats play a role in shaping the current status of CB 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 1998a, Secor 2002, Bushnoe *et al.* 2005, ASSRT 2007) as well as subsistence fishing and attempts at commercial fisheries as early as the 17th century (Secor 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 CB 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 1998b, 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 the some areas of the Bay's health, the ecosystem remains in poor condition. In 2020, the Chesapeake Bay Foundation gave the overall health index of the Bay a grade of 32 percent (D+) based on the best available information about the Chesapeake Bay for indicators representing three major categories: pollution, habitat, and fisheries (Chesapeake Bay Foundation 2020). While 32 percent is one percent lower than the state of the Bay score in 2018, this was an 18.5 percent increase from the first State of the Bay report in 1998 which gave the Bay a score of 27 percent (D). According to the Chesapeake Bay Foundation, the modest gain in the health score was due to a relatively stable adult blue crab population, promising results from oyster reef restoration, less nitrogen and phosphorous in the water, a smaller dead zone, and improvements in water clarity as highlighted below:

- Monitoring data indicated that the 2020 dead zone was the seventh smallest in the past 35 years,
- Three decades of data recently reviewed by scientists at the Chesapeake Bay Program revealed that, although waters in the Bay may still look cloudy to the human eye, light attenuation trends are improving—in other words, more light is penetrating through the water due to changes in the types of particles in the water that block sunlight,

- Nitrogen and phosphorus pollution from the Susquehanna and Potomac Rivers was well below the 10-year average, partially a reflection of below-average precipitation,
- From 2019-2020, Maryland and Virginia completed 343 and 21 acres of oyster reef restoration projects in the Little Choptank River and the Eastern Branch of the Elizabeth River, respectively, and
- Although the most recent population estimate for blue crab declined slightly, it remained within the bounds fishery scientists consider healthy (Chesapeake Bay Foundation 2020).

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.* 2021). 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 *et al.* 2012d, Balazik, pers. comm. in ASMFC 2017, Fox *et al.* 2020). There have 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 CB 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.* 2004a, ASMFC 2007, ASSRT 2007).

Summary of the Chesapeake Bay DPS
There are no abundance estimates for the entire Chesapeake Bay DPS or for the spawning populations in the James River or the Nanticoke River system. Spawning for the CB DPS is known to occur in only the James and Pamunkey Rivers and in Marshyhope Creek. Spawning may be occurring in other rivers, such as the York, Rappahannock, Potomac, and Nanticoke, 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). 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.* 2021). By comparison, a total of 373 different adult-sized Atlantic sturgeon (*i.e.*, total count does not include recaptures of the same fish) were captured in the James River from 2009 through spring 2014 (Balazik and Musick 2015). 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.

There are 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 2017); 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.* 2017b). There is a single estimate of 12.2 (95% CI = 6.7– 21.9) for the Nanticoke River system (Secor *et al.* 2021), 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).

Some of the impact from the threats that facilitated the decline of the CB DPS have been removed (*e.g.*, directed fishing) or reduced as a result 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 CB DPS of Atlantic sturgeon. Of the 35 percent of Atlantic sturgeon incidentally caught in the Bay of Fundy, about one percent were CB 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 CB 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.

4.2.2.4 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 16. Sturgeon are commonly captured 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 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 YOY were observed or mature adults were present in freshwater portions of a system (Table 11). 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 11. Major rivers, tributaries, and sounds within the range of the Carolina DPS and currently available data on the presence of an 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 2002). Secor (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 percent 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.

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.

Though 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 percent 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.

4.2.2.5 South Atlantic DPS of Atlantic sturgeon

The South Atlantic (SA) 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 SA DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the SA DPS and the adjacent portion of the marine range are shown in Figure 16. Sturgeon are commonly captured 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 deep (Stein *et al.* 2004a, ASMFC 2007), but Atlantic sturgeon are recorded as bycatch out to 500 fathoms (900 meters).

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 YOY were observed, or mature adults were present, in freshwater portions of a system (Table 12). 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. Marys 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. Marys 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 SA DPS likely use other river systems than those listed here for their specific life functions.

Table 12. Major rivers, tributaries, and sounds within the range of the SA 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	

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 SA DPSs, it is likely that some of the historical 8,000 fish would be attributed to both the Carolina DPS and SA 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 SA DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters.

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 SA 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 SA 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 life-span also allows multiple opportunities to contribute to future generations, this is hampered within the SA 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 SA 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 SA 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 SA 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 SA 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 SA DPS.

5.0 ENVIRONMENTAL BASELINE

The Environmental Baseline for biological opinions 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 listed species or designated critical habitat 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 consequences of several activities that may affect the survival and recovery of sea turtles (NWA DPS loggerheads, leatherbacks, Kemp's ridleys, and North Atlantic DPS greens) and Atlantic sturgeon DPSs in the action area. The activities that shape the *Environmental Baseline* of this consultation in the action area generally include: dredging operations, vessel and fishery operations, water quality/pollution, and recovery activities associated with reducing those impacts.

The overall impacts that each federal, state, and private action or other human activities have on ESA-listed sea turtles and Atlantic sturgeon 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 and 4.2.2). Sections 4.2.1 and 4.2.2 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

We have conducted a number of section 7 consultations to address the consequences 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.

5.1.1 Dredging, Sand Mining, & Beach Nourishment

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. 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 Division.

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 consequences 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 associated with dredging projects may also impact these species.

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.

New York and New Jersey Harbor Deepening Project (HDP)
As mentioned in the *Project History* section, an Opinion regarding the HDP was issued by us to you on October 13, 2000 (NMFS 2000). The Opinion included an Incidental Take Statement (ITS) exempting the incidental taking of two loggerhead, one green, one Kemp's ridley, or one leatherback sea turtle for the duration (*i.e.*, three years) of the deepening, via a hopper dredge, of the Ambrose Channel. Consultation was reinitiated in 2012 and an Opinion was issued on October 25, 2012 (NMFS 2012). The Opinion included an ITS exempting the incidental taking of one Kemp's ridley, or one leatherback, and one Atlantic sturgeon (any DPS) for the duration of the deepening, via a hopper dredge, of the Ambrose Channel. The project was completed in 2016. On September 16, 2012, you informed us that the anterior portion of an Atlantic sturgeon was found within the inflow screening of the hopper dredge operating within the Ambrose Channel-Contract B. The sturgeon part was moderately decomposed. It is believed that the animal had died by some other cause(s) and thus, was not attributed as an entrainment incident related to or as a result of the Ambrose Channel deepening.

Amboy Aggregate Mining of Ambrose Channel
On October 11, 2002, NMFS issued an Opinion that considered the consequences of the USACE's proposed issuance of a permit to Amboy Aggregates, Inc. for sand mining activities in the Ambrose Channel, New Jersey (NMFS 2002). The permit authorized sand mining activities every year for a period of ten years. NMFS concluded that the proposed action may adversely affect, but was not likely to jeopardize the continued existence of listed species of sea turtles. The 2002 Opinion included an ITS which exempted the take, via injury or mortality, of two loggerhead, one green, one Kemp's ridley, or one leatherback sea turtle for the ten year duration of the permit. On July 23, 2012, the USACE started coordination to reinitate this consultation to re-authorize the project for another 10 years. On May 20, 2013, NMFS concluded that the re-authorization of the project was not likely to adversely affect ESA-listed species. Therefore, this project currently no longer has an ITS. To date, no takes of listed species have been recorded.

5.1.2 Offshore Disposal at the HARS Site
Over the past century, dredged material from the Port of New York and New Jersey was routinely disposed of at the Mud Dump Site (MDS), which is located within the current HARS site (*i.e.*, located 5.6 km (3.5 miles) east of Sandy Hook, New Jersey). The EPA formally designated the MDS as an "interim" ocean dredged material disposal site in 1973, and gave it final designation in 1984. On September 29, 1997, EPA under 40 CFR §228, closed MDS and simultaneously re-designated the site and surrounding areas that were used historically as disposal sites for contaminated dredged material as the HARS, and proposed that the site be managed to reduce impacts to acceptable levels (in accordance with 40 CFR §228.1(c)) (62 FR

46142) through remediation with uncontaminated dredged material (Remediation Material).

EPA published final rule 67 FR 62659 on March 17, 2003, to modify the designation of the HARS to establish a HARS-specific worm tissue polychlorinated biphenyl (PCB) criterion of 113 parts per billion (ppb) for use in determining the suitability of proposed dredged material for use as Remediation Material. This amendment to the HARS designation established a pass/fail criterion for evaluating PCBs in worm tissue from bioaccumulation tests performed on dredged material proposed for use at HARS as Remediation Material (USACE and EPA 2010).

Pursuant to NEPA, EPA Region 2 prepared a Supplement to the Environmental Impact Statement (SEIS) on the Dredged Material Disposal Site Designation for the Designation of the HARS in 1997 (EPA 1997). EPA prepared a BA that concluded that the closure of the Mud Dump Site and designation of the HARS was not likely to adversely affect loggerhead and kemps ridley sea turtles and humpback and fin whales (EPA 1997). Special conditions are included in USACE Section 103 permits for placement of Remediation Material at HARS that requires the presence of NMFS approved Endangered Species Observer(s) on disposal scows during their trips to the HARS. The role of these observers is to prevent adverse impacts to endangered or threatened species transiting the area between the proposed dredge site and the HARS. In a letter dated July 30, 1997, we concurred with the EPA's determination and noted that while the BA did not consider right whales, our conclusions also applied to right whales. On August 21, 2012, EPA requested re-initiation of consultation pursuant to Section 7 of the ESA of 1973, as amended, on the continued usage of the HARS, because of the listing of a new species (five distinct population segments (DPSs) of Atlantic sturgeon) on February 6, 2012. On September 21, 2012, we issued a letter to the EPA concurring with their determination that continued disposal operations, including transport of material from dredge sites to the HARS site, were not likely to adversely affect any listed species under our jurisdiction (*i.e.*, NMFS listed species of sea turtles, Atlantic sturgeon, and whales). As Section 7 consultation has previously been conducted on HARS disposal operations and no new information is available which changes the previous conclusion, no further consultation regarding the disposal of material at the HARS is necessary and will not be considered further in this document.

5.1.3 Artificial Reefs

Existing reefs are already permitted and are covered by ESA Section 7 consultations to receive rock from Federal Navigation projects. One of the most recent ESA consultations was completed on April 30, 2021, which determined that the consequences of the continued use, expansion, and creation of the Rockaway, McAllister Grounds, Fire Island, Moriches, Shinnecock, Atlantic Beach, Hempstead, Sixteen Fathom, Twelve Mile, Yellowbar, Kismet, Matinecock, Huntington/Oyster Bay, Smithtown, Port Jefferson/Mount Sinai, and Mattituck artificial reefs are not likely to adversely affect ESA-listed species. Therefore the consequences of artificial reef placement will not be considered further. If new reefs are proposed for use by the states, they will be similarly permitted, including all necessary compliance with all environmental federal statutes including initiating an ESA consultation, in order to receive any rock from the proposed federal action.

5.1.4 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 the FMPs and their implementing regulations. The action area includes a portion of NOAA Statistical Area 612. Fisheries that operate in the action area that may affect sea turtles and Atlantic sturgeon include: American lobster, Atlantic bluefish, Atlantic herring, Atlantic mackerel/squid/ butterfish, Atlantic sea scallop, coastal migratory pelagics, monkfish, northeast multispecies, pelagic longline Atlantic highly migratory species, spiny dogfish, Atlantic surf clam and ocean quahog, and summer flounder/scup/black sea bass. Section 7 consultations have been completed on these fisheries to consider consequences to sea turtles and Atlantic sturgeon.

In the Northwest Atlantic, NMFS Greater Atlantic Regional Fisheries Office (GARFO) manages federal fisheries from Maine to Cape Hatteras, North Carolina; however, the management areas for some of these fisheries range from Maine through Virginia, while others extend as far south as Key West, Florida. The NMFS Southeast Regional Office (SERO) manages federal fisheries from Cape Hatteras, North Carolina to Texas, including Puerto Rico and the U.S. Virgin Islands. 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 that could potentially occur in the action area: (1) coastal migratory pelagics (NMFS 2015, NMFS 2017a); and (2) pelagic longline Atlantic highly migratory species (NMFS 2020b). NMFS GARFO has formally consulted on the following fisheries that could potentially occur in the action area: American lobster, northeast multispecies, monkfish, spiny dogfish, Atlantic bluefish, Atlantic mackerel/squid/butterfish, and summer flounder/scup/black sea bass fisheries (inclusive of the NEFMC Omnibus EFH Amendment 2) (GARFO batched fisheries; NMFS 2021c) and Atlantic sea scallop fishery (NMFS 2021b).

In these past Opinions, only those on the GARFO batched fisheries and Atlantic sea scallop fisheries (NMFS 2021c, b) concluded that there was a potential for collisions between fishing vessels and an ESA-listed species (specifically, sea turtles). Any consequences to their prey and/or habitat were found to be insignificant and discountable. We have also determined that the GARFO Atlantic herring and Atlantic surfclam and ocean quahog 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 consequences 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 was not likely to jeopardize the continued existence of any sea turtle species. Each of these Opinions included an ITS exempting a certain amount of lethal or non-lethal take resulting from interactions with the fisheries. These ITSs are summarized below (Table 13). 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 14). Each of these estimates was used in developing the ITS for the two current GARFO fishery Opinions (Atlantic sea scallop and batched fisheries).

Table 13. 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)
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

* 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 14. Estimates of average annual turtle interactions in 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	2012-2016	Mid-Atlantic	Loggerhead: 141 (3.8) Kemp's ridley: 29 Leatherbacks: 5.4 Unid. hardshell: 22.4	Loggerhead: 111.4 Kemp's ridley: 23 Leatherbacks: 4.2 Unid. hardshell: 17.6	Murray (2018)

The anticipated take of sea turtles for the two GARFO Opinions in Table 13 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 15).

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.* 2004a). More recent analyses were completed in 2011 and 2016.

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 percent and the mortality rate in otter trawls was estimated at five percent. Based on this estimate, 391 Atlantic sturgeon were estimated to be killed annually in federal fisheries in the Greater Atlantic Region (Miller and Shepard 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 percent) were caught in gillnet fisheries and 1,062 fish (41 lethal; 4 percent) were caught in otter trawl fisheries each year from 2000-2015. Atlantic sturgeon bycatch estimates for Northeast gillnet and trawl gear from 2011-2015 (approximately 761 fish per year for gillnets, 777 for trawls) are 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 15. 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

* 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 2015, 2017a).

At this time, fisheries regulated by NMFS SERO for which a bycatch estimate is available for Atlantic sturgeon and could overlap in the action area is coastal migratory pelagic fishery. In their 2015 Opinion, 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.

5.1.5 Research and Other Permitted Activities

NMFS Northeast Fisheries Science Center

In June 2016, we completed a programmatic Opinion (NMFS 2016a) on all fisheries and ecosystem research activities to be conducted and funded by the NEFSC from June 2016 to June 2021. 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 308 from the NYB DPS (15 lethal),
    - up to 130 from the SA DPS (seven lethal),
    - up to 70 from the CB DPS (four lethal),
    - up to 60 from the GOM DPS (three lethal),
    - up to 14 from the Carolina DPS (one lethal), and
    - up to 13 Canadian origin (non-listed); and
- up to five Gulf of Maine DPS Atlantic salmon (two lethal).

That Opinion has recently been replaced with a programmatic Opinion (completed in October 2021) (NMFS 2021a) on all fisheries and ecosystem research activities to be conducted or funded by the NEFSC over a five-year period from October 2021 through 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 loggerhead sea turtles (up to ten lethal);
- up to 95 Kemp's ridley sea turtles (up to 15 lethal);
- up to ten North Atlantic DPS green sea turtles (up to one lethal);
- up to ten leatherback sea turtles (up to five lethal);
- up to ten 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 130 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 6 Canadian origin (non-listed);
- up to six Gulf of Maine DPS Atlantic salmon (up to 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 2018c). 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.

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 (Table 16) and sturgeon (Table 17) that are occurring in the action area are provided below.

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 sturgeon in New York and New Jersey waters. However, many research activities include a larger area of the Atlantic Ocean, and the requested take did not always specify the waters where take would occur. Thus, some of the requested take in the tables below include take for activities outside of the action area (*i.e.*, mid-Atlantic coastal waters in general).

The requested take reported in Table 16 and Table 17 only includes take authorized under section 10(a)(1)(A) of the ESA. Permits relating to stranding and salvage programs are described in that section. In addition, research projects may include take authorized under other authorities (*e.g.*, under section 7 of the ESA). These takes are presented 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 within the action area that authorize take of sea turtles for scientific research.

Permittee	File #	Project	Area	Sea Turtle 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	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
NMFS Northeast Fisheries Science Center	20197	Biological sampling of incidentally caught sea turtles, during commercial fishing operations, by Northeast Fisheries Science Center (NEFSC) certified observers	US Locations including offshore waters	Totals for all fisheries and gear types: Loggerhead - 1,025 Leatherback - 49 Kemp's ridley - 14 Green - 25	6 years, 01/10/2017 to 01/15/2022
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.	5 years, 05/23/2017 to 05/31/2022

Permittee	File #	Project	Area	Sea Turtle Takes	Research Timeframe
				Total over 5 yrs., unintentional mortality: 2 green, 1 hawksbill, 2 Kemp's, 1 leatherback, 3 loggerhead, and 1 olive.	
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
New England Aquarium	21301	Distribution, movements, behavior, physiology, genetics, health and habitat use of leatherback sea turtles in the NW Atlantic	US Locations including offshore waters	Annual take for Project 1: capture, measure, weigh, flipper/PIT tag, tissue biopsy, blood sample, opportunistic fecal and urine sample, attach instrument (satellite/acoustic transmitter), release, recapture (for gear removal if necessary), and photograph/video up to 10 leatherbacks. Annual take for Project 2: attach instrument (camera/TDR/VHF/acoustic transmitter/AUV transponder), tracking (with AUV or vessel), recapture (for gear removal if necessary), and photograph/video up to 20 leatherbacks. Annual take for Unmanned Aerial System (UAS) work: observe, photograph/video up to 50 turtles (based on known aggregation sizes of this species in our study region).	10 years, 03/09/2018 to 09/30/2027
Coonamessett Farm Foundation, Inc.	23639	Coonamessett Farm Foundation Sea Turtle Ecology Program	US Locations including offshore waters	Annually, capture, sample, and tag 30 loggerhead, 30 leatherback, 15 Kemp's ridley, and 15 green sea turtles; document observations in-water of 60 loggerheads, 60 leatherbacks, 45 Kemp's ridley, and 45 green sea turtles using techniques including videography, aerial surveys, and PIT scans; and harass (*i.e.*, through failed capture attempts) 60 loggerheads, 60 leatherbacks, 45 Kemp's ridey, and 45 green sea turtles. For unidentified turtles, 10 annual harass takes for pursuit and unsuccessful capture attempts and 20 annual in-water observation harass takes (*i.e.*, videography and aerial survey).	10 years, 09/25/2020 to 09/30/2030
NMFS Southeast Fisheries Center (SEFSC)	24368	SEFSC Observer Program Sea Turtle Research from Specimens taken in Commercial Fisheries in the Gulf of Mexico and off the East Coast of the United States, and Oil / Gas Platform Removal Programs in the Gulf of Mexico	US Locations including offshore waters International waters Foreign Countries including territorial waters	A maximum of 111 green, 490 loggerhead, 260 Kemp's ridley, 31 hawksbill, 117 leatherback, 20 olive ridley, and 23 combined species/unidentified/hybrid live turtles will be sampled annually, as distributed per fishery in the take tables. Additional samples from incidental mortalities also will be collected (20 green, 56 loggerhead, 18 Kemp's ridley, 9 hawksbill, 25 leatherback, 2 olive ridley,	10 years, 09/22/2021 to 09/30/2031

Permittee	File #	Project	Area	Sea Turtle Takes	Research Timeframe
				and 59 combined species/unidentified/hybrid.	

Table 17. Active section 10(a)(1)(A) permits within the action area that authorize 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
Stony Brook University	20351	Atlantic and Shortnose Sturgeon Population Dynamics and Life History in New York and Coastal Marine and 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 Headquarters	24016	Chesapeake Bay Atlantic and shortnose sturgeon population dynamics, metapopulation analysis, and phenological assessment of reproductive ecology	US Locations including offshore waters	Year-round sampling (*i.e.*, handle, measure, mark, sample, telemeter and release) of 50 adult and sub-adult and 50 juvenile Atlantic sturgeon incidentally captured in other permits or authorized projects.	10 years, 01/28/2021 to 01/31/2031

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.

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. Most coastal Atlantic states are either in the process of applying for permits or considering applications for state fisheries. We are actively working with several states and other parties on section 10(a)(1)(B) permits; however to date no section 10(a)(1)(B) permits have been authorized for New York or New Jersey state fisheries.

5.1.6 Operations of Vessels Carrying Out Federal Actions

Potential sources of adverse consequences to sea turtles and Atlantic sturgeon from federal vessel operations in the action area include operations of the US Navy (USN), the 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 adverse consequences to listed species.

5.1.7 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 2018a). 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 to 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 from acoustic stressors of ESA-listed fish, but rather used a surrogate expressed as a distance to reach consequences 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.

5.1.8 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 one of the four Planning Areas (North Atlantic). The draft proposed program for leasing, published in 2018, calls for leasing in the North Atlantic Planning Area in 2021, 2023 and 2025. At this time, the proposed program has not been approved or finalized.

5.2 State or Private Activities in the Action Area

5.2.1 State Authorized 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 (NMFS SEFSC 2001, 2009, Murray 2015b, 2018, 2020) and Atlantic sturgeon (ASSRT 2007, ASMFC 2017) in these fisheries have been reported through state reporting requirements, research studies, vessel trip reports (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.

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 percent) and gillnets (40.7 percent) 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.

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 percent 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 percent), New York (23 percent), and Virginia (22 percent) 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 percent 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 2009). 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 percent. 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 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.* 2004a). 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 percent 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 2019, 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). 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 percent (Stein *et al.* 2004a). 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.[11] 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.

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 (NMFS 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 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.

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

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

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 2010b). 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.

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, 2018). Several states have reported incidental catch of Atlantic sturgeon during striped bass fishing activities (NMFS 2011). There are 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 percent 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 might occur 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. 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.

State Trawl Fisheries
Trawl fisheries also occur in state waters. 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 percent) of Atlantic sturgeon bycatch in otter trawls occurs at depths <20 meters, with 90 percent 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 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. Sea turtle captures on recreational hook and line gear are not uncommon, but the overall level of take and post-release mortality are unknown.

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 Contaminants, Pollution, and Water Quality

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. Dredging and point source discharges (*i.e.*, municipal wastewater, industrial or power plant cooling water or waste water) and compounds associated with discharges or released from the sediments during dredging operations (*i.e.*, metals, dioxins, dissolved solids, phenols, and hydrocarbons) contribute to poor water quality and may also impact the health of sturgeon populations. The compounds associated with discharges can alter the pH or dissolved oxygen levels of receiving waters, which may lead to mortality, changes in fish behavior, deformations, and reduced egg production and survival.

Sediment contamination in NY/NJ Harbor has included: polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyl (PCB) congeners, metals, and dioxin/furans (USACE 2020c). Sources of contamination include combined sewer discharges, urban runoff, stormwater runoff, industrial discharges, and maritime and industrial accidents. Chemical contaminants may also have a consequence on sea turtle reproduction and survival. Pollution may make sea turtles more susceptible to disease by weakening their immune systems.

Excessive turbidity due to coastal development and/or construction sites could influence sea turtle and Atlantic sturgeon foraging ability; however, based on the best available information, turtle and Atlantic sturgeon foraging ability is not very easily affected by changes in increased suspended sediments unless these alterations make habitat less suitable for listed species and hinder their capability to forage and/or for their foraging items to exist. If the latter occurs, eventually these species will tend to leave or avoid these less desirable areas (Ruben and Morreale 1999). As the action area is entirely in saline waters, no early life stages of sturgeon species are expected to be in the action area. Thus, the consequences to Atlantic sturgeon would only be limited to adults and subadults.

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 or sturgeon causing injury or mortality. Sea turtles may ingest plastic or 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 consequences have not been quantified and impacts at the population level are not well understood.

Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from coastal development, groundwater discharges, industrial development, and debris. While the consequences of contaminants on Atlantic sturgeon and turtles are relatively unclear, pollutants may make Atlantic sturgeon and sea turtles more susceptible to disease by weakening their immune systems or may have a consequence on Atlantic sturgeon and sea turtle reproduction and survival.

The noise level in the ocean is thought to be increasing at a substantial rate due to increases in shipping and other activities, including seismic exploration, offshore drilling and sonar used by military and research vessels (Southall and Scholik-Schlomer 2007). Because under some conditions, low frequency sound travels very well through water, few oceans are free of the threat of human noise. Concerns about noise in the action area of this consultation include increasing noise due to increasing commercial shipping and recreational vessels. Although noise pollution has been identified as a concern for marine mammals, these elevated levels of underwater noise may also be of concern for sea turtles and Atlantic sturgeon. Until additional studies are undertaken, it is difficult to determine the consequences these elevated levels of noise will have on sea turtles and Atlantic sturgeon and to what degree these levels of noise may be altering the behavior or physiology of these species.

As noted above, private and commercial vessels, including fishing vessels, operating in the action area of this consultation also have the potential to interact with sea turtles and Atlantic sturgeon. The consequences 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. It is important to note that minor vessel collisions may not kill an animal directly, but may weaken or otherwise affect it so it is more likely to become vulnerable to consequences such as entanglements. Listed species may also be affected by fuel oil spills resulting from vessel accidents. Fuel oil spills could affect animals directly or indirectly through the food chain. Fuel spills involving fishing vessels are common events. However, these spills typically involve small amounts of material that are unlikely to adversely affect listed species.

5.3.2 Private and Commercial Vessel Operations

The New York/New Jersey Harbor complex is a major shipping port and center of commerce, there are numerous private and commercial vessels (*e.g.*, container ships, commuter ferries) that operate in the action area that have the potential to interact with listed species. An unknown number of private recreational boaters frequent coastal waters; some of these are engaged in whale watching or sport fishing activities. These activities have the potential to result in lethal (through entanglement or boat strike) or non-lethal (through harassment) takes of listed species. Consequences of harassment or disturbance which may be caused by such vessel activities are currently unknown; however, no conclusive detrimental consequences have been demonstrated.

The existing HDP consists of the main navigation channels in the Port of New York and New Jersey that support various vessels including container terminals. The Port of NY/NJ is a multi-use port and receives calls from bulkers, containerships, general cargo vessels, passenger vessels, RoRo vessels, and tankers. Non-containerized vessels transported approximately 50 percent of all cargo in 2018 (Table 18) (USACE 2020b). Behind containerships, tankers carry the most cargo as a percent of total throughput at NY/NJ.

Table 18. 2018 Port of NY/NJ vessel calls by type.

Vessel Type	Percent of Throughput Tonnage Carried	2018 Total Vessel Calls Estimate*
Bulker	7%	275
Containership	50%	2,206
General Cargo	0%	67
Other	0%	33
Passenger	0%	123
RoRo	1%	560
Tanker	40%	1,128
Total	**100%**	**4,238**

* National Navigation Operation & Management Performance Evaluation Assessment System estimate to determine vessel distribution. Actual calls may vary.

The navigation channels extend from the Atlantic Ocean through the Port of New York and New Jersey and to the marine terminals that are called on by commercial deep-draft vessels. The HDP is authorized by Section 435 of the Water Resources Development Act of 1996 (Pub. L. No. 104-303) to a depth of -50 feet at mean lower low water (MLLW) or greater. The HDP has been constructed and is maintained at -50 feet MLLW and -53 feet MLLW in Ambrose Channel. The Port of New York and New Jersey is the busiest container port on the East Coast and the second busiest container gateway in the United States (USACE 2020c). Major container terminals included in this study are Elizabeth Port Authority Marine Terminal (EPAMT), Port Jersey Port Authority Marine Terminal (PJPAMT), and Port Newark (Figure 4).

The Port of New York and New Jersey is typically the first port of call for the largest container vessels calling on the U.S. East Coast. For the purposes of the HDCI study, the Port Authority of New York and New Jersey marine facilities consist of six container terminals: Red Hook Container Terminal, Global Container Terminal (GCT) Bayonne, GCT New York, A.P. Moller (APM) Terminal, Maher Terminal, and Port Newark Container Terminal (USACE 2020c) (Figure 17).

Figure 17. Map of container terminals in the NY/NJ Harbor complex (USACE 2020c).

ULCVs transiting to Global Terminal Bayonne (Port Jersey - Port Authority Marine Terminal), Kill Van Kull, and Elizabeth - Port Authority Marine Terminal may currently draft up to 49 feet (USACE 2020c). ULCVs are restricted to a maximum of two channel transits per tide window, which generally means a maximum of four transits per day. Many ULCV calls are located at Elizabeth - Port Authority Marine Terminal, which has several berths and cranes that are suited to accommodate a ULCV. Transit to and from Elizabeth - Port Authority Marine Terminal through the Newark Bay Channel is restricted to one-way (meaning they have to back out when they leave), imposing significant delay on the interacting traffic.

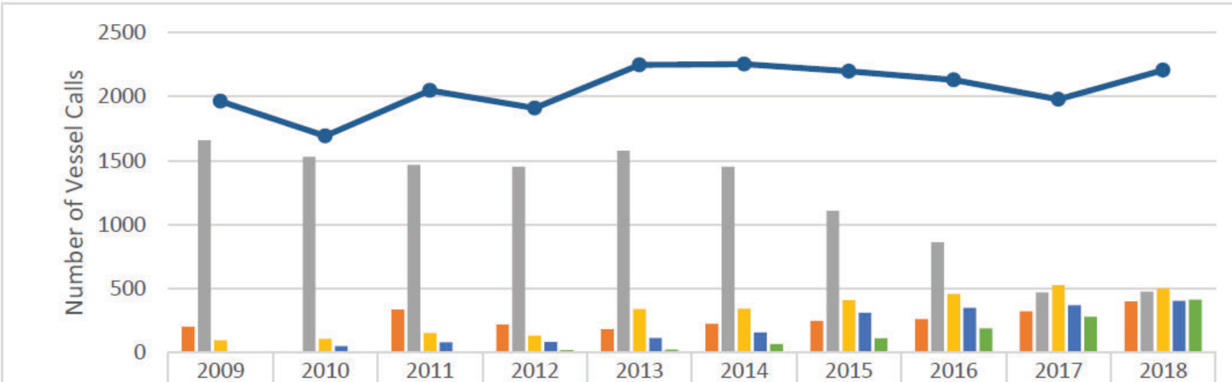
The District obtained data for the current container fleet from Waterborne Commerce Statistics Center, the National Navigation Operation & Management Performance Evaluation Assessment System and the Port Authority of New York and New Jersey to determine vessel characteristics of the fleet calling the port (USACE 2020c). The ships are classified as sub-Panamax (SPX), Panamax (PX), post-Panamax Generation I (PPX1), post-Panamax Generation II (PPX 2), post-Panamax Generation III (PPX 3) and post-Panamax Generation IV (PPX 4). The vessels are distinguished based on physical and operation characteristics, including lengths overall, design draft, beam, speed and TEU capacity. Containership classes overlap in all facets of dimensions, such as length, beam, depth and TEU capacity. For purposes of Environmental Assessment (USACE 2020c), the District separated the classes of the containership class sizes using the beam width (Table 19).

Table 19. Containership classes (USACE 2020b, c).

CLASS	DEADWEIGHT TONNAGE (METRIC TONS)	LENGTH OVERALL (FEET)	BEAM (FEET)	DESIGN DRAFT (FEET)
Subpanamax (SPX)	6,500 – 40,000	390 - 730	65 - 103	20 - 40

CLASS	DEADWEIGHT TONNAGE (METRIC TONS)	LENGTH OVERALL (FEET)	BEAM (FEET)	DESIGN DRAFT (FEET)
Panamax (PX)	24,000 – 69,000	558 - 930	105 - 107	27 - 45
Post-Panamax Generation 1 (PPX1)	71,200 – 80,900	930 – 1,000	108 - 133	45 - 47
Post-Panamax Generation 2 (PPX2)	80,901 – 110,000	1,026 – 1,100	134 - 145	46 - 49
Post-Panamax Generation 3 (PPX3)	117,500 – 144,500	1,100 – 1,200	149 - 177	49 - 51
Post-Panamax Generation 4 (PPX4)	150,000 – 194,600	1,201 – 1,308	178 - 194	51 – 52.5

Historical trends in containership vessel sizes and fleet composition for the Port of New York and New Jersey show the sub-Panamax vessels are continuing to be used at relatively the same rate. The number of Panamax calls has dropped dramatically as larger post-Panamax vessel transition to services calling The Port of New York and New Jersey (Figure 18) (USACE 2020b). The most significant change in vessel size comes with the growth in PPX2 and PPX3 class vessels from 2011 to 2018. As of 2018, 60 percent of calls are from Post-Panamax vessels compared with only 5 percent of calls in 2009. The total number of annual vessel calls from 2009-2018 has roughly stayed the same, fluctuating from 1,692 to as high as 2,253 calls in any particular year.



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
SPX	206	0	338	221	184	228	250	264	325	402
PX	1660	1529	1467	1452	1577	1453	1110	863	472	478
PPX1	98	109	156	134	342	344	410	459	528	504
PPX2	0	54	82	83	117	159	313	352	372	406
PPX3	0	0	5	20	27	69	114	192	281	416
Total	1,964	1,692	2,048	1,910	2,247	2,253	2,197	2,130	1,978	2,206

Figure 18. Containership vessel trends for the NY/NJ Harbor complex 2009-2018 (USACE 2020b).

Data shows that vessel traffic is a substantial cause of sea turtle mortality. Fifty to 500 loggerheads and five to 50 Kemp's ridley turtles are estimated to be killed by vessel traffic per year in the U.S. (NRC 1990). The report indicates that this estimate is highly uncertain and could be a large overestimate or underestimate. As described in the Recovery Plan for loggerhead sea turtles (NMFS and U.S. FWS 2008), propeller and collision injuries from boats and ships are common in sea turtles. From 1997 to 2005, 14.9 percent of all stranded loggerheads in the U.S. Atlantic and Gulf of Mexico were documented as having sustained some type of propeller or collision injuries although it is not known what proportion of these injuries were post or ante-mortem. As noted from the National Research Council (NRC) (1990), the regions of greatest concern for vessel strike are outside the action area and include areas with high concentrations of recreational-boat traffic such as the eastern Florida coast, the Florida Keys, and the shallow coastal bays in the Gulf of Mexico. In general, the risk of strike for sea turtles is considered to be greatest in areas with high densities of sea turtles and small, fast moving vessels such as recreational vessels or speed boats (NRC 1990).

There have been sightings of floating or stranded dead sea turtles that have shown evidence of a watercraft injury within the action area including two that were found in the Anchorage channel (Figure 19; STSSN, unpublished data). Based on the photographs of the deceased sea turtles, one sea turtle found in the Anchorage channel appeared to be injured by a smaller propeller, suggesting it was from a private vessel, while the other appeared to be injured by a larger propeller, suggesting it was likely from a commercial vessel. The sightings could be an underestimate of the number of sea turtle strikes that do occur in the area as not all dead sea turtles are discovered and documented. It is also unknown whether the vessel strikes occurred before or after the sea turtles died.

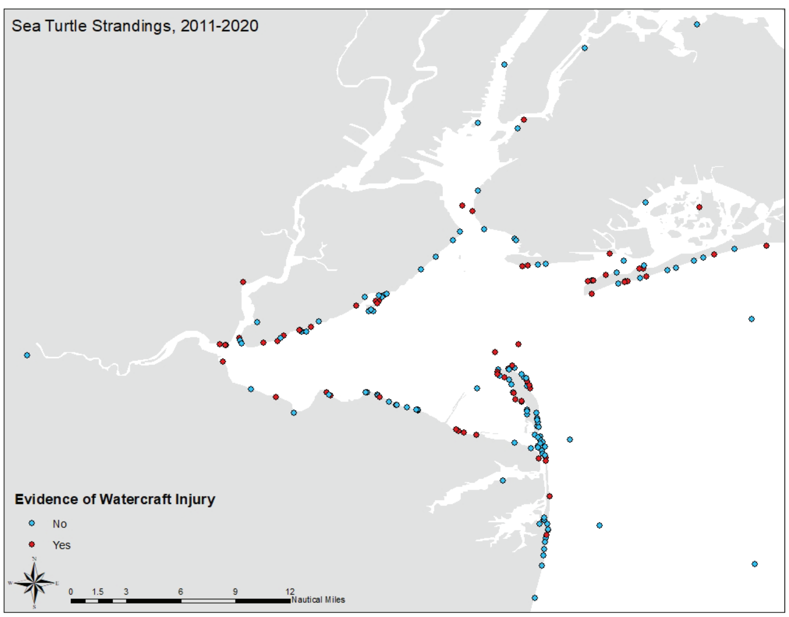


Figure 19. 2011-2020 observed NY/NJ sea turtle strandings and evidence of watercraft injury (shown in red) (STSSN, unpublished data).

In certain geographic areas, vessel strikes have been identified as a threat to Atlantic sturgeon. Although the exact number of Atlantic sturgeon killed as a result of being stuck by vessels is unknown, records of these interactions have been documented (Brown and Murphy 2010, Balazik *et al.* 2012d, Balazik 2018). Studies conducted in the Delaware River and in the James

River indicate that Atlantic sturgeon do not avoid or move away from vessels (Balazik *et al.* 2017a, Barber 2017, DiJohnson 2019). The best available information supports the conclusion that sturgeon are struck by small (*e.g.*, recreational) as well as large vessels. However, examination of the salvaged carcasses indicates that most fatalities are the result of the sturgeon being struck by a large vessel causing either blunt trauma injuries (*e.g.*, broken scutes, bruising, damaged soft tissues) or propeller injuries (*e.g.*, decapitation, complete transection of other parts of the sturgeon body, or deep slices nearly through the body depth of large sturgeon) (Balazik *et al.* 2012d). NMFS has only minimum counts of the number of Atlantic sturgeon that are struck and killed by vessels, because only sturgeon that are found dead with evidence of a vessel strike are counted. It is unknown if sturgeon involved in vessel strikes in the Ambrose channel would end up on shore. Looking at strandings from the NMFS Sturgeon Salvage Program (unpublished data) as far west as Rockaway, NY, only two salvage reports mention that the damage was from a vessel strike (one was very decomposed). From 2013 to 2020, there have also been 13 reported-but-not-salvaged carcass reports from the NYSDEC where they found some evidence of a possible vessel strike within the HDCI project area. The reports do not mention the size of the vessels involved, but it is understood that only a large vessel could cut through a large fish or cause noticeable traumatic injury. There has been documentation of smaller fish with fatal wounds, but not necessarily cut through that appear to be from smaller vessels. It is unclear whether the strikes occurred before or after the sturgeon died. New research 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 *et al.* 2012d, Balazik pers. comm in ASMFC 2017).

Other commercial and private activities therefore, have the potential to result in lethal (boat strike) or non-lethal (through harassment) takes of listed species that could prevent or slow a species' recovery. As sea turtles, and Atlantic sturgeon may be in the area where high vessel traffic occurs, the potential exists for collisions with vessels transiting from within and out of the action area.

5.4 Reducing Threats to ESA-Listed Species

Numerous efforts are ongoing to reduce threats to listed sea turtles and sturgeon. These include regulations that have been implemented to reduce the potential for incidental mortality of sea turtles from commercial fisheries, recovery planning, education/outreach activities, and the salvage programs. 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 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 consequences 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's 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. These 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. 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 the 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

TED Requirements in Trawl Fisheries
Turtle Excluder Devices (TEDs) are required in the summer flounder fishery. TEDs allow sea turtles to escape the trawl net, reducing injury and mortality resulting from capture in the net. 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).

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, b). 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 NMFS SEFSC (2019). 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 Turtle Deflector Dredge (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 consequences 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 Atlantic Sturgeon

Atlantic Sturgeon Recovery Planning

Several conservation actions aimed at reducing threats to Atlantic sturgeon are currently ongoing. In the near future, NMFS will be convening a recovery team and drafting a recovery plan which will outline recovery goals and criteria, as well as steps necessary to recover all Atlantic sturgeon DPSs. Numerous research activities are underway involving NMFS and other federal, state, and academic partners to obtain more information on the distribution and abundance of Atlantic sturgeon throughout their range, including in the action area. Efforts are also underway to better understand threats faced by the DPSs 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 consequences 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 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 an interim final rule that applied all prohibitions of section 9(a)(1) to the GOM DPS beginning on December 19, 2013 (78 FR 69310).

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 and sturgeon are present. However, if closures shift effort to areas with a comparable or higher density of sea turtles or sturgeon, 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.

5.5 Status of the Species within the Action Area

5.5.1 Sea Turtles

The HDCI study 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 areas where the HDCI study 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, Braun-McNeill and Epperly 2002, James *et al.* 2005c, Morreale and Standora 2005, Mansfield *et al.* 2009, TEWG 2009, NMFS NEFSC and SEFSC 2011, Ceriani *et al.* 2012, Griffin *et al.* 2013, Winton *et al.* 2018).

Sea turtles 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. Within the action area, sea turtles are present in NY/NJ waters from May to November each year, with the highest number of individuals present from June to October. One of the main factors influencing sea turtle presence in northern waters 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 2013a). Sea turtles are most likely to occur in the action area between June and October when water temperatures are above 10°C and depending on seasonal weather patterns and prey availability, could be present in May through November. 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).

Satellite tracking studies of sea turtles in the Northeast found that foraging turtles mainly occurred in areas where the water depth was between approximately 16 and 49 feet (Ruben and Morreale 1999). This depth was interpreted not to be as much an upper physiological depth limit for turtles, as a natural limiting depth where light and food are most suitable for foraging turtles (Morreale and Standora 1994). The areas to be dredged and the depths preferred by sea turtles may overlap, suggesting that if suitable forage is present, adult and juvenile loggerheads, juvenile Kemp's ridleys, and juvenile green sea turtles may forage in the channel areas where dredging will occur. As there are no SAV beds in any of the channel areas where dredging will take place, primarily herbivorous adult green sea turtles are not likely to use the areas to be deepened as forage habitat.

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, Winton *et al.* 2018, NMFS 2019, Palka *et al.* 2021). The STSSN data (unpublished) also shows the documented strandings from 2011-2020 in the general area were mostly loggerhead sea turtles (Figure 20). There were no strandings reported in Kill Van Kull or Newark Bay.

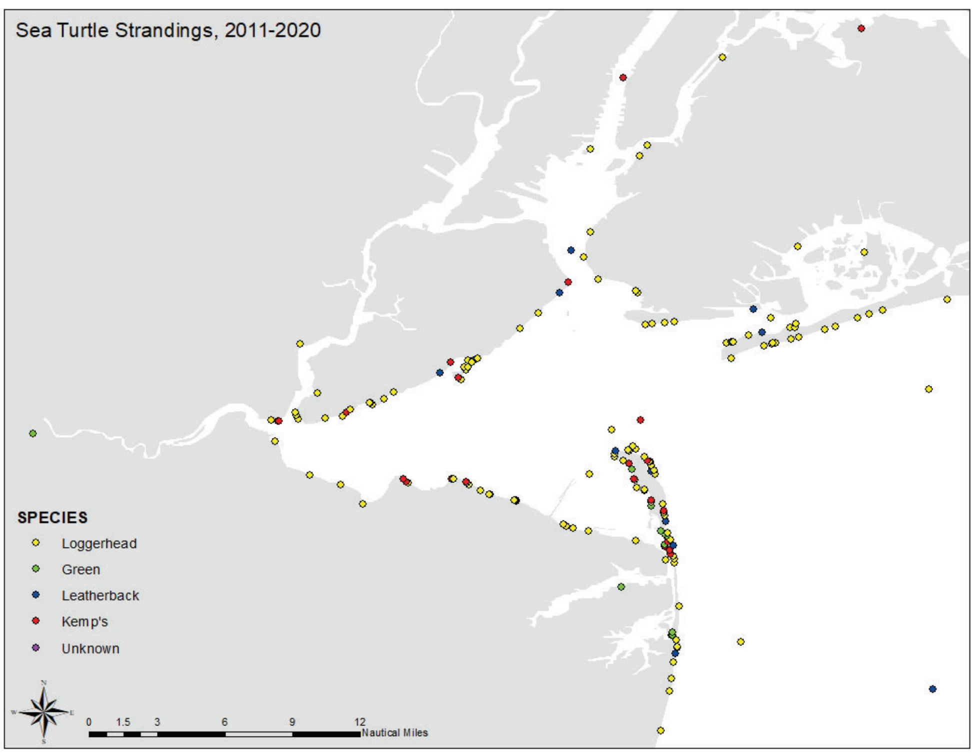


Figure 20. 2011-2020 reported sea turtle strandings off the coast of NY/NJ (STSSN, unpublished data).

Based on the best available information, we expect migratory and opportunistically foraging adult and juvenile sea turtles to be present in the Port Jersey, Anchorage, and Ambrose channels from May to November. Due to the lack of recorded observations in the other channels, we do not expect sea turtles to be present in Kill Van Kull or Newark Bay.

5.5.2 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 data, Atlantic sturgeon originating from any of five DPSs could occur in the waters of the action area (O'Leary *et al.* 2014). 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. Subadult and adult Atlantic sturgeon occur in waters off of NY/NJ year-round. Atlantic sturgeon are known to use the action area for spawning migration and to opportunistically forage. 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.* 2004b).

Migratory behaviors occur starting from March (Frisk *et al.* 2020) or April to November (Dovel and Berggren 1983, Welsh *et al.* 2002, Frisk *et al.* 2020). Both adults and subadults are expected to wander among coastal and estuarine habitats of the channels. There is an Atlantic sturgeon aggregation off the coast of Long Island that is outside of Ambrose channel (Figure 21). Atlantic sturgeon aggregations are generally restricted to shallow depths (<20 m) in New York waters, following a seasonal pattern with peak abundance during the spring and fall (Dunton *et al.* 2015). In a study by Dunton *et al.* (2015), catches of Atlantic sturgeon were an order of magnitude higher than in other areas and months of the year during the peak aggregation months of May, June, September, and October.

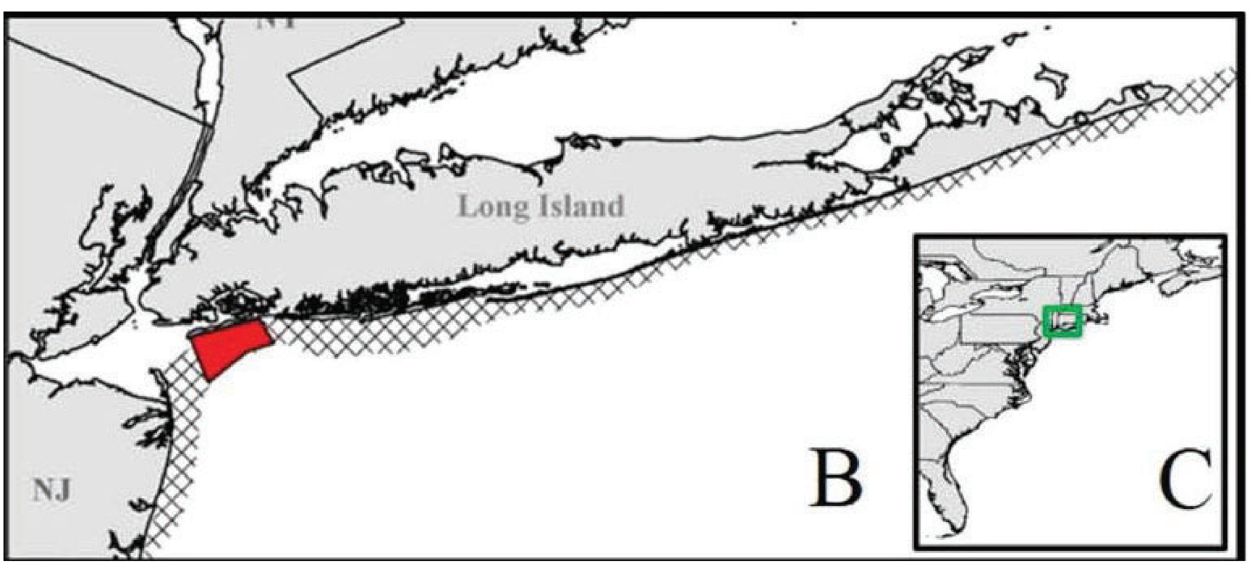


Figure 21. Atlantic sturgeon aggregation area (red area) and their migration corridors (hatched) (Dunton et al. 2015).

Erickson *et al.* (2011) and Breece *et al.* (2017, 2018) also provided new information that better informs the seasonal, migratory movements of the New York Bight DPS, and their use of aggregation areas. The new information supports the understanding of the movements of Atlantic sturgeon into deeper waters in the fall compared to the depth where they occur in the spring. We knew when we listed the DPS that, in general, there is a northerly coastal migration of subadult and adult Atlantic sturgeon to estuaries in the spring, and a southerly coastal migration from estuaries in the fall. Some marine aggregation areas were suspected of being overwintering areas, such as in waters off of the Virginia and North Carolina coast. However, the adult sturgeon tagged by Erickson *et al.* (2011) did not appear to move to a specific marine area where the fish reside throughout the winter. Instead, the sturgeon occurred within different areas of the Mid-Atlantic Bight and at different depths, occupying deeper and more southern waters in the winter months and more northern and shallow waters in the summer months with spring and fall being transition periods. The model constructed by Breece *et al.* (2017, 2018) similarly predicts an increase in probability of occurrence in shallow water during the spring, which shifts to an increase in probability of occurrence in deeper water in the fall.

The Kill Van Kull and Newark Bay are not known for sturgeon aggregations, and they are located outside of the migratory pathway where sturgeon transit back and forth from the marine offshore coastal waters to the spawning sites in the Hudson River. However, Atlantic sturgeon have been detected there. From May through July 2011, 11 acoustic tagged subadult Atlantic sturgeon were detected in Kill Van Kull (Frisk *et al.* 2020; Keith Dunton, personal communication, 2021). In the District's literature review of fish communities in Kill Van Kull, Atlantic sturgeon were one of the species that were caught in only one or two of the surveys, but they might not have been efficiently captured with the gear used for those studies (USACE 2004).

The HDCI study overlaps with Atlantic sturgeon in marine and coastal waters and within the channels to be deepened, suggesting that if suitable forage and/or habitat features are present, adults and subadults from any of the five listed DPSs may be foraging or undertaking migrations in the areas where HDCI study will occur.

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[12], 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 and information on past and predicted future consequences of global climate change throughout the range of the listed species considered here. Additionally, we present the available information on predicted consequences 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*, *Consequences of the Action*, 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.

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 an 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) emmissions 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

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[12] 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.

the winter and spring throughout New England. The 2020 summer sea surface temperatures were the highest on record in Georges Bank with a heatwave at 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, b).

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 m under the very low GHG emissions scenario, 0.32-0.62 m under the low GHG emissions scenario, 0.44-0.76 m under the intermediate GHG emissions scenario, and 0.63-1.01 m 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 and the magnitude and rate of rise depend on future emission pathways (IPCC 2021). Temperature increase 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 the U.S. Northeast Shelf and Northwest Atlantic Ocean 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 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 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 are thought to 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 consequences of climate change globally, it is more difficult to assess the potential consequences of climate change on smaller geographic scales, such as the action area. The consequences of future change will vary greatly in diverse 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)(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 consequences 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 consequences 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 consequences 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 Consequences

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 consequences 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 consequences 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 and Jones 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 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 percent 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 percent 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 percent 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 consequence in dry climates (Santidrián-Tomillo *et al.* 2015). In Grenada, increased rainfall (another consequence 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 consequences 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 consequences 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 consequences of warming, but has also been linked to shorter nesting seasons in this population (Pike *et al.* 2006), which could have negative consequences 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 consequences 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 percent 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. Sea turtles may be present in the action area 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 consequences 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 percent) 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 percent (range 18-88 percent) 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 consequences may not be seen for 30 to 50 years because of the longevity of sea turtles (Davenport 1997, Hawkes *et al.* 2007, Hulin and Guillon 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 2013a). 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 consequence 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 Atlantic Sturgeon

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 consequences to sturgeon are possible. Rising sea level may result in the salt wedge moving upstream in affected rivers. Atlantic sturgeon spawning occurs in freshwater reaches of rivers because early life stages have little to no tolerance for salinity. For foraging and physical development, juvenile sturgeon need aquatic habitat with a gradual downstream gradient of 0.5 up to as high as 30 parts per thousand (NMFS 2017d). 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. 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. When looking at the response of fish cells upon exposure to industrial solvents in relation to a temperature increase (20°C and 25°C), Grunow *et al.* (2021) found that Atlantic sturgeon demonstrated lower mortality rates in the presence of isopropanol and recovered better during long-term ethanol exposure than the maraena whitefish (*Coregonus* *maraena*), thus, showing that Atlantic sturgeon cells have higher adaptation potential for these alcohols.

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.

Atlantic sturgeon in the action area are most likely to experience the consequences 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 consequence to 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 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 consequence would be minimal. The greatest potential for consequences 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) provided a method for assessing the vulnerability of all Atlantic sturgeon to climate change using the best available information from climate models and what we know of the subspecies life history, biology, and habitat use. Based on their comprehensive assessment, Hare et al. determined that Atlantic sturgeons (all DPSs) are highly vulnerable to climate change. Contributing factors include their low potential to change distribution in response to climate change (*e.g.*, spawning locations are specific to a DPS within a specific geographic region), and their exposure to climate change throughout their range, including in estuarine and marine waters. The determinations are supported by the information of Balazik *et al.* (2010) that suggests individual spawning populations will respond to changing climate temperatures with physiological changes (*e.g.*, changes in growth rate) rather than redistributing to a more southern or northern habitat to maintain their exposure to a consistent temperature regime. Atlantic sturgeon's low likelihood to change distribution in response to current global climate change will also expose them to climatic consequences on estuarine habitat such as changes in the occurrence and abundance of prey species in currently identified key foraging areas.

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 consequences 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 percent (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.

7.0 CONSEQUENCES OF THE ACTION

In this *Consequences of the Action* section, we present the results of our assessment of the probable consequences of the federal actions that are the subject of this consultation on threatened and endangered species. Consequences 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. Consequences 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). Because there is no critical habitat in the action area, there are no consequences to critical habitat to consider in this Opinion.

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 consequences 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. When appropriate in those cases, the uncertainty is resolved in favor of the species (House of Representatives Conference Report No. 697, pg. 1442, 96th Congress, Second Session, 12 (1979)). We generally select the value that would lead to conclusions of higher, rather than lower, risk to endangered or threatened species. This approach provides the "benefit of the doubt" to threatened and endangered species.

In this section of the Opinion, we assess the likely consequences of the proposed action on ESA-listed sea turtles and Atlantic sturgeon. The purpose of the assessment is to determine if it is reasonable to conclude that the proposed actions are likely to have consequences 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 Actio*n section (3.0), the action under consideration in this Opinion includes the initial deepening of the Kill Van Kull, Ambrose, Anchorage, Port Jersey, Newark Bay, South Elizabeth, and Port Elizabeth Channels by five feet. We also consider consequences of this project through 2039. Sea turtles and Atlantic sturgeon may be affected by the proposed actions in a number of ways. This includes via: (1) change in water quality; (2) consequences to prey and habtiat; (3) increased risk of a vessel strike; (4) injury and/or harassment from blasting and noise; and (5) dredge entrainment and entrapment. The following consequences analysis will be organized along these topics.

7.1 Approach to the Assessment

We begin our analysis of the consequences 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 and Atlantic sturgeon 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 *Consequences of the Action* section and integrates information we presented in the *Status of the Species, Environmental*

Baseline, and *Cumulative Effects* sections 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 (section 4.1), these listed species and critical habitat are not considered in the analyses that follow.

To identify, describe, and assess the consequences to listed species considered in this Opinion, we reviewed information on: (1) interactions and captures of sea turtles and Atlantic sturgeon in past deepening projects, (2) the life history of sea turtles and Atlantic sturgeon, and (3) the consequences of deepening equipment, active acoustic sources, and vessel interactions on sea turtles and Atlantic sturgeon in similar deepening activities in the U.S. Atlantic. These sources of information include status reviews, stock assessments, biological reports, recovery plans, impact assessments, 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 and their ecological interactions. Potential stressors from the proposed actions include dredging interactions, blasting, vessel strikes, sedimentation and turbidity as well as impacts to prey and habitat, although we have determined that consequences from the latter three are insignificant and discountable. Dredging related consequences 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.

7.2 Dredging Entrapment

The scope of the Proposed Action includes 15 years of initial dredging. Over the 15 years, we anticipate that approximately 33,238,000 CY of material will be dredged during the HDCI study. From the 33,238,000 CY of material, 13,192,000 CY will be removed hydraulically (hopper or cutterhead dredge) in the Ambrose, Anchorage, and Port Jersey Channels. The remaining 20,046,000 CY will be removed via mechanical dredge in the Kill Van Kull, Newark Bay, South Elizabeth, and Port Elizabeth Channels (Table 2).

7.2.1 Mechanical Dredges

Mechanical dredging entails lowering the open bucket or clamshell through the water column, closing the bucket after impact on the bottom, lifting the bucket up through the water column, and emptying the bucket into a barge. The bucket operates without suction or hydraulic intake, moves relatively slowly through the water column and affects only a small area of the aquatic bottom at any time. In order to be captured in a dredge bucket, an animal must be on the bottom directly below the dredge bucket as it contacts the substrate and remain stationary as the bucket closes. Species captured in dredge buckets can be injured or killed if entrapped in the bucket or buried in sediment during dredging and/or when sediment is deposited into the dredge scow. Species captured and emptied out of the bucket can suffer stress or injury, which can lead to mortality.

7.2.1.1 Mechanical Dredging Consequences on Sea Turtles

Sea turtles are not known to be vulnerable to entrapment in mechanical dredges, presumably because they are able to avoid the dredge bucket. Thus, if a sea turtle were to be present at the dredge site, it would be extremely unlikely to be injured or killed because of dredging operations carried out by a mechanical dredge. Based on this information, and the fact that sea turtles are not expected to occur in the KVK and Newark Bay Channels, the likelihood of an interaction between a sea turtle and the mechanical dredge is extremely unlikely.

7.2.1.2 Mechanical Dredging Consequences on Sturgeon

In 2012, the USACE provided us with a list of all documented interactions between dredges and sturgeon reported along the U.S. East Coast; reports dated as far back as 1990. The list includes five incidents of sturgeon captured in dredge buckets. These include the capture of a decomposed Atlantic sturgeon in Wilmington Harbor in 2001. The condition of this fish indicated it was not killed during the dredging operation and was likely dead on the bottom or in the water column and merely scooped up by the dredge bucket. Another record was the reported lethal capture of an Atlantic sturgeon in Wilmington Harbor in 1998; however, this record was never verified. An Atlantic sturgeon was captured in a clamshell bucket, deposited in the dredge scow, and released apparently unharmed during dredging operations at Bath Iron Works (BIW) in 2001. On April 30, 2003, a shortnose sturgeon was captured in a clam-shell bucket dredge operating in the BIW sinking basin; the fish was nearly cut in half. This fish was killed during the last hour of a 24-hour a day dredging operation that had been ongoing for approximately six weeks. One shortnose sturgeon was captured in a clamshell bucket and detected in the dredge scow on June 1, 2009, during dredging operations at BIW. Observer coverage at dredging operations at the BIW facility has been 100 percent for approximately 20 years, with dredging occurring every one to two years.

Monitoring has been ongoing at dredging projects associated with the Tappan Zee Bridge replacement project on the Hudson River. The first stage of dredging occurred in 2013. Two dredges were used between August 2 and October 30, 2013, and a total of 844,120 CY of material were removed using a bucket dredge. NMFS-approved observers were present to monitor 100 percent of all dredging. All dredge observer forms were submitted to us on December 31, 2013. While fish and other biological materials were observed in 279 loads (out of approximately 1,500), no shortnose or Atlantic sturgeon were observed. Dredging occurred again in 2015 with approximately 150,000 CY of material removed; observer coverage was 100 percent and no shortnose or Atlantic sturgeon were observed. The area where dredging occurred is a high use area for shortnose and Atlantic sturgeon.

We expect the risk of interactions between sturgeon and mechanical dredges to be highest in areas where large numbers of sturgeon are known to aggregate. The behavior of sturgeon in the area may also affect the risk of capture. While foraging, sturgeon are at the bottom of the river interacting with the sediment. This behavior may increase the susceptibility of capture with a dredge bucket. We also expect the risk of capture to be higher in areas where sturgeon are overwintering in dense aggregations as overwintering sturgeon may be less responsive to stimuli which could reduce the potential for a sturgeon to avoid an oncoming dredge bucket. The area to be mechanically dredged is not a known aggregation site for sturgeon.

Most mobile organisms, including adult and subadult Atlantic sturgeon, are able to avoid mechanical dredge buckets. For a bucket dredge to capture a sturgeon, the sturgeon has to be immediately below the bucket and remain stationary as the bucket jaw closes. The slow movement of the dredge bucket through the water column and the relatively small area of bottom impacted by each pass of the bucket makes the likelihood of interaction between a dredge bucket and an individual fish unlikely. Based on all available evidence, the risk that a mechanical dredge will capture a subadult or adult sturgeon is low.

Based on this information, and that the areas to be mechanically dredged (*i.e.*, Kill Van Kull, Newark Bay, Port Elizabeth and South Elizabeth Channels) are only expected to have rare transient Atlantic sturgeon entering the area, entrapment from a mechanical dredge is extremely unlikely to occur.

7.2.2 Hydraulic Cutterhead Dredges

Some of the future dredging at the Anchorage and Port Jersey Channels may be accomplished with a cutterhead dredge. The cutterhead dredge operates with the dredge head buried in the sediment; however, a flow field is produced by the suction of the operating dredge head. The amount of suction produced is dependent on linear flow rates inside the pipe and the pipe diameter. High flow rates and larger pipes create greater suction velocities and wider flow fields. The suction produced decreases exponentially with distance from the dredge head (Boysen and Hoover 2009). With a cutterhead dredge, material is pumped directly from the dredged area to a beach nourishment site. As such, there is no opportunity to monitor for biological material on board the dredge; rather, observers work at the disposal site to inspect material.

7.2.2.1 Cutterhead Dredging Consequences on Sea Turtles

Sea turtles are not known to be vulnerable to entrainment in cutterhead dredges, presumably because they are able to avoid the relatively small intake and low intake velocity. Thus, if a sea turtle were to be present at the dredge site, it would be extremely unlikely that cutterhead dredging operations would result in injury or mortality of a turtle.

7.2.2.2 Cutterhead Dredging Consequences on Atlantic Sturgeon

While entrainment of smaller sturgeon in cutterhead dredges has been observed (as evidenced by the presence of a few individual shortnose sturgeon at the Money Island Disposal Site in the Delaware River in 1996 and 1998), these instances are rare and have been limited to dredging events that occur near sturgeon overwintering areas where sturgeon are known to form dense aggregations of lethargic sturgeon that are less likely to respond to disturbance. However, although sturgeon may be present in the action area year round, the action area is not a known overwintering area for Atlantic sturgeon. The risk of entrainment is also higher for small fish, including early life stages and small juveniles. Because these life stages are not present in the action area and the smallest sturgeon present would be at least 2.3 feet (the size at which we expect them to begin migrations from their natal river), the risk of entrainment is minimal in the action area. Increased risk factors (*i.e.*, small fish, overwintering area) are not present in the action area, overall.

Cutterhead dredges operate with the dredge intake buried in the sediment; therefore, in order to have contact with the dredge intake, sturgeon would have to be on the bottom. It is generally assumed that adult and subadult Atlantic sturgeon are mobile enough to avoid the suction of an oncoming cutterhead dredge and that any adult or subadult sturgeon in the vicinity of such an operation will avoid the intake and escape. In New York, tagging work by Erickson *et al.* (2011) showed that adult Atlantic sturgeon from the Hudson River move about within the Mid-Atlantic Bight, occurring as far south as Delaware for the late fall to early winter and then as far south as the area off Chesapeake Bay for the latter part of the winter. The data do not suggest movement from the river to a specific overwintering area where the fish reside throughout the winter. Dunton (2014) did a tag and recapture study for sturgeon that were initially sampled off the southern coast of Long Island. For the sturgeon that were recaptured by state, federal, and academic agencies, the days at large ranged from 0.3 to 929 days while estimated distances from the original tagging locations ranged from 1-542 km. For the sturgeon that were recaptured by commercial and recreational fisheries, the estimated distance from the original tagging sites ranged from 1-293 km while days at large ranged from 26-245 days (Dunton 2014).

The risk of entrainment is believed to be highest in areas/environments where the movements of animals are restricted (*e.g.*, rivers, narrow confined channels, small semi-enclosed harbors) and therefore, where the animal has limited opportunity to move away from the dredge. If these restricted areas also occur within sites where species are known to concentrate, the likelihood of an interaction further increases. Balazik *et al.* (2021), however, did a study on the movement of Atlantic sturgeon near an operating cutterhead dredge in the James River in Virginia. The hot spot analysis showed that adult sturgeon were concentrated in the channel (where the dredging was occurring) during upstream migration regardless of the presence or absence of an operating dredge in the immediate area. The results showed that adult and subadult Atlantic sturgeon were able to swim past the dredge during their estuarine migrations and no incidents of entrainment occurred (Balazik *et al.* 2021).

The risk of an individual sturgeon being entrained in a cutterhead dredge is difficult to calculate. While a large area overall will be dredged, the dredge operates in an extremely small area at any given time (*i.e.*, the channel bottom in the immediate vicinity of the intake). As Atlantic sturgeon are well distributed throughout the action area and an individual would need to be in the immediate area where the dredge is operating to be entrained (*i.e.*, within one meter of the dredge head) (Clarke 2011), the overall risk of entrainment is low. It is extremely unlikely that any Atlantic sturgeon in the action area will ever encounter the dredge as they would not occur within one meter of the dredge.

7.2.3 Hopper Dredges

Hopper dredges are self-propelled seagoing vessels that are equipped with propulsion machinery, sediment containers (hoppers), dredge pumps, and trailing suction drag-heads required to perform their essential function of excavating sediments from the channel bottom. Hopper dredges have propulsion power adequate for required free-running speed and dredge against strong currents. They also have excellent maneuverability.

Dredged material is raised by dredge pumps through dragarms connected to drags in contact with the channel bottom and discharged into hoppers built in the vessel. Hopper dredges are equipped with large centrifugal pumps similar to those employed by other hydraulic dredges. Suction pipes (dragarms) are hinged on each side of the vessel with the intake (drag) extending downward toward the stern of the vessel. The forward moving vessel moves the drag along the bottom at speeds up to three mph (2.5-3.0 knots). The dredged material is sucked up through the pipe and deposited and stored in the hoppers of the vessel.

A hopper dredge removes material from the bottom of the channel in relatively thin layers, usually 2-12 inches, depending upon the density and cohesiveness of the dredged material. Pumps located within the hull, but sometimes mounted on the dragarm, create a region of low pressure around the dragheads and force water and sediment up the drag arm and into the hopper. The more closely the draghead is maintained in contact with the sediment, the more efficient the dredging, provided sufficient water is available to slurry the sediments. Hopper dredges can efficiently dredge non-cohesive sands and cohesive silts and low-density clay. Draghead types may consist of IHC and California type dragheads.

California type dragheads sit flatter in the sediment than the IHC configuration which is more upright. Individual draghead designs (*i.e.*, dimensions, structural reinforcing/configuration) vary between dredging contractors and hopper vessels. Port openings on the bottom of dragheads also vary between contractors and draghead design. The port geometry is typically rectangular or square with minimum openings of ten inch by ten inch or twelve inch by twelve inch or some rectangular variation.

Industry and government hopper dredges are equipped with various power and pump configurations and may differ in hopper capacity with different dredging capabilities. An engineering analysis of the known hydraulic characteristics of the pump and pipeline system on the USACE hopper dredge "Essayons" (a 6,423 CY hopper dredge) indicates an operational flow rate of forty cubic feet per second with a flow velocity of eleven feet per second at the draghead port openings. The estimated force exerted on a one-foot diameter turtle (*i.e.*, one-foot diameter disc shaped object) at the pump operational point in this system was estimated to be twenty-eight pounds of suction or drag force on the object at the port opening of the draghead.

Dredging is typically parallel to the centerline or axis of the channel. Under certain conditions, a waffle or crisscross pattern may be utilized to minimize trenching or during clean-up dredging operations to remove ridges and produce a more level channel bottom. This movement up and down the channel while dredging is called trailing and may be accomplished at speeds of 1-3 knots, depending on the shoaling, sediment characteristics, sea conditions, and numerous other factors. In the hopper, the slurry mixture of the sediment and water is managed by a weir system to settle out the dredged material solids and overflow the supernatant water. When an economic load is achieved, the vessel suspends dredging, the drag arms are raised, and the dredge travels to the designated placement site. Because dredging stops during the trip to the placement site, the overall efficiency of the hopper dredge is dependent on the distance between the dredging location and placement sites; the more distance to the placement site, the less efficient the dredging operation resulting in longer contract periods to accomplish the work.

Sea turtle deflectors utilized on hopper dredges are rigid V-shaped attachments on the front of the dragheads and are designed and intended to plow the sediment in front of the draghead. The plowing action creates a sand wave that rolls in front of the deflector. The propagated sand wave is intended to shed a turtle away from the deflector and out of the path of the draghead. The USACE modeled and field-tested the effectiveness of the rigid deflector design and its ability to reduce entrainment during the 1980s and early 1990s (Banks and Alexander 1994, Nelson and Shafer 1996). The deflectors are most effective when operating on a uniform or flat bottom. Presence of significant ridges and troughs that prevent the deflector from plowing and maintaining the sand wave and the dragheads from maintaining firm contact with the bottom may diminish the deflector effectiveness.

The proposed action comprises medium to large volume hopper dredge equipment to remove sediment from the Ambrose, Anchorage, and Port Jersey Channels. The equipment likely to be utilized for these projects are of similar size and capacity used in recent previous hydraulic dredge projects in the region, depending upon dredge contractor equipment availability at the time of award. You have stated that a hydraulic cutterhead dredge may be used occasionally for the Anchorage and Port Jersey Channels; however, you have not determined how often it will be used or the volume, if any, that may be removed via cutterhead dredge. Therefore, to be conservative, we assume the worst case scenario that all dredging will occur with a hopper dredge. Initial dredging will occur until 2039 (Table 2). The volume of sediment to be dredged for the Ambrose Channel is 6,389,000 CY. For the Anchorage Channel, 3,800,000 CY of sediment will be dredged. Lastly, for the Port Jersey Channel, 3,003,000 CY of sediment will be dredged. The initial dredge events could occur year-round except for the Port Jersey Channel which has a dredge window of June 1-January 14 of any year until 2039.

7.2.3.1 Entrainment and Entrapment in Hopper Dredges – Sea Turtles

Entrainment is defined as the direct uptake of aquatic organisms by the suction field generated at the draghead. Dredging operations within the Ambrose, Anchorage, and Port Jersey channels will involve the use of a medium to large volume hopper dredge. Given their large size, leatherback sea turtles are not vulnerable to entrainment in hopper dredges. To date, there have only been four reported leatherback sea turtle takes from a hopper dredge in the South Atlantic region. There was one from the 2006-2007 Waltron County/City of Destin Beach Nourishment project, two from a dredge during the 2016 Town of Hilton Head Island beach renourishment project, and one from the 2020 Wilmington Harbor Ocean Bar dredging project. To date, there have been no reported leatherback sea turtle takes in the North Atlantic region (USACE ODESS, https://dqm.usace.army.mil/odess/#/home, last accessed October 19, 2021). Therefore, this section of the Opinion will only consider the consequences of entrainment on loggerhead, Kemp's ridley, and green sea turtles. Sea turtles are likely to be feeding on or near the bottom of the water column during the warmer months, with loggerhead and Kemp's ridley sea turtles being the most common species in these waters. Although not expected to be as numerous as loggerheads and Kemp's ridleys, green sea turtles are also likely to occur seasonally in the

Ambrose, Anchorage, and Port Jersey Channels.

Most sea turtles are able to escape from the oncoming draghead due to the slow speed that the draghead advances (up to 3 mph or 4.4 feet/second). Interactions with a hopper dredge result primarily from crushing when the draghead is placed on the bottom or when an animal is unable to escape from the suction of the dredge and becomes stuck on the draghead (impingement). Entrainment occurs when organisms are sucked through the draghead into the hopper. Mortality most often occurs when animals are sucked into the dredge draghead, pumped through the intake pipe and then killed as they cycle through the centrifugal pump and into the hopper. Interactions with the draghead can also occur if the suction is turned on while the draghead is in the water column (*i.e.*, not seated on the bottom).

Sea turtles may become entrained in hopper dredges as the draghead moves along the bottom. Because entrainment is believed to occur primarily while the draghead is operating on the bottom, it is likely that only those species feeding or resting on or near the bottom would be vulnerable to entrainment. Turtles can also be entrained in the suction current flow while the draghead is being placed or removed, or if the dredge is operating on an uneven or rocky substrate and rises off the bottom. Recent information from the USACE suggests that the risk of entrainment is highest when the bottom terrain is uneven or when the dredge is conducting "clean up" operations at the end of a dredge cycle when the bottom is trenched and the dredge is working to level out the bottom. In these instances, it is difficult for the dredge operator to keep the draghead buried in the sand and sea turtles near the bottom may be more vulnerable to entrainment.

There is some evidence to indicate that turtles can become entrained in trunions or other water intakes (Nelson and Shafer 1996). For example, a large piece of a loggerhead sea turtle was found in a UXO screening basket on Virginia Beach in 2013. The hopper dredge was operated with UXO screens on the draghead designed to prevent entrainment of any material with a diameter greater than 1.25". The pieces of turtle found were significantly larger. Because an inspection of the UXO screens revealed no damage, it is suspected that the sea turtle was entrained in another water intake port. According to the District, they will be requiring the use of UXO screens on hopper dredges operating in the Ambrose Channel only. The USACE does mandate the use of screening of all portholes and other inlets that could intake a small individual so as to permit the ESA observer to inspect these areas, as well as the hopper intake area and baskets for such evidence.

Background Information on Entrainment of Sea Turtles in Hopper Dredges

Sea turtles have been killed in hopper dredge operations along the East and Gulf coasts of the US. Documented turtle mortalities during dredging operations in the USACE South Atlantic Division (SAD; *i.e.*, south of the Virginia/North Carolina border) are more common than in the USACE North Atlantic Division (NAD; Virginia-Maine) (USACE ODESS, https://dqm.usace.army.mil/odess/#/home, last accessed October 19, 2021) presumably due to the greater abundance of turtles in these waters and the greater frequency of hopper dredge operations. According to ODESS, in the USACE SAD, approximately 676 sea turtles (not incuding the four leatherback sea turtles that were previously mentioned above) have been entrained in hopper dredges since 1980. Records of sea turtle entrainment in the USACE NAD begin in 1993. According to ODESS, through May 2020, 103 sea turtles takes (Table 20) related to hopper dredge activities have been recorded in waters north of the North Carolina/Virginia border (USACE ODESS, https://dqm.usace.army.mil/odess/#/home, last accessed October 19, 2021). The majority of these turtles have been entrained in hopper dredges operating in Chesapeake Bay. It should be noted that the ODESS database does not identify whether the takes were lethal or not. It is also unclear whether all hopper takes within the regions have been entered into ODESS.

Table 20. Reported Sea Turtle Takes in USACE NAD Hopper Dredging Operations from 1993-2020 (USACE ODESS, https://dqm.usace.army.mil/odess/#/home, last accessed October 19, 2021). Note: Takes labeled as "unknowns" were left out, because it is unclear whether they were sea turtles or sturgeon.

Project/Location	**Year(s) of Operation**	**Cubic Yardage Removed**	**Observed Takes**
Thimble Shoals Channel - Virginia Port Authority	2020	Unknown	4 loggerhead
Delaware Coast	2018	Unknown	6 Kemp's ridley 15 loggerhead
Long Beach Island, NJ	2015-2016	Unknown	1 loggerhead
York Spit	2015	Unknown	6 loggerheads
Thimble Shoals/Cape Henry	2014-2015	Unknown	1 Kemp's ridley 3 loggerheads
Cape Henry	2011-2012	Unknown	1 loggerhead
York Spit Channel	2011-2012	145,332	1 loggerhead
Thimble Shoals/York Spit	2010-2012	Unknown	1 loggerhead
Thimble Shoal Channel	2009	Unknown	3 loggerheads
York Spit Channel	2007	608,000	1 Kemp's ridley
Cape Henry	2006	Unknown	3 loggerheads
Thimble Shoal Channel	2006	Unknown	1 loggerhead
Thimble Shoal Channel & Virginia Beach	2003	1,828,312	1 Kemp's ridley 7 loggerheads
York Spit Channel	2002	911,406	1 Kemp's ridley 8 loggerheads
Cape Henry	2002	1,407,814	1 green 1 Kemp's ridley 6 loggerheads
Virginia Beach Hurricane Protection Project	2002	Unknown	1 loggerhead
Cape Henry	2001-2002	1,641,140	1 Kemp's ridley 2 loggerheads
Virginia Beach	2001	Unknown	5 loggerheads

Project/Location	Year(s) of Operation	Cubic Yardage Removed	Observed Takes
Hurricane Protection Project			
Sandbridge Beach	2001-2013	Unknown	1 loggerhead
Thimble Shoal Channel	2000	831,761	2 loggerheads
York River Entrance Channel	1998	672,536	6 loggerheads
Sandy Hook to Barnegat Inlet (Section I)	1997	Unknown	1 loggerhead
Thimble Shoal Channel	1996	529,301	1 loggerhead
Delaware River Navigation Channel	1995	218,151	1 loggerhead
York Spit Channel	1994	61,299	4 loggerheads
Delaware River Navigation Channel	1994	Unknown	1 loggerhead
Cape Henry	1994	552,671	4 loggerheads
Cape May Inlet Beachfill – New Jersey/ Delaware City	1993	Unknown	1 loggerhead
			TOTAL: 103 Turtles

Interactions are likely to be most numerous in areas where sea turtles are resting or foraging on the bottom. When sea turtles are at the surface, or within the water column, they are not likely to interact with the dredge because there is little, if any, suction force in the water column. Sea turtles have been found resting on the ocean bottom in deeper waters, which could increase the likelihood of interactions from dredging activities. In 1981, observers documented the take of 71 loggerheads by a hopper dredge at the Port Canaveral Ship Channel, Florida (Slay and Richardson 1988). This channel is a deep, low productivity environment in the Southeast Atlantic where sea turtles are known to rest on the bottom, making them extremely vulnerable to entrainment. The large number of turtle mortalities at the Port Canaveral Ship Channel in the early 1980s resulted in part from turtles being buried in the soft bottom mud, a behavior known as brumation. Since 1981, 77 loggerhead sea turtles have been taken by hopper dredge operations in the Port Canaveral Ship Channel, Florida. Chelonid turtles have been found to make use of deeper, less productive channels as resting areas that afford protection from predators because of the low energy, deep water conditions. Habitat in the action area is not consistent with areas where sea turtle brumation has been documented; therefore, we do not anticipate any sea turtle brumation in the action area. Very few interactions with sea turtles have been recorded in the action area. This may be because the area where the hopper dredge is operating is generally more wide-open providing more opportunities for escape from the dredge as compared to a narrow river.

On a hopper dredge without UXO screens, it is possible to monitor entrainment because the dredged material is retained on the vessels as opposed to the direct placement of dredged material both overboard or in confined disposal facilities by a hydraulic pipeline dredge. A hopper dredge contains screened inflow cages from which an observer can inspect recently dredged contents. Typically, the observer inspection is performed at the completion of each load while the vessel is transiting to the authorized placement area and does not affect production of the dredging operations.

Before 1994, endangered species observers were not required on board hopper dredges and dredge baskets were not inspected for sea turtles or sea turtle parts. The majority of sea turtle takes in the NAD have occurred in the Norfolk District. This is largely a function of the large number of loggerhead and Kemp's ridley sea turtles that occur in the Chesapeake Bay each summer and the intense dredging operations that are conducted to maintain the Chesapeake Bay entrance channels and for beach nourishment projects at Virginia Beach. According to ODESS, since 1993, there is has only been one loggerhead take from a hopper dredge that has been reported from the New York District (1997 Sandy Hook to Barnegat Inlet (Section I) project).

It should be noted that the observed takes may not be representative of all the turtles killed during dredge operations. Formerly, endangered species observers were required to observe a total of 50 percent of the dredge activity (*i.e.*, 8 hours on watch, 8 hours off watch). As such, if the observer was off watch or the cage was emptied and not inspected or the dredge company either did not report or was unable to identify the turtle incident, there is the possibility that a turtle could be taken by the dredge and go unnoticed. Additionally, in older Opinions (*i.e.*, prior to 1995), we frequently only required 25 percent observer coverage and monitoring of the overflows which has since been determined to not be as effective as monitoring of the intakes. These conditions may have led to sea turtle takes going undetected.

We raised this issue to the USACE Norfolk District during the 2002 season, after several turtles were taken in the Cape Henry and York Spit Channels (Table 20), and expressed the need for 100 percent observer coverage. On September 30, 2002, the USACE informed the dredge contractor that when the observer was not present, the cage should not be opened unless it is clogged. This modification was to ensure that any sea turtles that were taken on the intake screen (or in the cage area) would remain there until the observer evaluated the load. The USACE's letter further stated "Crew members will only go into the cage and remove wood, rocks, and man-made debris; any aquatic biological material is left in the cage for the observer to document and clear out when they return on duty. In addition, the observer is the only one allowed to clean off the overflow screen. This practice provides us with 100 percent observation coverage and shall continue." Theoretically, all sea turtle parts were observed under this scheme, but the frequency of clogging in the cage is unknown at this time. The most effective way to ensure that 100 percent observer coverage is attained is to have a NMFS-approved endangered species observer monitoring all loads at all times. This level of observer coverage would document all turtle interactions and better quantify the impact of dredging on turtle populations.

It is likely that not all sea turtles killed by dredges are observed onboard the hopper dredge. Several sea turtles were stranded on Virginia shores with crushing type injuries from May 25 to October 15, 2002. The Virginia Marine Science Museum (VMSM) found 10 loggerheads, two Kemp's ridleys, and one leatherback exhibiting injuries and structural damage consistent with what they have seen in animals that were known dredge takes. While it cannot be conclusively determined that these strandings were the result of dredge interactions, the link is possible given the location of the strandings (*e.g.*, in the southern Chesapeake Bay near ongoing dredging activity), the time of the documented strandings in relation to dredge operations, the lack of other ongoing activities which may have caused such damage, and the nature of the injuries (*e.g.*, crushed or shattered carapaces and/or flipper bones, black mud in mouth). Additionally, in 1992, three dead sea turtles were found on an Ocean City, Maryland beach while dredging operations were ongoing at a borrow area located three miles offshore. Necropsy results indicate that the deaths of all three turtles were dredge related. It is unknown if turtles observed on the beach with these types of injuries were crushed by the dredge and subsequently stranded on shore or whether they were entrained in the dredge, entered the hopper, and then were discharged onto the beach with the dredge spoils. A dredge could crush an animal as it was setting the draghead on the bottom, or if the draghead was lifting on and off the bottom due to uneven terrain, but the actual cause of these crushing injuries cannot be determined at this time. Further analyses need to be conducted to better understand the link between stranded sea turtles with evidence of injury from crushing and dredging activities, and if those strandings need to be factored into an incidental take level. Regardless, it is possible that dredges are taking animals that are not observed on the dredge which may result in strandings on nearby beaches.

Due to the nature of interactions between listed species and dredge operations, it is difficult to predict the number of interactions that are likely to occur from a particular dredging operation. Projects that occur in an identical location with the same equipment year after year may result in interactions in some years and none in other years as noted above in the examples of sea turtle takes. Dredging operations may go on for months, with sea turtle takes occurring intermittently throughout the duration of the action. For example, dredging occurred at Cape Henry over 160 days in 2002 with eight sea turtle takes occurring over three separate weeks while dredging at York Spit in 1994 resulted in four sea turtle takes in one week. In Delaware Bay, dredge cycles have been conducted during the May-November period with no observed entrainment and as many as two sea turtles have been entrained in as little as three weeks. Even in locations where thousands of sea turtles are known to be present (*e.g.*, Chesapeake Bay) and where dredges are operating in areas with preferred sea turtle depths and forage items (as evidenced by entrainment of these species in the dredge), the numbers of sea turtles entrained is an extremely small percentage of the likely number of sea turtles in the action area. This is likely due to the distribution of individuals throughout the action area, the relatively small area which is affected at any given moment and the ability of some sea turtles to avoid the dredge even if they are in the immediate area.

The number of interactions between dredge equipment and sea turtles seems to be best associated with the volume of material removed, which is closely correlated to the length of time dredging takes, with a greater number of interactions associated with a greater volume of material removed and a longer duration of dredging. The number of interactions is also heavily influenced by the time of year dredging occurs (with more interactions correlated to times of year when more sea turtles are present in the action area) and the type of dredge plant used (sea turtles are apparently capable of avoiding pipeline and mechanical dredges as no takes of sea turtles have been reported with these types of dredges). Uneven terrain or spot dredging (*e.g.*, when the dredge is moved around to target smaller areas that need dredging) may also influence the number of interactions as interactions are more likely when the draghead is moving up and off the bottom frequently. Interactions are also more likely at times and in areas when sea turtle forage items are concentrated in the area being dredged, as sea turtles are more likely to be spending time on the bottom while foraging.

As noted above, sea turtles are likely to be less concentrated in the action area for this consultation than they are in areas under the jurisdiction of the Norfolk District (*e.g.*, Chesapeake Bay). Based on this information, NMFS believes that hopper dredges operating in the Ambrose, Anchorage, and Port Jersey Channels are less likely to interact with sea turtles than hopper dredges operating in areas under the jurisdiction of the Norfolk District (*e.g.*, Chesapeake Bay). As a result, all Norfolk District hopper dredging projects will not be considered further in our analysis as they do not accurately reflect the potential rate of entrainment for projects that occur in areas where sea turtles are not as concentrated.

It is most appropriate to look at other hopper dredging projects that have been undertaken in similar environments or with similar geographic characteristics as the Ambrose, Anchorage, and Port Jersey Channels to determine a comparable level of potential sea turtle entrainment. As evidenced in ODESS, very few sea turtles have been entrained in hopper dredges operating in offshore waters. This is true even in the southeast, where large numbers of sea turtles are present year round. This is likely due to the transitory nature of most sea turtles occurring in offshore areas as well as the widely distributed nature of sea turtles in offshore waters. Some operations in similar environments have, and still are, operated with a UXO screen on the draghead of the hopper. It should also be noted that UXO screens are used when dredging borrow areas to obtain sand for beach nourishment. The UXO screens effectively hinder turtles from entering the dredge and only smaller turtle parts may be transported through the dredge. Thus, observers are unlikely to be able to record any turtle mortalities. Large pieces of a sea turtle were observed entrained within a dredge equipped with a UXO screen at Sandbridge Shoal, VA. The dredge was inspected after the incident and it was determined that the UXO screen was not damaged. Upon closer examination of the engineering design of the draghead and dredge assembly, it is possible that the sea turtle may have entered through ports or "trunions" that surround the draghead itself.

Despite this information, we still believe that UXO screens are likely to preclude an observer from detecting all entrained sea turtle or sea turtle parts. Accordingly past observer records from these projects are not appropriate to use in our assessment as they may not reliably and accurately reflect entrainment in relation to the cubic yards of material removed.

As the Ambrose, Achorage and Port Jersey Channels are located in an open estuarine/bay environment that extends into the waters of the Atlantic Ocean, we looked at all hopper dredging projects in the NAD, excluding the Norfolk District, that had comparable environmental or geographic characteristics of this area to use as baseline information on the levels of sea turtle entrainment that have occurred in these areas/environments. The most appropriate projects to consider were those undertaken in “offshore”/nearshore (*i.e.*, within 10 miles off the U.S. Eastern coastline) environments or open estuarine environments (Table 21). We did not consider riverine or enclosed to semienclosed bays or estuaries in our assessment as we do not feel the environmental characteristics of these areas are comparable to open estuarine or offshore environments and thus, the level of entrainment in these areas would not be comparable to the level of entrainment that may occur in the channels.

We have compiled records for 21 projects occurring during “sea turtle season” (*i.e.*, May – November 15th) in the Baltimore, Philadelphia, and New York District. As noted above, all projects listed in Table 21 are located in environments that are comparable to that of the channels and report the cubic yardage removed during a project; however an important caveat is that observer coverage for some of these projects ranged from 0 to 50 percent (Table 21).

As explained above, for projects prior to 1995, observers were only present on the dredge for every other week of dredging. For dredging undertaken since 1995, observers were present on board the dredge full time and worked an 8-hour on, 8-hour off shift. Since 2002, the only time that cages (where sea turtle parts are typically observed) were cleaned by anyone other than the observer was when there was no observer present and the cage was clogged. If a turtle or turtle part was observed in such an instance, crew were instructed to leave any biological material in the cage and inform the observer, even if off-duty. As such, it is reasonable to expect that even though the observer was on duty for only 50 percent of the dredge hours, an extremely small amount of biological material went unobserved. To make the data from the 1993 and 1994 dredge events when observers were only on board every other week, comparable to the 1995-2006 data when observers were on board full time, we have assumed that an equal number of turtles were entrained when observers were not present. This calculation is reflected in Table 21 as the "adjusted entrainment number."

Table 21. Offshore hopper Dredging Projects in USACE NAD 1995-2009 without UXO screens (with recorded cubic yardage and sea turtle entrainment; all Norfolk District projects and projects with unknown CY dredged were removed).[13]

Project Location	**Year of Operation**	**Cubic Yards Removed**	**Observed Entrainment**	**Adjusted Entrainment Number**
Dewey and Bethany Beach (DE)	2009	397,956	0	0
Sandy Hook Channel	2008	23,500	0	0
Dewey Beach/Cape Henlopen (DE Bay)	2005	1,134,329	0	0
Delaware Bay	2005	50,000	2 loggerheads	2 loggerheads
Cape May Point, NJ	2005	2,425,268	0	0
Off Ocean City, MD	2002	744,827	0	0
East Rockaway Inlet, NY	2002	140,000	0	0
Off Ocean City MD	1998	1,289,817	0	0
Westhampton, NY (offshore borrow site)	1997	884,571	0	0
Offshore New Jersey	1997	3,700,000	1 loggerhead	1 loggerhead
East Rockaway Inlet, NY	1996	2,685,000	0	0
Westhampton, NY (offshore borrow site	1996	2,518,592	0	0
Delaware Bay	1995	218,151	1 loggerhead	1 loggerhead
East Rockaway Inlet, NY	1995	412,000	0	0
Bethany Beach (DE Bay)	1994	184,451	0	0
Dewey Beach (DE Bay)	1994	624,869	0	0
Off Ocean City, MD	1994	1,245,125	0	0
Westhampton, NY (offshore borrow site)	1993	1,455,071	0	0
Off Ocean City, MD	1992	1,592,262	3 loggerheads	6 loggerheads
Off Ocean City, MD	1991	1,622,776	0	0
Off Ocean City, MD	1990	2,198,987	0	0
	TOTAL	**25,547,552 CY**	***7 loggerheads***	***10 loggerheads***

Predicted Sea Turtle Entrainment in Proposed Hopper Dredging

Based on the data presented in (Table 21), we have made calculations which indicate that an

[13] All projects were operating during "sea turtle season" (*i.e.*, May to November 15). Additionally, only dredges operating without a UXO screen (and do not have a calculated estimate of take based on the number of cubic yards dredged) were included, as these screens, are likely to preclude an observer from detecting entrained sea turtles or sea turtle parts and thus, do not accurately reflect observed entrainment in relation to the cubic yards of material removed.

average of one sea turtle is killed for approximately every 2,600,000 cubic yards of material removed by a hopper dredge in environments similar to, or like, the Ambrose, Anchorage, and Port Jersey Channels[14]. This calculation is based on a number of assumptions including the following: that sea turtles are evenly distributed throughout all open estuarine or "offshore" areas that all hopper dredges will take an identical number of sea turtles, and that sea turtles are equally likely to be encountered throughout the May to November time frame. Based on these calculations, we expect that for dredging in the NYOBA during the time of year when sea turtles are likely to be present, one sea turtle is likely to be entrained for every 2,600,000 million cubic yards of material removed by a hopper dredge. While this estimate is based on several assumptions, it is reasonable because it uses the best available information on entrainment of sea turtles from multiple projects over several years, all of which have had observer coverage.

Sea turtle species likely to be entrained
With the exception of one green turtle entrained in a hopper dredge operating in Chesapeake Bay, all other sea turtles entrained in dredges operating in the USACE NAD have been loggerheads and Kemp's ridley. Of these 103 sea turtles, 90 have been loggerhead (87 percent), 12 have been Kemp's ridleys (12 percent), and one green (1 percent). No Kemp's ridleys or greens have been entrained in dredge operations outside of the Chesapeake Bay/Delaware coast area. The high percentage of loggerheads is likely due to several factors including their tendency to forage on the bottom where the dredge is operating and the fact that this species is the most numerous of the sea turtle species in Northeast and Mid-Atlantic waters. It is likely that the documentation of only one green sea turtle entrainment in Virginia dredging operations is a reflection of the low numbers of green sea turtles that occur in waters north of North Carolina. The low number of green sea turtles in the action area makes an interaction with a green sea turtle extremely unlikely to occur.

Volume dredged during sea turtle presence

<u>Initial Dredging in the Ambrose, Anchorage, and Port Jersey Channels</u>
For the Ambrose Channel you will dredge 6,389,000 CY of sediment and for the Anchorage Channel you will dredge 3,800,000 CY of sediment. The projects are expected to occur year-round from 2025 to 2039. For the Port Jersey Channel you will dredge 3,003,000 CY of sediment which will occur from June 1 to January 14 from 2025 to 2039. Thus, the three projects will dredge a total volume of 13,192,000 CY. The exact months and years (from 2025-2039) when this dredging will occur is not known at this time. Assuming a worst case scenario, we will assume the initial dredging for all projects will occur during the months of May through November when sea turtles are present.

Number of Sea Turtles Entrained
Given that we anticipate one turtle take in hopper dredges for every 2,600,000 cubic yards of

[14] This is calculated by dividing the total number of CY of material removed (25,547,552) by the adjusted number of sea turtle entrainments (10). This results in 1 sea turtle per 2,554,755.2 CY removed in the Ambrose, Anchorage, and Port Jersey Channels.

material dredged, we estimate that no more than six (6)[15] sea turtles, rounded up, are likely to be entrained during the dredging at the Ambrose, Anchorage, and Port Jersey Channels from 2025-2039. We expect that nearly all of the sea turtles will be loggerheads and that the entrainment of a Kemp's ridley during a dredge cycle will be rare; however, as Kemp's ridleys have been documented in the action area and have been entrained in hopper dredges, it is likely that this species will interact with the dredge over the course of the project life. As explained above, approximately 87 percent of the sea turtles taken in dredges operating in the USACE North Atlantic Division have been loggerheads. Based on the ratio of sea turtle entrainment in the USACE NAD, no more than one (1) of the sea turtles likely to be entrained in a hopper dredge will be a Kemp's ridley. Thus, because loggerhead sea turtles are most likely to be entrained and the number of sea turtles expected to be entrained are so few, we expect that all six will be loggerhead with the possibility that one may be a Kemp's ridely sea turtle but with the total not exceeding six (6) sea turtles. As noted above, interactions with green sea turtles are extremely rare and have never been reported. Therefore, we do not expect that the proposed action will result in the entrainment of a green sea turtle in a hopper dredge.

7.2.3.2 Entrainment and Entrapment in Hopper Dredges – Atlantic Sturgeon

Atlantic sturgeon are vulnerable to entrainment in hopper dredges. Entrainment is believed to occur primarily when the draghead is not in firm contact with the channel bottom, so the potential exists that sturgeon feeding or resting on or near the bottom may be vulnerable to entrainment. Additionally, the size and flow rates produced by the suction power of the dredge, the condition of the channel being dredged, and the method of operation of the dredge and draghead all relate to the potential of the dredge to entrain sturgeon (Reine *et al.* 2014). These parameters also govern the ability of the dredge to entrain other species of fish, sea turtles, and shellfish.

The risk of interactions is related to both the amount of time sturgeon spend on the bottom and the behavior the fish are engaged in (*i.e.*, whether the fish are overwintering, foraging, resting or migrating) as well as the intake velocity and swimming abilities of sturgeon in the area (Clarke 2011). Intake velocities at a typical large self-propelled hopper dredge are 11 feet per second. Exposure to the suction of the draghead intake is minimized by not turning on the suction until the draghead is properly seated on the bottom sediments and by maintaining contact between the draghead and the bottom.

A significant factor influencing potential entrainment is based upon the swimming stamina and size of the individual fish at risk (Boysen and Hoover 2009). Swimming stamina is positively correlated with total fish length. Entrainment of larger sturgeon is less likely due to the increased swimming performance and the relatively small size of the draghead opening.

In general, entrainment of large mobile animals, such as sturgeon, is relatively rare. Several factors are thought to contribute to the likelihood of entrainment. In areas where animals are present in high density, the risk of an interaction is greater because more animals are exposed to the potential for entrainment. The risk of entrainment is likely to be higher in areas where the

[15] A total of 13,192,000 CY dredge during turtle presence divided by 2,600,000 CY = 5.07 turtles entrained.

movements of animals are restricted (*e.g.*, in narrow rivers or confined bays) where there is limited opportunity for animals to move away from the dredge than in unconfined areas such as wide rivers or open bays. The hopper dredge draghead operates on the bottom and is typically at least partially buried in the sediment. Sturgeon are benthic feeders and are often found at or near the bottom while foraging or while moving within rivers. Sturgeon at or near the bottom could be vulnerable to entrainment if they were unable to swim away from the draghead.

Entrainment of sturgeon during hopper dredging operations in Federal navigation channels appears to be relatively rare. From 1990-2012, USACE documented 35 confirmed incidents of sturgeon entrainment on monitored hopper dredges (Appendix A). Of these, 22 were Atlantic sturgeon, 11 were shortnose, three were Gulf sturgeon, and the species of two entrained sturgeon was not determined. Since that report was generated, one Atlantic sturgeon was entrained in the Ambrose Channel, New York (October 2012; alive); one Atlantic sturgeon was entrained in the Delaware River in May 2013 (released alive); five sturgeon were entrained in the Delaware River by hopper dredges in 2014; two sturgeon were entrained in 2017; and two Atlantic sturgeon and one shortnose sturgeon were entrained in 2018. In 2014, four of the entrainments occurred during maintenance of the 40’ Philadelphia to the Sea channel in areas that had not been deepened (May – dead juvenile Atlantic; August – dead adult Atlantic; September – dead juvenile Atlantic; October – dead juvenile Atlantic) and one of the five (November – live juvenile Atlantic) occurred during maintenance of the 45’ channel. In 2017, one entrainment occurred during maintenance of the Philadelphia to Trenton 40’ channel (July – dead adult shortnose) and the other during maintenance of the Philadelphia to the Sea 45’ channel (October – dead juvenile Atlantic). In 2018, one of three entrainments occurred during maintenance of the Philadelphia to Trenton 40’ channel (October – dead juvenile Atlantic) and the two other were entrained during maintenance of Philadelphia to Sea 45’ channel (November – dead juvenile Atlantic and dead adult shortnose). Additionally, part of a decomposed sturgeon was entrained in a hopper dredge in Delaware River in September 2013. With the exception of the adult Atlantic sturgeon entrained in August 2014[16], all recorded interactions with Atlantic sturgeon have been with juveniles or subadults (length <150 cm). Given the large size of Atlantic sturgeon adults (greater than 150cm) and the size of the openings on the dragheads used for this action (openings no greater than 4” x 4”), adult Atlantic sturgeon are unlikely to be vulnerable to entrainment.

According to ODESS (https://dqm.usace.army.mil/odess/#/home, last accessed October 21, 2021), from 2015-2021, the USACE has documented a total of 50 confirmed incidences of entrainment or capture of Atlantic sturgeon species on monitored hopper dredging projects. Information on these interactions is presented in (Table 22). Most of these interactions occurred within harbors and entrance channels. It is also unclear whether all hopper takes within the regions have been entered into ODESS. According to the Sea Bright Offshore Borrow Area biological opinion (dated March 7, 2014) (NMFS 2014), few records exist between hopper dredges and Atlantic sturgeon within offshore environments similar to the Ambrose, Anchorage, and Port Jersey Channels (Table 23).

[16] The draghead operating on August 31, 2014 in the Philadelphia to Trenton reach had 10” x 10” openings.

Table 22. USACE Atlantic Sturgeon Entrainment Records from Hopper Dredge Operations (2015-2021) (ODESS, https://dqm.usace.army.mil/odess/#/home, last accessed October 21, 2021).

Project Location	**Corps Division/District**	**Month/Year of Operation**	**Cubic Yards Removed**	**Observed Entrainment**
Kings Bay Entrance Channel	SAD/Jacksonville	February 2021-	70,3845	4
Savannah Harbor	SAD/Wilmington	January 2020-	695,624	2
Brunswick Harbor	SAD/Wilmington	January 2020	255,312	4
Kings Bay Entrance Channel	SAD/Jacksonville	January 2020-	Unknown	1
Wilmington Harbor	SAD/Wilmington	March-April 2019	Unknown	1
Savannah Harbor	SAD/Savannah	January-February 2019	Unknown	2
Kings Bay Entrance Channel	SAD/Jacksonville	January-March 2019	Unknown	1
Mayport Harbor	SAD/Jacksonville	January-April 2019	Unknown	1
Charleston Entrance Harbor	SAD/Charleston	May 2018-April 2019	Unknown	4
Charleston Entrance Harbor	SAD/Charleston	March 2018-January 2019	Unknown	9
Kings Bay Entrance Channel	SAD/Jacksonville	January 2018-March 2019	Unknown	1
Brunswick Harbor	SAD/Savannah	December 2017-March 2018	1,493,641	6
Wilmington Harbor	SAD/Wilmington	March-April 2017	31,773	1
Kings Bay Entrance Channel	SAD/Jacksonville	January-March 2017	1,220,067	1
Brunswick Harbor	SAD/Savannah	January-March 2017	Unknown	1
Savannah Harbor	SAD/Savannah	December 2016 – January 2017	Unknown	1
Charleston Entrance Channel	SAD/Charleston	April 2016-February 2017	2,088,476	1
Kings Bay Entrance Channel	SAD/Jacksonville	February-March 2016	1,224,123	2
Savannah Harbor	SAD/Savannah	September 2015-April 2018	Unknown	5
Savannah Harbor	SAD/Savannah	February-March 2015	Unknown	1
Brunswick Harbor	SAD/Savannah	January-February 2015	Unknown	1
			Total:	50

Table 23. Open Estuarine Channel Deepening projects in USACE NAD from 1998-2012 with recorded cubic yardage (taken from SBOBA biological opinion (dated March 7, 2014) (NMFS 2014)) and the number of observed Atlantic sturgeon entrainments.[17] Records are based on sea turtle observer reports which record listed species entrained as well as all other organisms entrained during dredge operations.

Project Location	**Year of Operation**	**Cubic Yards Removed**	**Observed Entrainment**
Ambrose Channel- Contact Area B*	2012	1,510,000	1
York Spit Channel, VA	2011	1,630,713	2
Cape Henry Channel, VA	2011	2,472,000	0
York Spit Channel, VA	2009	372,533	0
Sandy Hook Channel, NJ	2008	23,500	1
York Spit Channel, VA	2007	608,000	0
Atlantic Ocean Channel, VA	2006	1,118,749	0
Thimble Shoal Channel, VA	2006	300,000	0
Thimble Shoal Channel, VA	2004	139,200	0
VA Beach Hurricane Protection Project	2004	844,968	0
Thimble Shoal Channel, VA**	2003	1,828,312	0
Cape Henry Channel, VA***	2002	1,407,814	0
York Spit Channel, VA****	2002	911,406	0
East Rockaway Inlet, NY	2002	140,000	0
Cape Henry Channel, VA	2001	1,641,140	0
Thimble Shoald Channel, VA	2000	831,761	0
Cape Henry Channel, VA	2000	759,986	0
York Spit Channel, VA	1998	296,140	0
Cape Henry Channel, VA	1998	740,674	0
Thimble Shoal Channel, VA	1996	529,301	0
East Rockaway Inlet, NY	1996	2,685,000	0
Cape Henry Channel, VA	1995	485,885	0
East Rockaway Inlet, NY	1995	412,000	0
York Spit Channel, VA	1994	61,299	0
Cape Henry Channel, VA	1994	552,671	0
	Total:	22,303,052	4

*Observed entrainment of Atlantic sturgeon believed to be a result of a damaged UXO screen. Therefore, we assume that the risk of entrainment was the same as if the dreddged did not have a mounted UXO screen.
** Fourteen Atlantic sturgeon removed during pre-dredge trawl/relocation trawling (September and November, 2003).
*** One Atlantic sturgeon removed during pre-dredge trawl/relocation trawling on 10/26/02.
**** One Atlantic sturgeon removed during pre-dredge trawl/relocation trawling on 11/02/02.

[17] Only dredges operating without a UXO screen were included, as these screens, are likely to preclude an observer from detecting entrained sturgeon or sturgeon parts and thus, may not accurately reflect observed entrainment in relation to the cubic yards of material removed.

On September 16, 2012, you informed us that the anterior portion of an Atlantic sturgeon was found within the inflow screening of the hopper dredge operating within the Ambrose Channel-Contract B. The sturgeon part was moderately decomposed. It is believed that the animal had died by some other cause(s) and thus, was not attributed as an entrainment incident related to or as a result of the Ambrose Channel deepening, and thus, was not considered in the table above.

As some dredges have been operating with a UXO screen since 2006, we cannot discount the possibility that, so long as the screen was undamaged, unobservable interactions may have still occurred with Atlantic sturgeon. UXO screens, in undamaged states, are likely to preclude an observer from detecting entrained sturgeon or sturgeon parts. Accordingly, it is not appropriate to use data from dredging operations in which a UXO screen was used in our assessment of Atlantic sturgeon entrainment. In the absence of sufficient information specific to the Ambrose, Anchorage, and Port Jersey Channels that we can rely on to make our assessment, it is most appropriate to consider other projects that have been conducted in a comparable environment to that of the Ambrose, Anchorage, and Port Jersey Channels (see Table 23). The most appropriate projects to consider were those in "offshore"/ nearshore (*i.e.*, within 10 miles off the U.S. Eastern coastline) environments or open estuarine environments. We did not consider riverine estuaries in our assessment as the environmental characteristics of these areas are not comparable to open estuarine or offshore environments. As such, the level of entrainment in these areas would not be comparable to the level of entrainment that may occur in the Ambrose, Anchorage, and Port Jersey Channels.

As explained above, in the Greater Atlantic Region (Maine through Virginia), endangered species observers have been present on all hopper dredges operating between April 1 and November 30 since 1994. While the primary responsibility of observers is to document sea turtle interactions, observers document all biological material entrained in the dredges. As such, they record any observed interactions with sturgeon. Sturgeon interactions have routinely been reported to NMFS. Therefore, we expect that the "observed entrainment" numbers noted above are comprehensive and that any interactions with Atlantic sturgeon would be recorded. While observers have not operated on dredges working from December – March, in the Greater Atlantic Region dredging during this time of year is rare (due to weather conditions) and we do not anticipate that there are many undocumented interactions between Atlantic sturgeon and hopper dredges.

In general, entrainment of large mobile animals, such as sturgeon or sea turtles, is relatively rare. Several factors are thought to contribute to the likelihood of entrainment. In areas where animals are present in high density, the risk of an interaction is greater because more animals are exposed to the potential for entrainment. It is reasonable to assume that the risk of entrainment is highest in areas where the movements of animals are restricted (*e.g.*, in river channels) where there is limited opportunity for animals to move away from the dredge. Because hopper dredging will mainly occur in an offshore environment (*i.e.*, Ambrose Channel), and the Ambrose, Anchorage and Port Jersey Channels are not known for Atlantic sturgeon aggregations, the movements of Atlantic sturgeon will not be restricted and we anticipate that most Atlantic sturgeon would not interact with the dredge (Balazik *et al.* 2021). In addition, the hopper dredge draghead operates on the bottom and is typically at least partially buried in the sediment. Sturgeon are benthic feeders and are often found at or near the bottom while foraging or while moving within rivers. Information suggests that Atlantic sturgeon migrating in the marine environment do not move along the bottom, but move further up in the water column. If Atlantic sturgeon are up off the bottom while in offshore/migratory areas, such as the Ambrose, Anchorage, and Port Jersey Channels, the potential for interactions with the dredge are further reduced. Based on this information, the likelihood of an interaction of an Atlantic sturgeon with a hopper dredge operating in the Ambrose, Anchorage, and Port Jersey Channels is expected to be low.

However, because we know that entrainment is possible and that not all mobile animals will be able to escape from the dredge (as evidenced by past entrainment of sea turtles and sturgeon). Studies conducted in the Delaware River and in the James River also indicate that Atlantic sturgeon do not avoid or move away from vessels, including operating dredge vessels (Reine *et al.* 2014, Balazik *et al.* 2017a, Barber 2017, DiJohnson 2019, Balazik *et al.* 2020). Thus, we anticipate that entrainment is still possible and as such, consequences of these interactions on Atlantic sturgeon must be assessed. As noted above, outside of rivers/harbors, only four Atlantic sturgeon have been observed entrained in a hopper dredge from 1994 to 2012 (Table 23). The low level of interactions may be due to the use of pre-trawl/dredge relocation trawling. Although no Atlantic sturgeon were entrained in some locations, they were documented in the area prior to dredging operations. Another explanation for the low levels of interactions may be that some interactions were not reported to NMFS; however, based on information that has been provided to NMFS and discussions with observers, under-reporting is likely to be very rare.

As noted above, based on what we know about Atlantic sturgeon behavior in environments comparable to the Ambrose, Anchorage, and Port Jersey Channels, it is reasonable to consider that the risk of entrainment at this site is generally similar to that of sites located within open estuarine environments (*i.e.*, Table 23). Some of the areas considered in this analysis (Table 23) are closer to shore than the area being dredged with a hopper dredge in the Ambrose, Anchorage, and Port Jersey Channels and may be more heavily used than this area. Thus, an estimate of interactions derived from this information is conservative; however, at this time, this is the best available information on the potential for interactions with Atlantic sturgeon.

Past experience calculating the likelihood of interactions between hopper dredges and other species (*i.e.*, sea turtles) indicates that there is a relationship between the number of animals entrained and the volume of material removed. The volume of material removed is correlated to the amount of time spent dredging but is a more accurate measure of effort because reports often provide the total days of a project but may not provide information on the actual hours of dredging vs. the number of hours steaming to the disposal site or in port for weather or other delays. Thus, we will use information available for all dredging projects that have been undertaken in open estuarine or offshore environments in the mid-Atlantic and in areas of no known sturgeon aggregations for which cubic yards of material removed are available to calculate the number of Atlantic sturgeon likely to be entrained during dredging operations (Table 23). Using this method, and using the dataset presented in Table 23, we have calculated an entrainment rate of one Atlantic sturgeon is likely to be injured or killed for approximately every 5,600,000 CY of material removed during hopper dredging operations undertaken at the Ambrose, Anchorage, and Port Jersey Channels. This calculation is based on a number of assumptions including the following: that adult and subadult Atlantic sturgeon are evenly distributed throughout the action area, that all hopper dredges will have the same entrainment rate, and that Atlantic sturgeon are equally likely to be encountered throughout the time period when dredging will occur. While this estimate is based on several assumptions, it is reasonable, because it uses the best available information on entrainment of Atlantic sturgeon from past dredging operations, including dredging operations in the vicinity of the action area, it includes multiple projects over several years, and all of the projects have had observers present which we expect would have documented any entrainment of Atlantic sturgeon.

Based on the information outlined above, we anticipate that dredging at the Ambrose, Anchorage and Port Jersey Channels will result in entrainment in the hopper dredge of a total of three (3) Atlantic sturgeon (Table 24). Because we expect that adult Atlantic sturgeon are too large to be vulnerable to entrainment and given the size of other sturgeon that have been entrained in other hopper dredging operations, we expect that these sturgeon will be subadults.

There is evidence that some Atlantic sturgeon, particularly small subadults, could be entrained in the dredge and survive. However, as the extent of internal injuries and the likelihood of survival is unknown, and the size of the fish likely to be entrained is impossible to predict, it is reasonable to conclude that any Atlantic sturgeon entrained in the hopper dredge are likely to be killed.

Table 24. Total volume initially dredged at Ambrose, Anchorage, and Port Jersey channels over 15 years and estimated number of Atlantic sturgeon entrained in the hopper dredge.

Channel Name	Volume (CY) Dredged from 2025-2039	Atlantic Sturgeon Entrainment
Ambrose	6,389,000	1.1
Anchorage	3,800,000	0.7
Port Jersey	3,003,000	0.5
Total	13,192,000	3*

* Rounded up to be conservative

We have considered the best available information to determine from which DPSs individuals that will be killed are likely to have originated. Using mixed stock analysis explained above, we have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 87%; CB 8%; SA 3%; and GOM and Carolina (combined) 2%. The three Atlantic sturgeon expected to be killed by hopper dredge will most likely be of NYB DPS (NYB DPS ratio is 2.55) origin but it is possible that one could be from any other DPS. Therefore, we expect that Atlantic sturgeon take by hopper dredge could be three NYB DPS or two NYB DPS and one from any of the GOM, CB, Carolina, or SA DPS.

7.3 Blasting

It is currently unknown exactly where, or if, blasting will occur. We can assume at this time that some parts of the NB Complex (South Elizabeth and Port Elizabeth Channels), especially near the KVK intersection, might require blasting. Based on the information we have received, we understand that the blasting may occur during daylight hours only, Monday through Saturday, and will occur only from July 1 through February 28 of any year, in discreet locations within the NB complex, only. The initial blasting events could occur anytime from 2025 through 2039. Because sea turtles are not expected to be present in the Newark Bay/Kill Van Kull area, the consequences of blasting on sea turtles will not be considered further.

In a follow-up email dated October 26, 2021, you confirmed the following:

Underwater overpressure and noise will be minimized in confined blasting by:

- using clean, crushed, stone stemming at the top of the blasthole,
- using timed delays of at least 25 milliseconds between blastholes, and
- using timed delays greater than 25 milliseconds between rows of blastholes.

The stemming will minimize the blast energy entering the water column. The timed delays will limit the underwater overpressure by effectively reducing the size of the blast to the size of an individual blasthole.

During a follow-up call on November 23, 2021, and in an email dated December 1, 2021, you proposed additional measures to avoid and minimize consequences from the use of explosives. Multiple options may be implemented to reduce the presence of fish, including as an example:

- Use of fish and mammal observers with sonar to image fish in the blast area prior to blasting,
- Use of an acoustic fish startle system to move fish from the blast area prior to blasting,
- Use of a series of small scare charges detonated in the water column at one-minute intervals prior to each blast, and
- Use of fish and mammal observers to document potential fish take after each blast.

The blasting aquatic monitoring program (BAMP) will be developed in collaboration with us. Currently, it is specified in dredge contracts that upon sighting of protected species all operations that could cause harm are to cease until such time it is determined that it is safe to resume operations and not risk harm to the animal. As data from the BAMP are reviewed and analyzed, this BMP could be revised.

As noted above, all blasting will occur between July 1 to February 28 of any year, when Atlantic sturgeon are expected to be leaving the spawning area in the Hudson and migrating to the offshore foraging and winter aggregation sites. Blasting could cause physical injury or mortality to individual Atlantic sturgeon and displace any individuals opportunistically using the area while blasting is occurring. The blasting may also affect individuals by modifying the habitat and benthic community within the reach as well as by reducing opportunistic foraging opportunities.

However, the time of year that the work will be occurring makes the likelihood of an encounter with sturgeon during blasting extremely low with only rare transients being present. Furthermore, blasting will occur in rocky areas (which in this portion of the action area are not known aggregation or spawning areas as demonstrated in other studies (Brundage and O'Herron 2014)). As opportunistically foraging adult and sub-adult Alantic sturgeon prefer soft habitat for foraging, the likelihood of an encounter is further reduced.

Additionally, you propose to use scare charges for each blast. A scare charge is a small charge of explosives detonated immediately prior to a blast for the purpose of scaring aquatic organisms away from the location of an impending blast without producing so much pressure or noise that they could be injured or killed. In an email dated December 1, 2021, you proposed to use a series of small scare charges detonated in the water column at one-minute intervals prior to each blast.

7.3.1 Acoustic Deterrence – Background based on Delaware River Deepening

You propose to possibly use an acoustic fish startle system. Because you do not have specific information at this time about the type of acoustic fish startle system you will be using and how it will be used for the project, we will assume that it will be similar to the acoustic deterrent system that was used for the Delaware Deepening project (NMFS 2019). The purpose of an acoustic deterrent system is to behaviorally deter sturgeon from entering or remaining in the blasting area (In this situation, the system was designed to deter both shortnose and Atlantic sturgeon as both were present and affected by the DE Deepening project). In July 2015, ERC (2015) conducted a feasibility study to test an acoustic deterrent system for the Delaware Deepening project. Their analysis provided evidence that some sturgeon avoided the loudest portions of an experimental sound field and that sturgeon experienced no latent effects of the sound exposure. The study showed that sturgeon spent 4.55 hours less in the regions of interest when the sound was on than when the sound was off; however, the difference in time spent during test and control conditions was not statistically significant at the $\alpha = 5\%$ level. Regardless, there was some evidence of avoidance behavior, and the authors concluded that ensonifying the blast area would add a degree of protection to the sturgeon that cannot otherwise be accomplished.

The deterrent system for the Delaware Deepening project consisted of a sound source capable of producing impulsive sound of the appropriate amplitude and frequency range, and a generator to power the source, mounted on a self-propelled pontoon boat. The sound source was an Applied Acoustic Engineering Ltd. (AAE) "boomer" typically used for subsurface geophysical profiling (Moody and Van Reenan 1967). The boomer is an electromagnetically driven sound source consisting of a triggered capacitor bank that discharges through a flat coil. Eddy currents are induced in aluminum plates held against the coil by heavy springs or rubber bumpers. The plates are violently repelled when the capacitor fires, producing a cavitation volume in the water, which acts as a source of low-frequency sound (Edgerton and Hayward 1964).

The sound source was set to produce a sound level (as determined at 33 ft. (10 m) from the source) of ≤204 dB re 1 μPa peak at a repetition rate of 20/minute; it was also mounted horizontally such that the sound is projected downward and laterally into the water column below the pontoon boat.

The sound source was moored as closely to the blasting location as safety and operational considerations allow, and operated continuously for at least five hours prior to each detonation. The sound source was operated as close in time to the blast as safety allowed before being moved away from the blasting site (approximately 30 minutes).

7.3.1.1 Effects of Noise Produced by the Acoustic Deterrent

As noted above, the sound source was set to produce a sound level of ≤204 dB re 1 µPa peak at a repetition rate of 20/minute for at least five hours prior to each detonation. Based on the results of the pilot study trials where the system operated at maximum energy (350 J), we expected peak noise to be 193 dB 1 µPa peak-to-peak (146 dB re 1 µPa single-pulse SEL) at a distance of 5.3 m from the sound source. The ensonified area was approximately 0.4km^2, and all Atlantic sturgeon behavioral responses were anticipated to occur within the ensonified area.

We expect potential injury to Atlantic sturgeon upon exposure to impulsive noises greater than 206 dB re 1µPa peak or 187 dB re 1uPa cSEL. Peak noise levels for the Delaware Deepening project did not exceed 193 dB re 1uPa^2·s peak and, therefore, we expect it will not exceed the peak noise exposure threshold of 206 dB re 1µPa during the HDCI blasting.

In addition to the "peak" exposure criteria, which relates to the energy received from a single impulse, the potential for injury exists for multiple exposures to lesser noise. That is, even if an individual fish is far enough from the source to not be injured during a single impulse, the potential exists for the fish to be exposed to enough less noisy impulses to result in physiological impacts. The cSEL criterion is used to measure such cumulative impacts. The cSEL is not an instantaneous maximum noise level, but is a measure of the accumulated energy over a specific period of time (*e.g.*, the period of time it takes to install a specific structure, such as a pile). For the Delaware Deepening action, the impulsive noise was generated for five hours prior to each detonation (max of two detonations per day). The cSEL is calculated by incorporating both the noise level associated with a single impulse as well as the total number of noise events. In this instance, this would mean accounting for every impulse over the entire day (*i.e.*, one impulse every 2 seconds for two five-hour periods, for a total of 18,000 impulses). We calculated that the distance to the 187 dB re 1uPa cSEL isopleth was less than 5 meters from the noise source[18]. That means that in order to accumulate enough energy to be injured, a sturgeon would need to stay within 5 meters of the noise source for the entire 10-hour period that the system is operational. We do not expect this to happen because sturgeon in the Kill van Kull/Newark Bay area are highly mobile and are expected to only be opportunistically foraging and/or migrating to other areas. While some of the sturgeon tracked during the noise deterrent study did not avoid the ensonified area during the deterrent study, none of them were stationary for hours at a time. Therefore, it is not reasonable to anticipate that any sturgeon would stay within 5 meters of the

[18] Using the NMFS pile driving calculator (available at: www.wsdot.wa.gov/) and using a peak noise level of 193 dB, SEL of 146, and RMS of 178 (calculated by subtracting 15 from the peak as recommended by the authors of the calculator), all measured at a distance of 5.3 m from the sound source as described in ERC (2015).

sound deterrent system for 10 hours. Based on this, we do not expect any injury or mortality to result from exposure to the noise produced by the deterrent system.

This conclusion is supported by the findings of ERC (2015). All of the sturgeon that were exposed to sound during ERC's 2015 tests were detected by multiple receivers in the weeks following testing. All of them showed normal patterns of movement, indicating that exposure to sound had not injured or impaired them. Based on the best available information (discussed above), it is extremely unlikely that any sturgeon will be exposed to injurious levels of underwater noise created by the deterrent device.

Here, we consider consequences to Atlantic sturgeon that leave and/or are excluded from the ensonified area. Because of the location, any sturgeon in the Kill van Kull/Newark Bay area will be migrating and opportunistically foraging. The area is not a known aggregation site. Therefore, any consequences to Atlantic sturgeon that are deterred from the Kill van Kull/Newark Bay area are too small to be meaningfully measured or detected and are insignificant.

7.3.2 Available Information on Consequences of Sound Pressure on Fish

Sturgeon rely primarily on particle motion to detect sounds (Lovell *et al.* 2005). While there are no data either in terms of hearing sensitivity or structure of the auditory system for Atlantic and shortnose sturgeon, there are data for the closely related lake sturgeon (Lovell *et al.* 2005, Meyer *et al.* 2010), which serve as a good surrogate for Atlantic and shortnose sturgeon when considering acoustic impacts due to the biological similarities among the species. The available data suggest that lake sturgeon can hear sounds from below 100 Hz to 800 Hz (Lovell *et al.* 2005, Meyer *et al.* 2010). However, since these two studies examined responses of the ear and did not examine whether fish would behaviorally respond to sounds, it is hard to determine the level of noise that would trigger a behavioral response (that is, the lowest sound levels that an animal can hear at a particular frequency) using information from these studies. The best available information indicates that Atlantic and shortnose sturgeon are not capable of hearing noise in frequencies above 1,000 Hz (1 kHz) (Popper 2005). Sturgeon are categorized as hearing "generalists" or "non-specialists" (Popper 2005). Sturgeon do not have any specializations, such as a coupling between the swim bladder and inner ear, to enhance their hearing capabilities, which makes these fish less sensitive to sound than hearing specialists. Low-frequency impulsive energies, including pile driving, cause swim bladders to vibrate, which can cause damage to tissues and organs as well as to the swim bladder (Halvorsen *et al.* 2012a). Sturgeon have a physostomous (open) swim bladder, meaning there is a connection between the swim bladder and the gut (Halvorsen *et al.* 2012a). Fish with physostomous swim bladders, including Atlantic and shortnose sturgeon, are able to expel air, which can diminish tension on the swim bladder and reduce damaging consequences during exposure to impulsive sounds. Fish with physostomous swim bladders are expected to be less susceptible to injury from exposure to impulsive sounds, such as pile driving, than fish with physoclistous (no connection to the gut) swim bladders (Halvorsen *et al.* 2012a).

If a noise is within a fish's hearing range and is loud enough to be detected, consequences can range from mortality to a minor change in behavior (*e.g.*, startle), with the severity of consequences increasing with the loudness and duration of the exposure to the noise (Hastings and Popper 2005). The actual nature of consequences and the distance from the source at which they could be experienced will vary and depend on a large number of factors. Factors include fish hearing sensitivity, source level, how the sounds propagate away from the source, and the resultant sound level at the fish, whether the fish stays near the source, the motivation level of the fish, etc.

7.3.2.1 Criteria for Assessing the Potential for Physiological Consequences to Sturgeon
The Fisheries Hydroacoustic Working Group (FHWG) was formed in 2004 and consists of biologists from NMFS, U.S. FWS, FHWA, and the California, Washington, and Oregon DOTs, supported by national experts on sound propagation activities that affect fish and wildlife species of concern. In June 2008, the agencies signed a Memorandum of Agreement documenting criteria for assessing physiological consequences of pile driving on fish. The criteria were developed for the acoustic levels at which physiological consequences to fish could be expected. It should be noted that these are onset of physiological consequences (Stadler and Woodbury 2009), and not levels at which fish are necessarily mortally damaged. These criteria were developed to apply to all species, including listed green sturgeon, which are biologically similar to Atlantic sturgeon and, for these purposes, are considered a surrogate. The interim criteria are:

- Peak Sound Pressure Level (SPL): 206 decibels relative to 1 micro-Pascal (dB re 1 μPa) (206 dB_{Peak}).
- Cumulative Sound Exposure Level (cSEL): 187 decibels relative to 1 micro-Pascal-squared second (dB re 1μPa^2-s) for fishes above 2 grams (0.07 ounces) (187 dBcSEL).

At this time, these criteria represent the best available information on the thresholds at which physiological consequences to sturgeon from exposure to impulsive noise, such as pile driving, are likely to occur. It is important to note that physiological consequences may range from minor injuries from which individuals are anticipated to completely recover with no impact to fitness, to significant injuries that will lead to death. The severity of injury is related to the distance from the pile being installed and the duration of exposure. The closer the fish is to the source and the greater the duration of the exposure, the higher likelihood of significant injury.

Since the FHWG criteria were published, two papers relevant to assessing the consequences of pile driving noise on fish have been published. Halvorsen *et al.* (2011) documented consequences of pile driving sounds (recorded by actual pile driving operations) under simulated free-field acoustic conditions where fish could be exposed to signals that were precisely controlled in terms of number of strikes, strike intensity, and other parameters. The study used Chinook salmon and determined that onset of physiological consequences that have the potential of reduced fitness, and thus a potential consequence on survival, started at above 210 dB re 1μPa^2-s cSEL. Smaller injuries, such as ruptured capillaries near the fins, which the authors noted were not expected to impact fitness, occurred at lower noise levels.

Halvorsen *et al.* (2012a) exposed lake sturgeon to pile driving noise in a laboratory setting. Lake sturgeon were exposed to a series of trials beginning with a cSEL of 216 dB re 1uPa^2-s (derived from 960 pile strikes and 186 dB re $1uPa^2$-s sSEL). Following testing, fish were euthanized and examined for external and internal signs of barotrauma. None of the lake sturgeon died as a result of noise exposure. Lake sturgeon exhibited no external injuries in any of the treatments but internal examination revealed injuries consisting of hematomas on the swim bladder, kidney, and intestines (characterized by the authors as "moderate" injuries) and partially deflated swim bladders (characterized by the authors as "minor" injuries). The author concludes that an appropriate cSEL criteria for injury is 207 dB re $1uPa^2$-s. Chinook salmon are hearing generalists with physostomous swim bladders. Results from Halvorsen *et al.* (2012b) suggest that the overall response to noise between chinook salmon and lake sturgeon is similar.

It is important to note that both Halvorsen *et al.* (2012a), (2012b) papers used a response weighted index (RWI) to categorize injuries as mild, moderate, or mortal. Mild injuries (RWI 1) were determined by the authors to be non-life threatening. The authors made their recommendations for noise exposure thresholds at the RWI 2 level and used the mean RWI level for different exposures. We consider even mild injuries to be physiological consequences and we are concerned about the potential starting point for physiological consequences and not the mean. Therefore, for the purposes of carrying out section 7 consultations, we will use the FHWG criteria to assess the potential physiological consequences of noise on Atlantic and shortnose sturgeon and not the criteria recommended by Halvorsen *et al.* (2012a), (2012b). Following the FHWG criteria, we will consider the potential for physiological consequences upon exposure to impulsive noise of 206 dBPeak. Use of the 187 dBcSEL threshold is a cumulative measure of cumulative impulsive sound (such as impact pile driving) and is not appropriate for blasting. As explained here, physiological consequences from noise exposure can range from minor injuries that a fish is expected to completely recover from with no impairment to survival to major injuries that increase the potential for mortality or result in death.

7.3.3 Available Information on Consequences of Blasting on Fish

Numerous studies have assessed the direct impact of underwater blasting on fish. While not all of the studies have focused exclusively on Atlantic sturgeon, the results demonstrate that blasting does have an adverse impact on fish. Teleki and Chamberlain (1978) found that several physical and biological variables were the principal components in determining the magnitude of the blasting consequences on fish. Physical components include detonation velocity, density of material to be blasted, and charge weight, while the biological variables are fish shape, location of fish in the water column, and swimbladder development. Composition of the explosive, water depth, and bottom composition also interact to determine the characteristics of the explosion pressure wave and the extent of any resultant fish kill. Furthermore, the more rapid the detonation velocity, the more abrupt the resultant hydraulic pressure gradient, and the more difficulty fish appear to have adjusting to the pressure changes.

A blasting study conducted in Nanticoke, Lake Erie, found that fish were killed in radii ranging from 20 to 50 m for 22.7 kg per charge and from 45 to 110 m for 272.4 kg per charge (Teleki and Chamberlain 1978). Approximately 201 blasts were detonated in 4 to 8 m of water. Of the thirteen fish species studied, mortality differed by species at identical pressure. Common blast induced injuries included swimbladder rupturing and hemorrhaging in the coelomic and pericardial cavities.

The consequences of blasting on thirteen species of fish were measured in deep water (46 m) explosion tests in the Chesapeake Bay opposite the mouth of the Patuxent River (Wiley *et al.* 1981). No Atlantic sturgeon were tested. Fish were held in cages at varying depths during 16 midwater detonations with 32 kg explosives. For the 32 kg charges, the pressure wave was propagated horizontally most strongly at the depth at which the explosion occurred. While the extent of the injury varied with species, the fish with swimbladders are far more vulnerable than those lacking swimbladders, and toadfish and catfish were the most resistant to damage of those species with a swimbladder.

Many fish exposed to blasting exhibit injuries to the kidney and swimbladder, thus affecting their fitness (Wiley *et al.* 1981). Efficient osmoregulation is very important in fishes; even slight bruises to the kidney could seriously affect this efficiency, causing at least a higher expenditure of energy. Burst swimbladders cause the fish to lose their ability to regulate the volume of their swimbladders (destroying buoyancy control) and probably increases their vulnerability to predators.

Wiley *et al.* (1981) found that the oscillatory response of the swimbladder was a likely cause of the fishes' injuries. Their analyses demonstrate that fish mortality is strongly dependent on the depth of the fish. For larger fish (like Atlantic sturgeon) at shallower depths (~7 to 11 m), the swimbladder does not have time to fully respond to the positive portion of the explosion wave. Thus, at shallow depth the larger fish are in effect protected from harm by their swimbladders, while at the resonance depth their swimbladders are burst.

Burton (1994) conducted experiments to estimate the consequences of blasting to remove approximately 1,600 cubic yards of bedrock during construction of a natural gas pipeline in the Delaware River near Easton, Pennsylvania (upriver from Marcus Hook area). American shad and smallmouth bass juveniles were exposed to charges of 112.5 and 957 kg of explosives in depths ranging between 0.5 and 2 m. The fish were caged at a range of distances from the blasts. Tests with American shad were inconclusive due to an unavoidable delay between the time when the chambers were stocked and the detonation of the explosives; however, successful tests with smallmouth bass suggested that the explosives created a maximum kill radius of 12 m (for both charge magnitudes). No fish were killed by the shock wave at the 24 m position and beyond.

Hubbs and Rechnitzer (1952) looked at the consequences of blasting on the following caged fish: anchovies, jack mackerel, kingfish, sardine, queenfish, pompano, and grunion. The cages were placed anywhere from 10-92 feet from the charge. They determined that the lethal threshold peak pressure for a variety of marine fish species exposed to dynamite blasts varied from 40 psi (280 kilopaschals, kPa) to 70 psi (480 kPa) (Hubbs and Rechnitzer 1952).

Keevin (1995) compared the mortality of bluegill exposed to three high-explosive types (T-100 Two Component, Pellite, and Apex 260) spanning the range of detonation velocities within commercially available explosives. Using equivalent weights of explosives, there was no significant difference in mortality curves based on distance from the explosive charge. An abrupt increase in internal damage (ruptured swimbladder, kidney, liver, and spleen damage) occurred at values above approximately 700 kPa peak pressure, and mortality abruptly increases at approximate values above 500 kPa peak pressure (Keevin 1995). According to the USACE (2004), Keevin (1995) found no mortality or internal organ damage to bluegill exposed to a high explosive at pressures at or below 400 kPa (60 psi).

The preceding studies were not conducted on Atlantic sturgeon, but the nature of the injuries and the optimal distance from the detonations could be applied to blasting activities and the sturgeon species. The consequences of blasting on shortnose sturgeon have been examined. Test blasting was conducted in the Wilmington Harbor, North Carolina, in December 1998 and January 1999 in order to adequately assess the impacts of blasting on shortnose sturgeon, the size of the LD1 area (the lethal distance from the blast where 1 percent of the fish died), and the efficiency of an air curtain for mitigating blast consequences. An air curtain is a stream of air bubbles created by a manifold system on the river bottom surrounding the blast. In theory, when the blast occurs, the air bubbles are compressed, and the blast pressure is reduced outside the air curtain.

As explained in Moser (1999a), the test blasting consisted of 32-33 blasts (3 rows of 10 to 11 blast holes per row with each hole and row 10 feet apart), about 24 to 28 kg of explosives per hole, stemming each hole with angular rock, and an approximate 25 m/sec delay after each blast. During test blasting, 50 hatchery reared juvenile striped bass and shortnose sturgeon were placed in 0.25" plastic mesh cylinder cages (2 feet in diameter by 3 feet long) 3 feet from the bottom (worst case scenario for blast pressure as confirmed by test blast pressure results) at 35, 70, 140, 280, and 560 feet upstream and downstream of the blast location. For each test, 200 caged shortnose sturgeon were held at a control location 0.5 mi from the test blast area. The caged fish had a mean weight of 55 grams. The cages were enclosed in a 0.6" nylon mesh sock to prevent the escape of any sturgeon if the cage was damaged during blasting. The caging experiments were conducted during seven blasts between December 9, 1998 and January 7, 1999. Three test blasts were conducted with the air curtain in place, and four were conducted without the air curtain. The air curtain (when tested) was 50 feet from the blast. The caged fish were visually inspected for survival just after the blast and after a 24-hour holding period. Mortality rates for control fish were generally low, with 15 fish dead or mortally injured on inspection (out of a total of 1,400 samples). The numbers of injured, dead, and mortally injured sturgeon varied greatly between tests. Of the 500 fish tested during each blast, mortalities (dead or mortally injured) ranged from one to 89 fish. Mortality rates for shortnose sturgeon as compared to the other species tested were low, with the author of the report concluding that this was likely due to the larger size of shortnose sturgeon tested (approximately 30cm average) as compared to the size of the other species (3cm – 20cm).

In addition to the external examinations of fish immediately following the blast and 24 hours later, a sample of 10 randomly selected, apparently unaffected, sturgeon from each of seven cages nearest the blasts were sacrificed and later necropsied (Moser 1999b). After the necropsy was completed, the total extent of injury was scored on a scale of 0-10, with 10 being the most severe level of injury observed. It is important to note that all of the fish necropsied were alive

24 hours following the blast and appeared to be uninjured based on the initial external observations. Fish scored at 7 or higher were thought to be unlikely to survive and function normally with the injuries they sustained. Injuries ranged from no sign of external injury to extensive internal hemorrhaging and ruptured swim bladders.

All fish necropsied were within 70 feet of the drill holes (most within 35 feet). These fish were in apparently normal condition when sacrificed 24 hours after the blast. The fish were swimming normally in their cages and exhibited no outward signs of stress or physical discomfort (Moser 1999b). However, internal examinations revealed extensive damage in many of the fish necropsied. Of the 70 sturgeon necropsied, ten had an index of injury of 7 or higher, meaning that they likely would not have survived the injuries sustained during blasting. While sturgeon had relatively little damage to their swim bladders, they more often had distended intestines with gas bubbles inside and hemorrhage to the body wall lining. In the fish caged 70 feet away, there was no sign of hemorrhage or swim bladder damage but two of the fish exhibited distended intestines, which may have been caused by the blast. Moser (1999b) speculated that sturgeon fared better than striped bass because their air bladder has a free connection to the esophagus, allowing gas to be expelled rapidly without damage to the swim bladder. Additionally, there was no clear relationship between size and the Index of Injury, size and gut fullness, or Index of Injury and gut fullness. The author notes that external observation of the fish following blasting was not sufficient to identify all blast-related injuries and that many of the internal injuries observed in fish that externally appeared unaffected would have resulted in eventual mortality.

Some fish caged as far as 560 feet away from the blast died or were injured/mortally injured within 24 hours of the blast. Given that some fish in the control study also died, and that none of the fish caged this far away were necropsied, it is impossible to know whether they died of causes unrelated to the blasting experiment.

A monitoring program was implemented for the Kill Van Kull Deepening project (part of the 2000 harbor deepening) in 2004 to examine the fish communities of the NY/NJ Harbor Complex, the potential consequences of blasting on the aquatic biota of the harbor, and recorded water-borne pressures from confined blasts. In-situ blast pressure monitoring was conducted to record water-borne blast pressures from confined blasts. Data was collected from actual blasts to compare with open water blasts, which are unconfined and produce high peak pressures in the water. Pressure data was collected from confined blasts of varying intensities to calculate theoretical mortality radii for aquatic organisms. The blast pressures recorded in the Kill Van Kull were noted to be quite low (3.4 to 20 pounds per square inch (psi)) compared to the theoretical value of an equivalent charge weight, open water shot (71-104 psi) (USACE 2004). The St. Louis District has performed numerous studies on the waterborne energy from blasting, and stated that the blast pressures recorded during the Kill Van Kull study were among the lowest levels of maximum pressure recording that they have taken (USACE 2004). The data inferred that the confined charges used in the Kill Van Kull Blasting Program appear to have less of an impact on aquatic biota than would equivalent open water charges (USACE 2004). The fish kill that did occur was likely very close to the placed charges. The actual limits of the kill radii cannot be determined without caged fish. Stunned and killed fish were recovered by handnet from the surface. A theoretical estimate of the pressure and impact of the “average” blast event monitored during this study would result in a pressure of about 90 psi with a kill radius of about 375 feet (USACE 2004). The data also implies that the confined charges used in the Kill Van Kull Blasting Program appear to have less of an impact on fish than would equivalent open water charges. However, without completion of a caged fish study, quantitative estimates and/or calculations of mortality radii may not be made.

7.3.4 Consequences of Proposed Blasting on Atlantic Sturgeon
During the blasting window (July 1 to February 28), we expect adult and subadult Atlantic sturgeon to be leaving the spawning sites in the Hudson River and heading downstream through the Port Jersey, Anchorage, and Ambrose Channels to head to the offshore foraging and aggregation sites (Dunton *et al.* 2010, Erickson *et al.* 2011, Breece *et al.* 2021). These sites are well downstream and away from the blasting areas in Kill Van Kull and Newark Bay. Therefore, it is reasonable to conclude that any potential blasting impacts in Newark Bay/ Kill Van Kull would not reach areas in which Atlantic sturgeon are known or expected to migrate through the NY/NJ Harbor (*i.e.*, Port Jersey Channels) to their spawning or overwintering grounds.

As mentioned in the *Best Management Practices* section, you propose to use fish and mammal observers with side scan sonar to image fish in the blast area prior to and after the blasting as well as an acoustic fish startle system and scare charges to move fish from the blast area prior to blasting.

Based on the information presented above, the low probability of fish using the action area, combined with these additional protection measures, makes adverse consequences to Atlantic sturgeon from blasting extremely unlikely to occur.

7.4 Vessel Traffic

7.4.1 Background Information on the Risk of Vessels to Sea Turtles
Records from the Sea Turtle Standing and Salvage Network (STSSN) show that both juvenile and adult sea turtles are subject to vessel strikes (NMFS, unpublished data). Sea turtles are vulnerable to vessel collisions because they regularly surface to breathe and often rest at or near the surface. Hazel *et al.* (2007) demonstrated sea turtles preferred to stay within three meters of the water’s surface, despite deeper water being available.

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 turtles are more likely to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel.

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 nine percent of living and dead stranded sea turtles had propeller or other vessel strike injuries (Lutcavage *et al.* 1997). According to the 2001 STSSN stranding data, at least 33 sea turtles (loggerhead, green, Kemp's ridley and leatherbacks) that stranded on beaches within the northeast (Maine through North Carolina) were struck by a vessel. This number underestimates the actual number of vessel strikes that occur since not every vessel 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 vessel. It should be noted, however, that it is not known whether all vessel strikes were the cause of death or whether they occurred post-mortem (NMFS SEFSC 2001).

7.4.2 Background Information on the Risk of Vessels to Atlantic Sturgeon

The factors relevant to determining the risk to Atlantic sturgeon from vessel strikes are currently unknown, but based on what is known for other species we expect they are 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.). Geographic conditions (*e.g.*, narrow channels, restrictions, etc.) may also be relevant risk factors. Large vessels have been typically implicated because of their deep draft relative to smaller vessels, which may increase the probability of vessel collision with demersal fishes like sturgeon, even in deep water (Brown and Murphy 2010). Larger vessels also draw more water through their propellers given their large size and therefore may be more likely to entrain sturgeon in the vicinity. However as documented below, sturgeon are also at risk from exposure to smaller vessels with shallower drafts, thus making vessel traffic analyses difficult. Sturgeon are known to breach the surface and are seen over foraging areas where sturgeon congregate. Atlantic sturgeon that ascend to the surface may be exposed to shallow draft vessels. One of one of the reasons for this behavior may be related to the fish needing to gulp air to fill their gas or swim bladder (Watanabe *et al.* 2008, Logan-Chesney *et al.* 2018). The need to inflate the swim bladder may be more pronounced and surfacing can occur more often at depths of ≤10 meters as the sharpest change in hydrostatic pressure with lateral movement occurs within this depth range. The number of surfacing events decreases substantially when at deeper depths, and the swim bladder may collapse at depths of 40 meters such that a sturgeon is negatively buoyant, remains near the bottom, and will have to swim actively to move off the bottom (Watanabe *et al.* 2008, Logan-Chesney *et al.* 2018). Since buoyancy is related to hydrostatic pressure, at depths of ≤10 meters, the need for regulating air in the swim bladder to control buoyancy may increase during flooding and ebbing tides when the hydrostatic pressure changes rapidly. Logan-Chesney *et al.* (2018) found in their study that about half of the recorded surfacing events occurred during flood tide, from mid- to high-tide, and the maximum number of breach events occurred between 23:00 and 03:00. Sturgeon actively swim when ascending and descending at swim speeds ranging from 0.17 to 3.17 m/s. Thus, the ability to avoid approaching vessels may be limited when ascending.

Atlantic sturgeon interactions with vessels have been documented in the James River (Balazik *et al.* 2012d). The Balazik *et al.* (2012d) study was conducted in the freshwater portion of the James River from 2007-2010 and 31 carcasses of adult Atlantic sturgeon were used in the study.

Twenty-six of the carcasses had scars from propellers and five were too decomposed to determine the cause of death. Nearly all of the carcasses were recovered (84 percent) from a narrow reach of the river near Turkey Island (RM 75) that was modified to enhance shipping efficiency. The width of the waterway in that area ranges from 100 to 400 meters. Balazik *et al.* (2012d) indicated that the vessel interactions were likely caused by deep draft vessels because of the benthic nature of Atlantic sturgeon based on the telemetry study. Balazik and Garman (2018) suggest that a high percentage of reports (unpublished) of dead Atlantic sturgeon may be interacting with vessels in the Thimble Shoals portion of the Chesapeake Bay which is one of the entrance channels into the James River. This area can support deep-draft vessels, and telemetry studies indicate that migrating sturgeon use the channel to enter the river system.

Although smaller vessels have a shallower draft and entrain less water, they often operate at higher speeds, which is expected to limit a sturgeon's opportunity to avoid being struck. There is evidence to suggest that small fast vessels with shallow drafts are a source of vessel strike mortality on Atlantic sturgeon. A tugboat moving at about 11 knots was observed striking and killing an adult Atlantic sturgeon female in the Delaware Bay in 2016 (Ian Park, DENRC, personal communication, June 2017). Additionally, Barber (2017) found correlations between channel morphology and vessel strike risk in the James River. Because risk varies depending on a number of factors, speed from smaller vessels may pose risk at similar levels as deep-draft vessels depending on the physical environment where the fish are found. Given these incidents, we conclude that interactions with vessels are not limited to large, deep draft vessels.

7.4.3 Consequences of Project Vessel Traffic on Sea Turtles and Atlantic Sturgeon

There is the potential for sea turtles and sturgeon to be killed or injured by interacting with transiting vessels associated with the action. We have considered the likelihood that an increase in vessel traffic associated with the project increased the risk of interactions between sea turtles and Atlantic sturgeon and vessels in the project area, when added to the baseline conditions.

While it is your conclusion that there is a net gain of zero vessels added to the action area due to the dredging operations established exclusionary zones implementation as well as the mandatory reduced speed of those vessels (as opposed to non-project-related vessels), to be conservative, we will assume that the proposed Federal action will add as many as six project vessels for each deepening event (see Table 2 for frequency of projects). You estimated that during the deepening activities, the project vessels will make four trips per day during the Ambrose Channel Deepening and the project vessels will make three trips per day for all the other channels. We do not expect all of these vessels to be operating at once, as many of them perform the same purpose, and we understand them to be part of a rotation depending on availability, costs, and ocean conditions. The speed of the dredges, tug boats, tow boats, and project barges are not expected to exceed 2.5 to 3.0 knots while dredging, 10 knots while transiting to the disposal sites, and no more than 11 knots while empty. In addition, the risk of vessel strike will be influenced by the amount of time the animal remains near the surface of the water. For the proposed action, the greatest risk of vessel collision will occur during transit between shore and the areas to be dredged.

Most reported vessel strikes of sturgeon have been associated with relatively confined areas, such as shipping channels, where the bottom of the hull and the propellers are relatively close to the sea bottom. This would not be the case for dredging of the Ambrose Channel, including along the transit route to placement sites. The depths that exist at the channels would not bring the vessel or its propellers into proximity of the bottom since the vessels do not typically sail into areas where maximum water depth is not at least six feet greater than the maximum vessel draft. These are extensive flat areas that would not bottleneck sea turtles and sturgeon and necessarily bring them close to a vessel.

Since sturgeon tend to be demersal and remain on or near the bottom while foraging, that behavior should keep them well below any vessels (in sufficiently deep water) (Fisher 2011, Balazik *et al.* 2012d, Reine *et al.* 2014). However, while migrating, Atlantic sturgeon tend to move into the middle water column, but will still be below many vessel drafts as they move within the water column of the channel during this behavior. Additionally, they can also ascend to the surface to gulp air and may be exposed to shallow draft vessels. This behavior likely accounts for an extremely low proportion of daily activity as a single sturgeon gulps air from zero to 12 times a day and each event is of short duration (seconds) (Logan-Chesney *et al.* 2018). For an ascending sturgeon to interact with one of the project vessels, the two have to be at the exact same spot (within a few feet) at the exact same time (seconds). Therefore, the probability of a project vessel striking an ascending sturgeon is extremely low given the large expanses of the channels and geomorphology of the action area, and the short time that the fish are at the surface where the vessels operate. Additionally, adult and sub-adult Atlantic sturgeon are expected to be only rare transients in the action area.

Although little is known about a sea turtle's reaction to vessel traffic, it is generally assumed that turtles are more likely to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel. An experienced protected species observer who could advise the vessel operator to slow the vessel or maneuver safely if sea turtles were spotted will be on board for all the hopper dredging operations which further reduces the potential risk for interaction with vessels.

As noted, dredging operations and biological monitoring typically adds approximately six vessels to the action area at one time. However, we acknowledge that implementation of established exclusionary zones during dredging operations may reduce the presence of non-dredge vessels within the action area. Thus, while the proposed action will cause an increase in vessel traffic the addition of these project-related vessels will be intermittent, temporary, and restricted to a small portion of the overall action area on any day dredging occurs. Given the large volume of traffic in the project area, the increase in traffic associated with the project vessels is extremely small. As such, any increased risk of a vessel strike caused by the project when added to the baseline will be too small to be meaningfully measured or detected.

7.4.4 Consequences of Vessel Traffic from Containership Operations

Vessels moving over a body of water can injure or kill aquatic species by vessel collision causing blunt trauma, by the propeller striking the animal, or by water drawn through the propeller entraining aquatic organisms. Observations of vessels strikes killing or injuring sturgeon have been reported (*e.g.* Ian Park, personal communication, 2017) and examinations of sturgeon and sea turtle carcasses indicate that vessel strikes caused many of the mortalities (Lutcavage *et al.* 1997, Brown and Murphy 2010, Balazik *et al.* 2012d).

The timing and location of vessel traffic in the action area also may influence the risk of a vessel striking a sturgeon. Sturgeon are migratory species that travel from marine waters to natal rivers to spawn. A significant increase in vessel traffic during the spawning period could potentially increase the risk of vessel strike for migrating adult sturgeon. Similarly, narrow channels or passageways with restricted clearance may increase the probability that sturgeon or sea turtles will be struck and killed by a vessel.

While the Port of NY/NJ is a multi-use port that also receives calls from bulkers, general cargo vessels, passenger vessels, RoRo vessels, and tankers, the purpose of the HDCI study is to improve navigation for the larger containerships. Therefore, the size and number of vessels calls of non-containership vessels is not expected to change as a result of the proposed project and thus, the *Consequences Analysis* will only look at the consequences of containership vessel traffic. While your BA indicates that the proposed HDCI improvements permit larger and cleaner vessels that are already accessing the port facilities to more safely do so, the Economic Analysis for the HDCI study (USACE 2020b) assumes that the channel deepening will lead to the lifting of the 49-foot draft restriction for container vessels to the Port Jersey and Elizabeth channels which will allow the largest vessels to use the deepened channels with an increased load and a maximum draft of 52.5 feet. Both project and shipping vessel activities could result in the vessels colliding with or the propellers striking listed species. Here we review what we know about vessel-species interactions and the factors contributing to such interactions, and analyze the consequences of the proposed increased draft size of containerships as a result of the HDCI study on ESA-listed sea turtles and Atlantic sturgeon.

7.4.4.1 Vessel Activity in the NY/NJ Channels

As described in Section 3.3, the HDCI study is anticipating the use of PPX4 vessels in the future and is expected to be the largest, most frequently calling vessel during the study period (USACE 2020b). The specifications for the vessel class are as follows:

- 1,308.0 feet length overall (LOA)
- 193.5 feet beam
- 52.5 feet design draft
- 18,000 TEU capacity

You have maintained that the HDCI deepening will improve the economic efficiency of ships moving through the NY/NJ ports, resulting in a reduction in total vessel trips. The greater efficiency associated with permitting safe navigation for larger vessels is anticipated to reduce overall vessel calls to the port as a fewer number of larger more efficient vessels will be able to meet the demand of the port. Deeper sailing drafts lead to higher cargo volumes per transit and less required vessel calls (USACE 2020b). Major container terminals included in this study are

Elizabeth Port Authority Marine Terminal (EPAMT), Port Jersey Port Authority Marine Terminal (PJPAMT), and Port Newark (Figure 4). Using the HarborSym Modeling Suite of Tools' (HMST) Container Loading Tool (CLT) algorithm, a vessel call list for the EPAMT (Table 3) and PJPAMT (Table 4) was generated by pairing the Port of NYNJ's commodity forecast for a given year with the expected fleet distribution and loading practices for that year, factoring in changes in vessel operations caused by channel improvements (USACE 2020b). As described in the *Project Description* section, Table 3 and Table 4 show that without the HDCI study (Future Without Project Condition (FWOP); *i.e.*, Environmental Baseline) the vessel calls are projected to increase over time and be much higher in numbers than they would be if the deepening brings the channel depths to -55 or -57 feet MLLW to allow for vessels with larger cargo loads. The expectation is that larger vessels with the capacity to carry and offload larger cargos will mean an overall reduction in vessel traffic as fewer trips will be necessary. Vessels will access the terminal from the federal navigation channel. If vessel size and volume of cargo increases in the future and results in consequences not considered here (*e.g.*, increase in vessel traffic), reinitiation may be necessary.

When moving through the channels to the terminals, vessel maneuvering speeds likely would be in the range of 7-10 knots, depending on the channel (Table 5). The speed of the vessel when turning is primarily a function of maneuverability and will depend on the size of the vessel, turning radius, and angle of approach. Based on these factors, vessel speeds in the turning area are generally not expected to exceed 10 knots for the Anchorage Channel, nine knots for the Ambrose Channel, and seven knots for both the Kill Van Kull and Newark Bay.

Based on the largest draft the vessels are expected to use in the waterway in the future (52.5 feet) and the depth to be dredged in the channels (approximately -55 feet with possible overdredge), vessels maneuvering within the berth would have a minimum of a 2.5 foot (0.7m) clearance from the bottom surface. The actual clearance may be greater, depending on the draft of a particular vessel and the depth of the channel. This is an increase of the current 1 foot clearance for 49' draft that vessels that are using for the current -50 foot channels.

7.4.4.2 Factors Relevant to Vessel Strike

Sea turtles are known to be injured and/or killed as a result of being struck by vessels. 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 percent 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 (NMFS 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.

As noted in the listing rules and status review, vessel strikes have been identified as a threat to 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 of the mortalities resulted from apparent vessel strikes and 71 percent of these (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 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.). Geographic conditions (*e.g.* narrow channels, restrictions, etc.) may also be relevant risk factors.

A moving vessel can cause injury or death to a sturgeon by the hull striking the sturgeon, the propeller striking the sturgeon, or the sturgeon becoming entrained through the propeller. We assume that the chance of injury and death increases with the vessel's speed and mass but we do not know at what speed mortality would occur for different types of vessels or for different sizes of sturgeon.

Entrainment of an organism means that a water current (in this case created by the propeller) carries the organism along at or near the velocity of the current without the organism being able to overcome or escape the current. Thus, as the boat propeller draws water through the propeller, it also consequently entrains the organism in that water. The risk of entrainment is likely to be highest for smaller sturgeon, which have decreased swimming ability and burst escape speed compared to larger individuals, and for larger vessels, which will entrain more water and may entrain that water at a higher velocity.

Propeller engines work by creating a low-pressure area immediately in front of the propeller and a high pressure behind. In the process the propeller moves water at high velocities (can exceed six m/s) through the propeller. Fish that cannot avoid a passing vessel, that are entrained by the propeller current, and who are unable to escape the low-pressure area in front of the propeller will be entrained through the propeller. Thus, whether a fish is able to avoid entrainment depends on its location relative to the force and velocity of the water moved by the propeller and its swimming ability relative to those forces.

Larger propellers draw larger volumes of water, and we therefore expect the likelihood of a propeller entraining a fish to increase with propeller size. Recreational vessels rarely have propellers exceeding 0.5 meter in diameter, towboats and tugs commonly have propellers between two and three meters in diameter, and tankers and bulk carrier vessels with a 40-foot draft may have propellers that are seven to eight meters in diameter. Some of the largest vessels could have propeller diameters of up to 10.3 meters. Commonly, all vessel types may have two propellers. Larger vessels such as tankers and cargo vessels have occasionally three propellers. Thus, we expect large tugboats, cargo vessels, and tankers to have a substantial larger area of influence than recreational or smaller fishing vessels.

Not all fish entrained by a propeller will necessarily be injured or killed. Killgore *et al.* (2011) in a study of fish entrained in the propeller wash (two four-blade propellers that were 2.77 meters in diameter) from a towboat in the Mississippi River found that 2.4 percent of all fish entrained and 30 percent of shovelnose sturgeon entrained showed direct sign of propeller injury (only estimated for specimens ≥12.5 cm TL). The most common injury was a severed body, severed head, and lacerations. This is consistent with injuries reported for sturgeon carcasses in the Delaware River and James River (Brown and Murphy 2010, Balazik *et al.* 2012d).

Killgore *et al.* (2011) found that the probability of propeller-induced injury (*i.e.*, that the propeller would contact an entrained fish) depends on the propellers revolution per minute (RPM) and the length of the fish. Simply put, the faster the propeller revolves around its axis, the less time a fish has available to move through the propeller without having a blade hitting it. Similarly, the longer the fish is, the longer time it would need to move through the propeller, thereby increasing the chance that a propeller blade hits it. The injury probability model developed by Killgore *et al.* (2011) showed a sigmoid (or "S" shaped) relationship between fish length and injury rate at a given RPM. The model estimated probability of injury at about 150 RPM for the towboat in their study increased from 1 percent for a 12.5-cm fish to 5 percent for a 35-cm long fish, and from 50 percent for a 72-cm long fish to 80 percent for a 90-cm long fish. However, Killgore *et al.* (2011) did not find that the number of fish entrained by the propeller was dependent on RPM.

Large vessels have been typically implicated because of their deep draft relative to smaller vessels, which increases the probability of vessel collision with demersal fishes like sturgeon, even in deep water (Brown and Murphy 2010). Larger vessels also draw more water through their propellers given their large size and, therefore, may be more likely to entrain sturgeon in the vicinity. Miranda and Killgore (2013) estimated that the high traffic of large towboats on the Mississippi River, which have an average propeller diameter of 2.5 meters, a draft of up to nine feet, and travel at approximately the same speed as tugboats (less than ten knots), kill a large number of fish by drawing them into the propellers. They indicated that shovelnose sturgeon

(*Scaphirhynchus platorynchus*), a small sturgeon (~50-85 cm in length) with a similar life history to shortnose sturgeon, were being killed at a rate of 0.02 individuals per kilometer traveled by the towboats. As the geomorphology and depth of the Mississippi River reaches and navigation channel where the study was conducted differ substantially from the action area, and as shovelnose sturgeon is a common species in the Mississippi River with densities that are likely not comparable to Atlantic sturgeon populations in the NY/NJ channels, this estimate cannot directly be used for this analysis. We also cannot modify the rate for this analysis because we do not know (a) the difference in traffic on the Mississippi and NY/NJ channels; (b) the difference in density of shovelnose sturgeon and Atlantic sturgeon; and, (c) if there are risk factors that increase or decrease the likelihood of strike in the NY/NJ channels. However, this information does suggest that high vessel traffic can be a major source of sturgeon mortality.

As described above, recreational and smaller commercial vessels (*e.g.*, fishing boats or vessels used for shellfish husbandry) have smaller diameter propellers, entrain smaller volume of water, and have a shallow draft. Consequently, they are extremely unlikely to entrain a subadult or adult sturgeon. The most likely interaction between smaller vessels and sturgeon would be through hull or propeller strike (the moving vessel and propeller hitting the fish). In that case, the sturgeon would have to be in the water column near the surface (because of the shallow draft of smaller vessels) and unable to escape as the vessel approached. Thus, the probability of a vessel striking a sturgeon is likely related to the speed of the vessel. Although smaller vessels have a shallower draft and entrain less water, they often operate at higher speeds, which is expected to limit a sturgeon's opportunity to avoid being struck. There is evidence to suggest that small, fast vessels with shallow draft can strike and kill Atlantic sturgeon when moving at high speeds and/or over shallow areas. Brown and Murphy (2010) included information on a commercial crabber reporting that his outboard engine had hit an Atlantic sturgeon in a shallow area of the Delaware River. On November 5, 2008, in the Kennebec River in Maine, the Maine Department of Marine Resources (MEDMR) staff observed a small (<20 foot) boat transiting through a known shortnose sturgeon overwintering area at high speeds. When MEDMR approached the area after the vessel had passed, they discovered a fresh dead shortnose sturgeon. They collected the fish for necropsy, which later confirmed that the mortality was the result of a propeller wound to the right side of the mouth and gills. In another case, a 35-foot recreational vessel traveling at 33 knots on the Hudson River was reported to have struck and killed a 5.5-foot Atlantic sturgeon (NYSDEC sturgeon mortality database (9-15-14)). However, the dense vessel activity on the NY/NJ channels, the presence of large ships, and local and regional restrictions on speed and wake is expected to limit the high-speed activities by small vessels, especially in shallow areas. Though these above-referenced reported observations show that interactions with vessels are not limited to large, deep draft vessels, we believe small vessels striking sturgeon to be a very small fraction of sturgeon vessel mortalities in the NY/NJ channels. For a shallow draft vessel to interact with a sturgeon, the sturgeon has to be near the surface at the same time as the vessel. While sturgeon do move through the water column and Atlantic sturgeon are known to jump out of the water, sturgeon are found foraging at the bottom or swimming within the water column outside the reach of shallow draft propellers for much of the time. It is therefore a low probability for a shallow draft recreational vessel to encounter a sturgeon (*i.e.*, that a vessel at high speed is at the same location and the exact same time when the sturgeon is present near the surface). The risk of interactions will increase with a very high density of small vessels or if a vessel transverses a location with a very high density of sturgeon, which does not occur in the action area). However, the combination of small propellers (*i.e.*, small area of influence) and shallow drafts of small vessels, and the expected limited high-speed activity in areas with high vessel density makes a very low probability for a recreational vessel interacting with a sturgeon. Empirical evidence support this conclusion (Brown and Murphy 2010, Balazik *et al.* 2012d).

Other factors also affect the probability of vessel strikes. Narrow channels can concentrate both sturgeon and vessels into a smaller area and thus increase the risk of vessel strike. Balazik *et al.* (2012d) noted that there is an inverse relationship between channel width and vessel mortalities in the James River. Sturgeon are likely to be higher in the water column and use navigation channels during periods of movement such as spawning migrations or seasonal movements between summer and overwintering areas (Hondorp *et al.* 2017). For example, a higher number of adult Atlantic sturgeon vessel mortalities occur in the Delaware River during spring months (NMFS 2017b). Besides being related to the immigration of adults and subadults during these months, it has also been suggested that the sturgeon behavior during migration increases their exposure to vessels (Brown and Murphy 2010, Fisher 2011).

The co-occurrence of vessels and ESA-listed species also affects interaction rates. Areas with high concentrations of vessel traffic and high concentrations of sea turtles or sturgeon are expected to have a higher probability and frequency of vessel strikes than areas where vessels and/or sea turtles/sturgeon are less abundant. Sea state and visibility will also influence the likelihood of an interaction between a vessel and a sea turtle. Typically, most vessel operators keep watch for potential obstructions or debris. The calmer the sea state and the greater the visibility, the easier it is to see floating objects, including sea turtles. When the sea state increases, observing floating objects gets increasingly difficult. When traveling east or west during a rising or setting sun, forward visibility can be limited and inhibit an operator from avoiding obstructions

Cargo and tanker vessels could have deep drafts that reach within less than three meters of the bottom of the Navigation Channel. The large propellers, possibly up to 10.3 meters in diameter, would draw water that exceeds the diameter of the propeller. As a ship moves forward, the water flows around the hull, flows into the “hole” that is left as the vessel move forward, and is drawn through the propeller. Often these ships have multiple propellers. Further, while sturgeon are benthic feeders, they also use the whole water column during non-foraging movements and migrations and have even been seen jumping out of the water. Therefore, we consider all sturgeon in the path of a cargo or tanker vessel (the width of the path being equal to the width of the ship) to be located in the water column where the moving vessel will expose them to the water drawn through its propellers.

There are no studies of how sturgeon respond to approaching large vessels with deep draft. In a study of Delaware River sturgeon distribution by using a camera on a sledge, individual sturgeon did not react to the approaching sled until it was nearly upon it indicating that approaching vessels may not elicit a flight response. However, we do not know if sturgeon would be similarly docile to the sound and size of approaching large vessels. Nevertheless, a large number of carcasses found in the Delaware River as well as in James River, Virginia, indicate interactions with the propellers of large vessels (Brown and Murphy 2010, Balazik *et al.* 2012d). These observations include adult sturgeon, showing that even large sturgeon are unable to escape entrainment.

7.4.4.3 Vessel Interactions

Throughout the consultation process on the HDCI study, you have maintained that the 55-foot project was formulated, evaluated, and authorized by Congress based on the parameter that no tonnage will be induced or attracted to the port's facilities as a direct result of the proposed deepening of the channel depth for the five-foot increment from -50 to -55 feet MLLW. Any future increase in the amount of tonnage through the port over the project life will be an equivalent amount for either the 50 or 55-foot channel depth conditions, and would be predicated on the performance of the U.S. economy. The 55-foot channel depth will improve the economic efficiency of ships moving through the NY/NJ channel ports, resulting in a reduction in total vessel trips. No induced tonnage (*i.e.*, commodity shifts from other ports) will take place with the proposed project deepening. The PPX4 class vessels will carry the same tonnage from the origin ports but will be able to operate more efficiently in the NY/NJ channels with a deepened channel from reduced lightering. In addition, a deeper channel depth will allow a segment of the current container and dry bulk vessels to carry more cargo as well as allow a fleet shift to more efficient sized vessels. These factors will more efficiently apportion operating costs for the same amount of total tonnage and further reduce total vessel trips through the port (USACE 2020b, 2021).

While the *Environmental Baseline* section shows that there has been evidence of vessel strikes for both sea turtles and Atlantic sturgeon in the action area (STSSN and NMFS Sturgeon Salvage Program, unpublished data), the HDCI study will improve the baseline vessel traffic conditions and decrease the risk of an interaction with an ESA-listed species. As mentioned previously, the HDCI study will reduce the total number of vessel trips through the port. In addition, the greater depth of the channel may also decrease the probability of Atlantic sturgeon interactions by providing slightly more clearance between the hull and channel bottom for sturgeon opportunistically foraging. Finally, all vessels using the channel are expected to be slow moving while in the channels (*i.e.*, traveling no more than 10 knots (Table 5)) that will further minimize chances of interactions.

The channels where the vessel traffic will occur are not known aggregation areas for Atlantic sturgeon or sea turtles. The Kill van Kull and Newark Bay are not expected to have sea turtles present and they are located outside of the migration path to the spawning grounds for Atlantic sturgeon. While the narrow section of the Anchorage Channel (known as the Narrows) is approximately 1,600 m wide at the Verrazzano-Narrows Bridge, it is considerably wider than other channels where vessel strikes are common (*e.g.*, the 100-400m narrow reach in the James River (Balazik *et al.* 2012d). Therefore, there is more room in the waterway for sturgeon and sea turtles to avoid the risk of a vessel strike.

Atlantic sturgeon and sea turtles that are expected to be present in the waterways will be transient. While there are studies showing that sturgeon concentrate in the channels in the rivers during spawning migrations (Balazik *et al.* 2021), the areas to be deepened are not a known hotspot for sturgeon and sturgeon have the ability to swim in and out of the channels as they migrate.

Based on this information, any associated increase in risk of a vessel strike would be too small to be meaningfully measured or detected.

7.5 Sedimentation and Turbidity

7.5.1 Hopper Dredge

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column, as distance increases from the dredge operations. The nature, degree, and extent of sediment suspension around a dredging operation are controlled by many factors including: the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, discharge/cutter configuration, discharge rate, and solids concentration of the slurry; operational procedures used; and the characteristics of the hydraulic regime in the vicinity of the operation, including water composition, temperature and hydrodynamic forces (*i.e.*, waves, currents, etc.) causing vertical and horizontal mixing (USACE 1983).

Resuspension of fine-grained dredged material during hopper dredging operations is caused by the dragheads as they are pulled through the sediment, turbulence generated by the vessel and its prop wash, and overflow of turbid water during hopper filling operations. During the filling operation, dredged material slurry is often pumped into the hoppers after they have been filled with slurry in order to maximize the amount of solid material in the hopper. The lower density turbid water at the surface of the filled hoppers overflows and is usually discharged through ports located near the waterline of the dredge. Use of this "overflow" technique results in a larger sediment plume than if no overflow is used. In 1998, a study was done of overflow and nonoverflow hopper dredging using the McFarland hopper dredge (USACE 2013). Monitoring of the sediment plumes was accomplished using a boat-mounted 1,200-kHz Broad-Band Acoustic Doppler Current Profiler (ADCP). The instrument collects velocity vectors in the water column together with backscatter levels to determine the position and relative intensity of the sediment plume. Along with the ADCP, a MicroLite recording instrument with an Optical Backscatterance (OBS) Sensor was towed by the vessel at a depth of 15 feet. The MicroLite recorded data at 0.5-sec intervals. Navigation data for monitoring were obtained by a Starlink differential Global Positioning System (GPS). The GPS monitors the boat position from the starting and ending points along each transect.

Transects were monitored in the test area to obtain the background levels of suspended materials prior to dredging activities. A period of eight minutes following the dredge passing during non-overflow dredging showed the level of suspended material to be returning to background levels. No lateral dispersion of the plume out of the channel was observed during the non-overflow dredging operation. During overflow dredging, a wider transect was performed to determine the lateral extent of the plume. At one-hour elapsed time following the end of the overflow dredging operation, the levels of suspended material returned to background conditions. Again, no lateral dispersion of the plume out of the Delaware River was observed. Overflow dredging is not proposed during dredging operations.

Near-bottom plumes caused by hopper dredges may extend approximately 2,300 to 2,400 feet (701-731 meters) downcurrent from the dredge (USACE 1983). TSS concentrations may be as high as several hundred mg/L near the discharge port and as high as several tens of mg/L near the draghead. In a literature review conducted by Anchor Environmental (2003), near-field concentrations ranged from 80.0-475.0 mg/L. TSS and turbidity levels in the near-surface plume usually decrease exponentially with increasing time and distance from the active dredge due to settling and dispersion, quickly reaching ambient concentrations and turbidities. In almost all cases, the majority of re-suspended sediments resettle close to the dredge within one hour, although very fine particles may settle during slack tides only to be re-suspended by ensuing peak ebb or flood currents (Anchor Environmental 2003).

7.5.2 Cutterhead Dredge

Cutterhead dredges use suction to entrain sediment for pumping through a pipeline to a designated discharge site. Production rates vary greatly based on pump capacities and the type (size and rotational speed) of cutter used, as well as distance between the cutterhead and the substrate. Sediments are re-suspended during lateral swinging of the cutterhead as the dredge progresses forward. Modeling results of cutterhead dredging indicated that TSS concentrations above background levels would be present throughout the bottom six feet (1.8 meters) of the water column for a distance of approximately 1,000 feet (305 meters) (USACE 1983). Elevated suspended sediment levels are expected to be present within a 984.3 to 1,640.4 foot (300-500 meters) radius of the cutterhead dredge (USACE 1983, LaSalle 1990, Hayes *et al.* 2000, Wilber and Clarke 2001). TSS concentrations associated with cutterhead dredge sediment plumes typically range from 11.5 to 282.0 mg/L with the highest levels (550.0 mg/L) detected adjacent to the cutterhead dredge and concentrations decreasing with greater distance from the dredge (Nightingale and Simenstad 2001, USACE 2015b).

7.5.3 Mechanical Dredging

Mechanical dredges include many different bucket designs (*e.g.*, clamshell, closed versus open bucket, level-cut bucket) and backhoe dredges, representing a wide range of bucket sizes. TSS concentrations associated with mechanical clamshell bucket dredging operations have been shown to range from 105 mg/L in the middle of the water column to 445 mg/L near the bottom (210 mg/L, depth-averaged) (USACE 2001). Furthermore, a study by Burton (1993) measured TSS concentrations at distances of 500, 1,000, 2,000, and 3,300 feet (152, 305, 610, and 1006 meters) from dredge sites in the Delaware River and were able to detect concentrations between 15 mg/L and 191 mg/L up to 2,000 feet (610 meters) from the dredge site. In support of the New York/New Jersey Harbor Deepening Project, the U.S. Army Corps of Engineers conducted extensive monitoring of mechanical dredge plumes (USACE 2015a). The dredge sites included Arthur Kill, Kill Van Kull, Newark Bay, and Upper New York Bay. Although briefly addressed in the report, the consequences of currents and tides on the dispersal of suspended sediment were not thoroughly examined or documented. Independent of bucket type or size, plumes dissipated to background levels within 600 feet (183 meters) of the source in the upper water column and 2,400 feet (732 meters) in the lower water column. Based on these studies, elevated suspended sediment concentrations at several hundreds of mg/L above background may be present in the immediate vicinity of the bucket, but would settle rapidly within a 2,400- foot (732 meter) radius of the dredge location.

7.5.4 Consequences of Turbidity and Suspended Sediments on Sea Turtles and Sturgeon

No information is available on the consequences of TSS on juvenile and adult sea turtles. TSS is most likely to affect sea turtles if a plume causes a barrier to normal behaviors or if sediment settles on the bottom affecting sea turtle prey. Sea turtles may be exposed to consequences of TSS or other water quality factors through the uptake of water when they feed. Even if sea turtles ingested the transient plumes, it would be brief and low in frequency. In all cases where sea turtles would be exposed to increased TSS resulting from proposed activities in this Opinion (mainly the Atlantic Ocean), the area is sufficiently wide for the highly mobile sea turtles to avoid any sediment plume with minor movements. The movements will be so small that it will not require use of energy beyond what they would use without the avoidance. They are also not nesting, therefore, the plume will not hinder access to nesting beaches and will, therefore, not result in major movements to find new beaches. As sea turtles breathe air and are highly mobile, they are likely to be able to avoid any sediment plume and any consequences on their movements will be insignificant. While the increase in suspended sediments may cause sea turtles to alter their normal movements, any change in behavior will only involve minor movements to alter their course away from the sediment plume which will not disrupt any essential life behaviors. Based on this information, we believe the consequences of suspended sediment on sea turtles resulting from increased turbidity are too small to be meaningfully measured or detected.

Studies of the consequences of turbid water on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The TSS levels expected for all of the proposed activities (ranging from 11.5 mg/L to 550.0 mg/L) are below those shown to have adverse consequences on fish (typically up to 1,000 mg/L) (Burton 1993). We expect sturgeon to either swim through the plumes associated with the project, or make small evasive movements to avoid them. Based on the best available information as presented above, we will not be able to meaningfully detect, evaluate, or measure the consequences of re-suspended sediment on sturgeon when added to baseline conditions.

7.6 Habitat Modification

7.6.1 Consequences on Sea Turtle Foraging

Sea grass beds do not occur in the areas to be dredged; therefore, dredging activities are not likely to disrupt normal feeding behaviors for adult green sea turtles. Leatherback sea turtles forage primarily on jellyfish. Since jellyfish are in the water column and relatively mobile, they will not be affected from project activities.

Of the listed species found in the action area, loggerhead, Kemp's ridley, and juvenile green sea turtles are the most likely to utilize the channel areas for feeding with the sea turtles foraging mainly on benthic species, namely crabs and mollusks (Bjorndal 1997, Morreale and Standora 1998). As noted above, suitable sea turtle items may occur in the channel. However, at least some areas of soft substrate in the channels experience daily disturbance (sedimentation from propellers/prop wash); we expect that this will have some impact on the ability of these areas to support an abundant and diverse community of benthic invertebrates. This may mean that sea turtles are more likely to forage in areas outside the channel area; however, we do not have fine scale information on sea turtle forage items or sea turtle distribution that we could use to make a conclusive determination about foraging in the channels versus outside the channels. Vessel disturbance of the substrate and benthos is more likely to disturb or displace non-mobile organisms that occur at the surface of the sediment and is less likely to impact mobile prey (such as crabs) or benthic invertebrates that bury deep into the substrate (such as worms).

Dredging can affect sea turtles by reducing prey species through the alteration of the existing biotic assemblages; this occurs through the entrainment of prey items. Some of the prey species targeted by turtles, including crabs, are mobile; therefore, some individuals are likely to avoid the dredge. However, there is likely to be some entrainment of mobile sea turtle prey items as well as benthic invertebrates that do not have sufficient (or any) mobility to avoid the dredge. Wilber and Clarke (2007) reviewed studies on recovery of invertebrate fauna from open water dredging and found that recolonization in the majority of studies occurred within a year in temperate and cold climatic areas.

In the dredging areas where sea turtles are expected to be present (Port Jersey, Anchorage, and Ambrose Channels), you propose to dredge 13,192,000 CY of sand/silt. The area to be affected is small compared to the available foraging habitat within the action area. While there is likely to be some reduction in the amount of prey, these losses are limited in space and time. That is, these reductions will only be experienced in the areas being dredged and will only last as long as it takes benthic resources to return to the area. We do not expect that these reductions in forage will have impacts on the fitness of any sea turtles. In addition, the dredging activities are not likely to alter the habitat in any way that prevents sea turtles from using the action area as a migratory pathway to other near-by areas that may be more suitable for foraging. Given the small portion of the total habitat available for foraging sea turtles, and the temporary nature of these impacts, any consequences on foraging from periodic dredging of the channels are too small to be meaningfully measured or detected.

7.6.2 Consequences on Sturgeon Foraging

7.6.2.1 Dredging

Atlantic sturgeon feed on a variety of benthic invertebrates. Shellfish typically make up a very small percentage of the prey base of Atlantic sturgeon; Atlantic sturgeon prey primarily on soft bodied invertebrates such as worms (Guilbard *et al.* 2007, Savoy 2007). The proposed dredging will occur in the navigation channels. As explained above in discussing consequences to sea turtle foraging, we expect the daily disturbance in the navigation channel (*e.g.*, sedimentation from propellers/prop wash) to have some impact on the ability of these areas to support an abundant and diverse community of benthic invertebrates. However, we expect that this disturbance is more likely to disturb or displace non-mobile organisms that occur at the surface of the sediment and is less likely to impact mobile invertebrates (such as crabs) or benthic invertebrates that bury deep into the substrate (such as worms). Dredging is likely to entrain and kill at least some of these potential sturgeon forage items. Turbidity and suspended sediments from dredging activities may affect benthic resources in those areas. Some of the TSS levels expected for the proposed activities (ranging from 445 mg/L to 550 mg/L) exceed the levels shown to have adverse consequences on benthic communities (390 mg/L (EPA 1986).

As noted above, dredging sites consists of sand/silt and bedrock (in areas where blasting and mechanical dredging will occur). Though we do not know the faunal composition of the site, we would expect aquatic worms and other benthic fauna that provide forage for Atlantic sturgeon to occur in the substrate. We also expect free moving invertebrates to be present. Burrowing Polychaeta worms, amphipods, and mollusks can migrate vertically through sediment 15 to 32 cm deep (Maurer *et al.* 1982, Robinson *et al.* 2005). Benthic fauna that survived the dredging process can also contribute to quick recovery of the depositional sediment. Recovery of dredged disposal sites usually occur within a year in temperate waters (Wilber and Clarke 2007).

Atlantic sturgeon may forage in the full extent of the action area, primarily over soft substrates. There is likely to be some reduction in the amount of sturgeon prey in the dredged areas. However, the area to be affected is an extremely small portion of soft substrate within the action area that provides habitat for invertebrates and forage for Atlantic sturgeon. While some of the TSS levels expected for the proposed activities (up to 550 mg/L) may exceed the levels shown to have adverse consequences on benthic communities (390 mg/L), the period of dredging and benthic grab sampling is short and within a small portion of the action area so it is not expected to take away a significant portion of habitat for these species. In addition, the dredging activities are not likely to alter the habitat in any way that prevents sturgeon from using the action area as a migratory pathway to other near-by areas that may be more suitable for foraging. Given the limited area where benthic resources will be removed or displaced, consequences on sturgeon from reductions in benthic resources in a limited area during limited periods, will be too small to be meaningfully measured or detected.

7.6.2.2 Blasting

After the blasting occurs, the substrate in the Kill Van Kull/Newark Bay area will still continue to be bedrock with traces of silt. The foraging habits of Atlantic sturgeon in the Kill Van Kull/Newark Bay area are unknown, but it is presumed that some foraging occurs in this area. However, Atlantic sturgeon feed over soft substrate with benthic worms being a major portion of their prey. Few benthic invertebrates are present in the rocky area where blasting will occur. However, any prey species that are present on the rock that will be removed by blasting or in the immediate project area would be destroyed. The impact should not extend beyond the immediate blasting area as previous studies indicate that invertebrates are relatively insensitive to pressure related damage from underwater detonations (USACE 2016). This could be attributable to the fact that all the invertebrate species tested lack gas-containing organs, which have been implicated in internal damage and mortality in vertebrates (Keevin and Hempen 1997). Nevertheless, the area immediately surrounding the blast zone would be void of preferred sturgeon prey and thus, sturgeon would not be likely to forage in this area.

It is important to note, however, that while blasting will destroy all of the prey resources in the immediate area, the impacts will not be permanent and as discussed above for dredging, the benthic community will likely reestablish. The area where blasting will occur is very small relative to forage grounds in the action area (see discussion above regarding dredging consequences to sturgeon foraging). Based on this information, blasting consequences on sturgeon foraging will be too small to be meaningfully measured or detected.

8.0 CUMULATIVE EFFECTS

"Cumulative effects" are those consequences 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 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 consequences 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 the 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 consequences of these activities over the life of the proposed action will have different consequences 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 consequences 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, vessel strikes and approaches, and underwater noise are likely to continue to increase in the future, although any increase in consequences 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 consequences remain unknown. The best scientific and commercial data available provide little specific information on any long-term consequences of these potential sources of disturbance on ESA-listed species populations. Thus, this consultation assumes consequences 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 CONSEQUENCES

In the Consequences Analysis outlined above, we considered potential consequences from the initial deepening of the Ambrose Channel, Anchorage Channel, Port Jersey Channel, Kill Van Kull, Newark Bay Channel, South Elizabeth Channel, and Port Elizabeth Channel by five feet during the years 2025 to 2039. These consequences include interactions with gear types such as dredges and blasting. In addition to these consequences, we considered the potential for interactions between ESA-listed species and project/commercial vessels, impacts to their habitats and prey, and noise consequences on these species from active acoustic sources used in the study.

We have estimated that the HDCI study will result in dredging entrapment of up to six sea turtles (all NWA DPS loggerhead with the possibility of one of them being a Kemp's Ridley sea turtle) and up to three Atlantic sturgeon over the 15-year period. These interactions are expected to result in serious injury or mortality. As explained in the *Consequences of the Actions* section, all other consequences to sea turtles and Atlantic sturgeon from the HDCI study, including consequences to their prey and habitat, and from project/commercial vessels, and blasting, will be insignificant and/or discountable.

In the discussion below, we consider whether the consequences of the proposed action 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 action. The purpose of this analysis is to determine whether the proposed action, 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 action will result in reductions in reproduction, numbers, or distribution of these species and then consider whether any reductions in reproduction, numbers, or distribution resulting from the proposed action 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 percent 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 percent 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 percent (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 percent 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 (NMFS and U.S. FWS 2008, Conant *et al.* 2009). In the 2009-2013 trend analysis by Ceriani and Meylan (2017), a 1 percent 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 percent (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 percent 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 (NMFS 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 and SEFSC 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 and SEFSC 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 percent of the juveniles and sub-adults utilizing this foraging habitat originated from the south Florida nesting stock, 12 percent from the northern nesting stock, 6 percent from the Yucatán nesting stock, and 2 percent 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 percent of the loggerheads sampled) respectively), northern (10 percent, respectively), and Mexico (20 percent) (Wiltzell *et al.* 2002). Similarly, analysis of stranded turtles from Virginia to Florida indicated that the turtles originated from three nesting areas: south Florida (59 percent), northern (25 percent), and Mexico (20 percent) (Rankin-Baransky *et al.* 2001). The previously defined loggerhead subpopulations do not share the exact delineations of the recovery units identified in the 2008 recovery plan. However, the PFRU encompasses both the south Florida and Florida panhandle subpopulations, the NRU is roughly equivalent to the northern nesting group, the Dry Tortugas subpopulation is equivalent to the DTRU, and the Yucatan subpopulation is included in the GCRU.

Based on the genetic analysis presented in Bass *et al.* (2004) and the small number of loggerheads from the DTRU or the NGMRU likely to occur in the action area it is extremely unlikely that the loggerheads likely to be killed during the dredging project will originate from either of these recovery units. The majority, at least 80 percent of the loggerheads killed, are likely to have originated from the PFRU, with the remainder from the NRU and GCRU. As such, of the six loggerheads likely to be killed, five are expected to be from the PFRU, with the possibility that one of the six instead coming from either the NRU or the the GCRU. Below, we consider the consequences of these mortalities on these three recovery units and the species as a whole.

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 six loggerheads are likely to be incidentally taken by the proposed actions over a 15-year period and that all six of those turtles may be seriously injured or killed. All other consequences to loggerhead sea turtles, including consequences to prey and habitat as well as consequences from vessel operations are expected to be insignificant and discountable.

The lethal removal of six loggerhead sea turtles from the Northwest Atlantic DPS over a 15-year period will reduce the number of loggerhead sea turtles compared to the number that would have been present in the absence of the proposed action (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 action 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 action would appreciably reduce the likelihood of survival for loggerheads depends on what consequence 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 consequences 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 percent) to moderate (10-20 percent) 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 consequences of those efforts, notable fisheries bycatch persists. The question we are left with for this analysis is whether the consequences of the proposed action appreciably reduces 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 consequences of the Deepwater Horizon oil release event and climate change on the population status and trends of loggerheads, there are a number of consequences 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 the HDCI study 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 conservative 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 consequences 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 action, 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 consequences of the proposed action will most directly affect the overall size of the population, the lethal take over a 15-year period represents a very small fraction, approximately 0.02 percent (=6/38,334*100) of the overall female population estimated by Richards *et al.* (2011) and a very small fraction (approximately 0.002 percent) 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 juveniles, 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 does not extend into waters off the continental shelf and only the juvenile life stage of loggerheads may be captured by the proposed action. 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 action is 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 percent per year was used for the PFRU, the least vulnerable recovery unit. A higher rate of increase of 3 percent per year was used for the NGMRU and DTRU, the most vulnerable recovery units. A rate of increase of 2 percent 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 percent) 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 action. 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 action are adult females, the HDCI study would remove between 0.01 and 0.02 percent of the nesting females from the DPS each year (3-6 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 0.002 percent 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 six loggerheads from the Northwest Atlantic in a 15-year period 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 the other sea turtle 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). 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, consequences 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 action on Kemp's ridley sea turtles. Out of the six sea turtles that expect to be entrained from the hopper dredge, there is the possibility that one may be a Kemp's ridely sea turtle. We expect the capture of up to one Kemp's ridley during the proposed action over the next 15 years, with that one turtle potentially experiencing post-interaction mortality. The proposed action 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 and Bevan (2019), the loss of one animal in a 15-year period represents a small fraction (0.004 percent) of the overall population. The proposed action could also result in a potential reduction in future reproduction, assuming this individual 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, a lethal interaction is expected to occur anywhere in the action area. 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 the proposed action. Whether the reductions in numbers and reproduction of Kemp's ridley sea turtles would appreciably reduce their likelihood of survival depends on the probable consequences the change 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 consequences 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 went into effect on December 20, 2019 (84 FR 70048), will further reduce impacts to Kemp's ridley sea turtles.

Overall, the consequences from the proposed action 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 one Kemp's ridley during a 15-year period 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 action 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 one Kemp's ridley sea turtle during a 15-year period is not likely to have any detectable consequence on nesting trends, we do not expect the proposed action to impede progress toward achieving this recovery objective. The loss of one Kemp's Ridley sea turtle would not affect the adult female nesting population or number of nests per nesting season. Thus, we assert that the proposed action will not result in an appreciable reduction in the likelihood of Kemp's ridley sea turtle recovery in the wild.

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 is also 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 consequences 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 Protected Resources Division (PRD) should help in the recovery of the species as well.

Based on the information provided above, the loss of up to one Kemp's ridley sea turtle during a 15-year period as a result of the HDCI study 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 Turtle

As noted in sections above, the physical disturbance of sediments and entrainment of associated benthic resources could reduce the availability of sea turtle prey in the affected areas, but these reductions will be localized and temporary, and foraging turtles are not likely to be limited by the reductions and any consequences will be insignificant. Also, as explained above, no green sea turtles are likely to be entrained in any dredge and this species is not likely to be involved in any collision with a project/commercial vessel. As all possible consequences to green sea turtles from the proposed project are likely to be insignificant or discountable, this action is not likely to adversely affect this species.

9.4 Leatherback Sea Turtles

As noted in sections above, the physical disturbance of sediments and entrainment of associated benthic resources could reduce the availability of sea turtle prey in the affected areas, but these reductions will be localized and temporary, and foraging turtles are not likely to be limited by the reductions and any consequences will be insignificant. Also, as explained above, no leatherback sea turtles are likely to be entrained in any dredge and this species is not likely to be involved in any collision with a project/commercial vessel. As all possible consequences to leatherback sea turtles from the proposed project are likely to be insignificant or discountable, this action is not likely to adversely affect this species.

9.5 Atlantic sturgeon

As explained above, the proposed action is likely to result in the incidental take of up to three Atlantic sturgeon from the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and/or South Atlantic DPSs from 2025 through 2039 during the hopper dredging in the NY/NJ channels. We expect that the Atlantic sturgeon killed could be subadults. No captures of eggs, larvae (yolk sac or post-yolk sac), young of the year, or juveniles are anticipated, because these life stages do not occur in the action area. All other consequences to Atlantic sturgeon, including consequences to habitat and prey due the deepening, blasting, and vessel traffic will be insignificant or discountable.

9.5.1 Determination of DPS Composition

Using mixed stock analysis explained above, we have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 87%; CB 8%; SA 3%; and GOM and Carolina (combined) 2% (O'Leary *et al.* 2014). As a result of the proposed action and given these percentages, the three Atlantic sturgeon expected to be killed by hopper dredge will most likely be of NYB DPS origin (NYB DPS ratio is 2.61) but it is possible that one could be from any other DPS. Therefore, we expect that Atlantic sturgeon take by hopper dredge could be three NYB DPS or a combination of two NYB DPS and one from any of the GOM, CB, Carolina, or SA DPS.

Given the above, we estimate the following lethal take from each Atlantic sturgeon DPS (Table 25).

Table 25. Estimated lethal take for Atlantic sturgeon from the HDCI study.

DPS	Total Take***
GOM/Carolina	1*
NYB	3**
CB	1*
SA	1*

* One of three sturgeon taken in the dredge could be of any other DPS than the NYB DPS.
** All three sturgeon taken in the dredge could be of NYB DPS origin.
*** The total take will not exceed three Atlantic sturgeon. The total column reflects the fact that the third lethal take from dredging may come from any other DPS than the NYB DPS and should be read as reflecting the uncertainty in the attribution of the take to a DPS, not as an expectation that takes will occur in all non-NYB DPSs. We anticipate only a single dredge take that could occur in any non NYB DPS.

9.5.2 Gulf of Maine and Carolina 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. There is currently no census of the number of Atlantic sturgeon in any river nor is any currently available for the entire DPS. NMFS use of the NEAMAP data indicates that the estimated ocean population of GOM DPS Atlantic sturgeon subadults and adults is 7,455 individuals. Gulf of Maine origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. While there are some indications that the status of the GOM DPS may be improving, 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 assessment also concluded that there was a 51 percent probability that the abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium. The ASMFC also concluded that there is a relatively high likelihood (74 percent probability) that mortality for the Gulf of Maine DPS exceeds the mortality threshold used for the assessment (ASMFC 2017).

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 percent 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 percent) that abundance of the Carolina DPS has increased since the implementation of the 1998 fishing moratorium, and a 75 percent probability that mortality for the Carolina DPS exceeds the mortality threshold used for the assessment (ASMFC 2017).

We have estimated that dredging activities could kill one subadult Atlantic sturgeon of either GOM or Carolina DPS origin. While it is possible that entrained/captured fish could survive, we assume here that this fish will be killed.

Here, we consider the consequences of the loss of up to one Atlantic sturgeon over a 15-year period from the GOM or Carolina DPS. The reproductive potential of the GOM or Carolina DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of up to one individual over a 15-year period, would have the consequences of reducing the amount of potential reproduction as any dead GOM or 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 consequence 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 consequence to future year classes is anticipated to be extremely small and would not change the status of either of these species. The proposed action will also not affect the spawning grounds within the rivers where GOM and Carolina DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by GOM and Carolina DPS fish.

Because we do not have a population estimate for the GOM and Carolina DPSs, it is difficult to evaluate the consequences of the mortality caused by this action on these species. However, because the proposed action will result in the loss of no more than one individual over a 15-year period, or an average of 0.07 mortalities each year, it is unlikely that this death will have detectable consequences on the numbers and population trend of the GOM and Carolina DPSs.

The proposed action is not likely to reduce distribution because the action will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by GOM or Carolina DPS subadults or adults. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of the area where the deepening and its impacts are occurring.

Based on the information provided above, the death of up to one GOM or Carolina DPS Atlantic sturgeon over a 15-year period, will not appreciably reduce the likelihood of survival of the GOM or 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 action will not affect GOM or 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 it will not result in consequences to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproducing, sustenance, and shelter. This is the case because: (1) the death of one GOM or Carolina DPS Atlantic sturgeon in any year will not change the status or trends of the species as a whole; (2) the loss of this GOM or Carolina DPS Atlantic sturgeon is not likely to have consequences on the levels of genetic heterogeneity in the population; (3) the action will have only a minor and temporary consequence on the distribution of GOM or Carolina DPSs of Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (4) the action will have no consequence on the ability of GOM or Carolina DPS Atlantic sturgeon to shelter and only an insignificant consequence on any foraging GOM or 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 action will not appreciably reduce the likelihood that the GOM and Carolina DPSs 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. Thus, we have considered whether the proposed action will affect the likelihood that the GOM and Carolina DPSs can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the GOM or Carolina DPSs 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 increasing population 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 action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

We do not expect the proposed action to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of GOM or Carolina DPS Atlantic sturgeon and since it will not affect the overall distribution of GOM or Carolina DPS Atlantic sturgeon. Any consequences to habitat will be insignificant 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 action will result in an extremely small amount of mortality over 15 years (one individual) and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the action to affect the persistence of the GOM or Carolina DPS of Atlantic sturgeon. The action will not change the status or trend of the GOM or Carolina DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the GOM and Carolina DPS of Atlantic sturgeon. The consequences of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The consequences of the proposed action 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 action will not appreciably reduce the likelihood that the GOM and Carolina DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened and endangered respectively. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of these species.

Despite the threats faced by individual GOM and Carolina DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to consequences related to the proposed action. We have considered the consequences of the proposed action 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 action, resulting in the mortality of up to one GOM or Carolina DPS Atlantic sturgeon over a 15-year period, is not likely to appreciably reduce the survival and recovery of these species.

9.5.3 New York Bight DPS

The NYB DPS is listed as endangered, and 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 also present in the in the Connecticut and Housatonic Rivers (82 FR 39160; August 17, 2017). However, there is no current evidence that spawning is occurring nor studies underway to investigate whether spawning is occurring in those rivers, aside from one recent study which found young SA DPS fish in the Connecticut River, which was unexpected to the researchers

(Savoy *et al.* 2017). Based on existing data, we expect any NYB DPS Atlantic sturgeon in the action area to originate from the Hudson or Delaware River.

There are no abundance estimates for the entire NYB DPS or for the entirety of either the Hudson River or Delaware River spawning populations. There are, however, some estimates for specific life stages (*e.g.*, natal juvenile abundance, spawning run abundance, and effective population size). Using side scan sonar technology in conjunction with detections of previously tagged Atlantic sturgeon, Kazyak *et al.* (2020, 2021) estimated the 2014 Hudson River spawning run size to be 466 sturgeon (95 percent CRI = 310-745). 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 percent CI=171.7-230.7; (O'Leary *et al.* 2014)) and 156 (95 percent 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 percent CI=74.7-186.1) (O'Leary *et al.* 2014) and 40 (95 percent 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.

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 percent) that the NYB DPS abundance has increased since the implementation of the 1998 fishing moratorium, and a 31 percent probability that mortality for the NYB DPS exceeds the mortality threshold used for the assessment (ASMFC 2017).

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 anticipate the mortality of up to three subadult NYB DPS Atlantic sturgeon as a result of the hopper dredging during a 15-year period. While it is possible that entrained fish in the hopper dredge could survive, we assume here that these fish will be killed.

Here, we consider the consequences of the loss of up to three Atlantic sturgeon over a 15-year period 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 up to three female sturgeon over over a 15-year period would have the consequences 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 female spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, extremely small consequences 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 consequences to future year classes is anticipated to be extremely small and would not change the status of this species. The proposed action will also not affect the spawning grounds within the rivers where NYB DPS fish spawn. The action 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 total population estimate for the NYB DPS, it is difficult to evaluate the consequences of the mortalities caused by this actions on the species. However, because the proposed action will result in the loss of no more than three individuals over a 15-year period, or an average of 0.2 per year, it is unlikely that these deaths will have detectable consequences on the numbers and population trend of the NYB DPS.

The proposed action is 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 NYB DPS subadults or adults. Further, the actions are not expected to reduce the river by river distribution of Atlantic sturgeon. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of the area where the deepening and its impacts are occurring.

Based on the information provided above, the death of up to three NYB DPS Atlantic sturgeon over a 15-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 action 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 it will not result in consequences to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of these NYB DPS Atlantic sturgeon over a 15-year period represents an extremely small percentage of the species as a whole; (2) the death of these NYB DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of these NYB DPS Atlantic sturgeon is not likely to have consequences on the levels of genetic heterogeneity in the population; (4) the loss of these NYB DPS Atlantic sturgeon is likely to have such small consequences on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the action will have only a minor and temporary consequence on the distribution of NYB DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and (6) the action will have no consequence on the ability of NYB DPS Atlantic sturgeon to shelter and only an insignificant consequence on individual 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 action will not appreciably reduce the likelihood that the NYB DPS 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. Thus, we have considered whether the proposed action 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 listed species must have a sustained positive trend over time and an increase in population. To allow that 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 this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action is 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 consequences to habitat will be insignificant 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 action will result in a small amount of mortality (no more than three individuals over 15 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. The action 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 action will not reduce the likelihood of improvement in the status of the NYB DPS of Atlantic sturgeon. The consequences of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The consequences of the proposed action 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 action 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 endangered or threatened. Based on the analysis presented herein, the proposed action is 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 action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to consequences related to the proposed action. Based on the analysis presented herein, the proposed action, resulting in the mortality of up to three NYB DPS Atlantic sturgeon over a 15-year period, is not likely to appreciably reduce the survival and recovery of this species.

9.5.4 Chesapeake Bay DPS

The CB DPS is listed as endangered, and Atlantic sturgeon occur and may potentially spawn in several rivers of the Chesapeake Bay. There is evidence of spawning in the James River (confirmed); Pamunkey River, a tributary of the York River; and Marshyhope Creek, a tributary of the Nanticoke River (Hager *et al.* 2014, Kahn *et al.* 2014, Balazik and Musick 2015, Richardson and Secor 2016, NMFS 2017c, Richardson and Secor 2017, Secor *et al.* 2021). In addition, detections of acoustically-tagged adult Atlantic sturgeon in the Mattaponi and Rappahannock Rivers at the time when spawning occurs in others rivers, and historical evidence for these as well as the Potomac River supports the likelihood of Atlantic sturgeon spawning populations in the Mattaponi, Rappahannock, and Potomac Rivers (NMFS 2017c).

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 subadult 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 percent) that abundance of the CB DPS has increased since the implementation of the 1998 fishing moratorium, and a 30 percent probability that mortality for the CB DPS exceeds the mortality threshold used for the assessment (ASMFC 2017).

We anticipate the mortality of up to one subadult CB DPS Atlantic sturgeon as a result of the hopper dredging during a 15-year period. While it is possible that entrained/captured fish could survive, we assume here that this fish will be killed.

Here, we consider the consequences of the loss of up to one Atlantic sturgeon over a 15-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 up to one individual over a 15-year period, would have the consequences 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, extremely small consequences on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that could be killed as a result of the proposed action, any consequence to future year classes is anticipated to be extremely small and would not change the status of this species. The proposed action will also not affect the spawning grounds within the rivers where CB DPS fish spawn. The action 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 consequences of the mortality caused by this action on the species. However, because the proposed action will result in the loss of no more than one individual over a 15-year period, or an average of 0.07 mortalities each year, it is unlikely that this death will have a detectable consequence on the numbers and population trend of the CB DPS.

The proposed action is not likely to reduce distribution because the action 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 subadults or adults. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of the area where the deepening and its impacts are occurring.

Based on the information provided above, the death of up to one CB DPS Atlantic sturgeon over a 15-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 action 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 it will not result in consequences to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of up to one CB DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (2) the loss of this CB DPS Atlantic sturgeon is not likely to have consequences on the levels of genetic heterogeneity in the population; (3) the action will have only a minor and temporary consequence on the distribution of CB DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (4) the action will have no consequence on the ability of CB DPS Atlantic sturgeon to shelter and only an insignificant consequence on any foraging CB DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the CB DPS 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. Thus, we have considered whether the proposed action 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 listed species must have a sustained positive trend over time and an increase in population. To allow that 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 action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

We do not expect the proposed action 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 consequences to habitat will be insignificant 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 action will result in an extremely small amount of mortality over the next 15 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 action will not reduce the likelihood of improvement in the status of the CB DPS of Atlantic sturgeon. The consequences of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The consequences of the proposed action 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 action 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 endangered or threatened. Based on the analysis presented herein, the proposed action is 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 action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to consequences related to the proposed action. We have considered the consequences of the proposed action 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 action, resulting in the mortality of up to one CB DPS Atlantic sturgeon over a 15-year period, is not likely to appreciably reduce the survival and recovery of this species.

9.5.5 South Atlantic DPS

The SA DPS is listed as endangered and consists of Atlantic sturgeon originating from at least six rivers where spawning is still thought to occur. 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 percent CI: 143-667) in 2004 and 386 (95 percent 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 percent probability that mortality for the SA DPS exceeds the mortality threshold used for the assessment (ASMFC 2017).

We anticipate the mortality of up to one SA DPS subadult Atlantic sturgeon as a result of the hopper dredging during a 15-year period. While it is possible that entrained/captured fish could survive, we assume here that this fish will be killed.

Here, we consider the consequences of the loss of up to one Atlantic sturgeon over a 15-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 up to one individual over a 15-year period, would have the consequence 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 consequence 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 consequence to future year classes is anticipated to be extremely small and would not change the status of this species. The proposed action will also not affect the spawning grounds within the rivers where SA DPS fish spawn. The action 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 consequences 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 a 15-year period, or an average of 0.07 mortalities each year, it is unlikely that this death will have a detectable consequence on the numbers and population trend of the SA DPS.

The proposed action is 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 subadults or adults. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of the area where the deepening and its impacts are occurring.

Based on the information provided above, the death of up to one SA DPS Atlantic sturgeon over a 15-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 action 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 it will not result in consequences to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of up to one SA DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (2) the loss of this SA DPS Atlantic sturgeon is not likely to have consequences on the levels of genetic heterogeneity in the population; (3) the loss of this SA DPS Atlantic sturgeon over a 15-year period is likely to have such a small consequence on reproductive output that the loss of this individual will not change the status or trends of the species; (4) the action will have only a minor and temporary consequence on the distribution of SA DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (5) the action will have have no consequence on the ability of SA DPS Atlantic sturgeon to shelter and only an insignificant consequence 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 action will not appreciably reduce the likelihood that the SA DPS of Atlantic 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. 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 that 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 action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

We do not expect the proposed action 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 consequences to habitat will be insignificant 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 action will result in an extremely small amount of mortality (up to one individual) and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the action to affect the persistence of the SA DPS of Atlantic sturgeon. This action 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 action will not reduce the likelihood of improvement in the status of the SA DPS of Atlantic sturgeon. The consequences of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The consequences of the proposed action 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 or endangered. Based on the analysis presented herein, the proposed action is 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 action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to consequences related to the proposed action. We have considered the consequences of the proposed action 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 action, resulting in the mortality of up to one SA DPS Atlantic sturgeon over a 15-year period, are not likely to appreciably reduce the survival and recovery of this species.

10.0 CONCLUSION

After reviewing the current status of the species, the environmental baseline and cumulative effects in the action area, and the consequences of the HDCI study, it is our biological opinion that the proposed action may adversely affect, but is not likely to jeopardize the continued existence of NWA DPS loggerhead and Kemp's ridley sea turtles and the GOM, NYB, CB, Carolina, and SA DPSs of Atlantic sturgeon. It is also our biological opinion that the proposed action is not likely to adversely affect leatherback and the North Atlantic DPS green sea turtles; North Atlantic right or fin whales; and shortnose sturgeon. Because no critical habitat is designated in the action area, none will be affected by the action.

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 ESA 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 USACE so that they become binding conditions for the exemption in section 7(o)(2) to apply. The USACE has a continuing duty to regulate the activity covered by this ITS. If the USACE (1) fails to assume and implement the terms and conditions or (2) fails to require any contractors and personnel to adhere to the terms and conditions of the ITS through enforceable terms that are added to contracts or other documents as appropriate, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the USACE must report on the progress of the action and its 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

The proposed action has the potential to result in the mortality of loggerhead and Kemp's ridley sea turtles and individuals from the New York Bight, Gulf of Maine, Chesapeake Bay, Carolina and South Atlantic DPSs of Atlantic sturgeon due to entrainment in hopper dredges. These interactions are likely to cause injury and/or mortality to the affected sea turtles and Atlantic sturgeon. This level of take is expected to occur over the entire period that comprises the life of the project *e.g.*, from 2025 through 2039, and is not likely to jeopardize the continued existence of listed species.

This ITS exempts the following incidental take over the life span of the project:

Table 26. Exempted incidental take over the lifespan of the project.

Species	**Lethal**
Northwest Atlantic DPS of loggerhead sea turtle	Up to 6 (hopper dredge entrainment)
Kemp's ridley sea turtle	Up to 1 (hopper dredge entrainment)
Sea Turtle Total	**6**
Atlantic sturgeon	Up to 3 subadults (hopper dredge entrainment)
Atlantic Sturgeon Total	**3**

Lethal take of sea turtles during dredging may be of any of the following combinations: six loggerhead or five loggerhead and one Kemp's ridley sea turtle.

We expect up to three lethal takes of Atlantic sturgeon during dredging. Lethal take during dredging may be of any of the following combinations: three from the NYB DPS or two from the NYB DPS and one from any of the other DPS.

Lethal take of Atlantic sturgeon by DPS:

- up to 3 from NYB DPS**
- up to 1 from CB DPS*
- up to 1 from SA DPS*
- up to 1 from GOM and/or Carolina DPS*

* One of three sturgeon taken in the dredge could be from any other DPS origin than the NYB DPS; accordingly, one lethal take is attributed to each of the non NYB DPSs, though only one Atlantic sturgeon will be taken from one of the four non NYB DPSs.
** All three sturgeon taken in the dredge could be of NYB DPS origin.

Again, we have determined that this level of anticipated take is not likely to result in jeopardy to any species of sea turtle or any DPS of Atlantic sturgeon.

When a hopper dredge is used, NMFS-approved endangered species observers are typically required on board the dredge to monitor for the entrainment of sea turtles and sturgeon. The endangered species observer program has been in place on hopper dredges since 1994 and is effective at monitoring take during hopper dredge operations. The use of observers relies on screening placed on the draghead being large enough to allow large sized pieces of biological material to pass through and be caught in cages that retain material that is then inspected by the observer. Once you reach the authorized number of sea turtles or Atlantic sturgeon takes provided in this Incidental Take Statement, any additional entrainment of a sea turtle or Atlantic sturgeon will exceed the exempted level of take and reinitiation is required.

11.1.1 Monitoring Incidental Take during Dredging with UXO Screens

We anticipate that interaction with hopper dredges will result in incidental take of sea turtles and Atlantic sturgeon. An observer is used to monitor the inflow of material from the draghead into the hopper. Screening is placed over the outflow into the hopper such that material with a diameter greater than 4" is captured in a basket. The baskets are inspected and cleaned out following each dredge load. In some instances, overflow screens are also used which prevent large pieces of material from overflowing out of the hopper. When UXO screening is in place on the draghead, the screen prevents any material with a diameter larger than 1.25" from passing through the screen. Thus, if the normal 4x4 screening was used on the outflow into the hopper, any biological material that was small enough to pass through the UXO screen would be small enough to pass through the openings of the intake screen. The use of outflow screening with spacing small enough to trap material with a diameter smaller than 1.25" is not practicable due to issues of clogging and dredge performance. Given these facts, we do not expect an observer to be able to detect any biological material that is small enough to pass through the UXO screens. Therefore, it is not reasonable to require an observer to monitor the inflow or overflow on the dredge when UXO screens are employed.

UXO screens will be used when initially dredging material in the Ambrose Channel. You estimate that a total of 6,389,000 cubic yards of sand will be dredged from 2025-2039. As explained above, we expect that one turtle will interact with the dredge and be killed for every 2,600,000 cubic yards removed. Thus, we expect three sea turtles to interact with the dredge and die when dredging is conducted with a UXO screen mounted on the draghead. Similarly, as explained in Section 7.2, we expect one sturgeon mortality of either species for every 5,600,000 cubic yards of material dredged. Thus, we expect two sturgeon killed during hopper dredging with an UXO screen mounted on the draghead. The three sea turtle takes and two sturgeon takes would not be in addition to the lethal take estimated for dredging entrainment, but rather be subtracted from that total.

We have considered whether monitoring of the baskets at the discharge location could serve to monitor take. While we expect that any biological material that passed through the UXO screen would be trapped within the discharge basket, the size of material will still be very small (between 0.75 and 1.25" diameter) and is likely to consist primarily of soft parts which would make detection and identification to species difficult. Additionally, we expect that the UXO screens prevent entrainment of biological material; thus, most interactions would not result in entrainment of body parts. Therefore, while inspection and documentation of material captured in the discharge baskets may provide some information on interactions with listed species, it is not likely to provide an accurate assessment of all interactions with listed species.

During the consultation for the NY/NJ HDP, the USACE and NMFS considered the following alternatives to monitor take of listed species during dredge operations in the Ambrose Channel with UXO screening in place (NMFS 2012).

1. Install a camera near the draghead: A camera installed on a draghead would allow users at the surface to observe underwater interactions. However, there are technical challenges to using video, including visibility due to water clarity and available light, improper

focus, inappropriate camera angle, and the range of the viewing field. The use of video would require additional resources, and it is unlikely that it would be effective for monitoring this type of dredge work. For these dredges, turbidity levels (*i.e.*, up to 450 mg/l) near the draghead while dredging operations are underway are too high to visually detect any animal impinged on or within the vicinity of the draghead. Therefore, this is not a reasonable and appropriate means to monitor take.

2. Use of sonar/fish finder: Sonar can be used to detect animals within the water and within the vicinity of the dredge. However, studies would need to take place to establish the signatures of sea turtles and sturgeon so that they could be readily identified electronically; this information is not currently available. As such, at this time, sonar alone could not indicate the take of an individual animal or identify the species potentially being taken. As such, the use of such devices would not be reasonable or appropriate for monitoring take.

3. Placement of observers on the shoreline: Observers placed on the shoreline may be able to detect stranded animals either in the water or on the shore. However, animals may not strand in the direct vicinity of the operation. Injured or deceased animal may not float to the surface immediately (*i.e.*, it may take days for this to occur) or may drift far from the incident where injury occurred. Therefore, an injured or deceased stranded animal often cannot be definitively attributed to a specific action. As such, this is not a reasonable and appropriate means to monitor take.

4. Relocation trawling: Relocation trawling is a method to remove sea turtles or Atlantic sturgeon from an area before an activity such as dredging occurs. In considering relocation trawling, you must also consider that animals can be injured/entrained in the trawl, and animals can return to the site depending on the length of time between dredging and trawling. While relocation trawling may potentially reduce take, it does not provide a means for monitoring take. As such, this is not a reasonable and appropriate means to monitor take.

5. Time of year restriction: In dredging operations, time of year restrictions may be used to reduce or eliminate take. Moving the dredge operations outside an area when the animals are present reduces the likelihood of interaction. Time of year restrictions have been suggested for sea turtles in New York waters, based on the best available information. However, Atlantic sturgeon may be in the project area year round. In addition, time of year restrictions do not provide a method for monitoring take, but rather reducing the take level. As sturgeon are present year-round, we did not think this was a reasonable alternative to monitor take.

Both agencies agreed that none of these methods were reasonable or appropriate for monitoring take for the proposed project. In situations where individual takes cannot be observed, a proxy must be considered. This proxy must be rationally connected to the taking and provide an obvious threshold of exempted take that, if exceeded, provides a basis for reinitiating consultation. As explained in Section 7.2 of this Opinion, the estimated number of sea turtles and Atlantic sturgeon to be adversely affected by this action is related to the volume of material removed via dredge, the time of year and the duration of dredging activity.

Therefore, the volume of material removed from the action area can, but not exclusively, serve as a surrogate for monitoring actual take. As explained in the Consequences of the Action, we anticipate one sea turtle will be killed for every 2,600,000 cubic yards of material dredged with a hopper dredge and one Atlantic sturgeon is likely to be killed for every 5,600,000 cubic yards dredged with a hopper dredge. This estimate provides a surrogate for monitoring the amount of incidental take during dredging operations when UXO screening is in place and direct observations of interactions cannot occur. This will be used as the primary method of determining whether incidental take has occurred; that is, we will consider that one sea turtle has been taken for every 2,600,000 cubic yards of material removed during hopper dredging operations. Similarly, we will consider that one subadult Atlantic sturgeon has been taken for every 5,600,000 cubic yards of material removed during hopper dredging operations. There is a possibility that a sea turtle or an Atlantic sturgeon may remain impinged on UXO screens after the suction has been turned off. These animals can be visually observed, via a lookout, when the draghead is lifted above the water. Animals documented on the draghead by the lookout will be considered a take and this monitoring will be considered as a part of the monitoring of the actual take level. Monitoring of the discharge cages will also be used as part of the monitoring. Similarly, should we receive any reports of injured or killed sea turtles or sturgeon in the area (*i.e.*, via the STSSN) and necropsy documents that suggests interactions with the hopper dredge operating during this project was the cause of death, we will consider those animals to be taken by these activities. This monitoring method (*i.e.*, proxy and/or observed) will only be used in the Ambrose Channel hopper dredging component. For the other channels where UXO screens will not be used, the takes will be monitored through observer coverage.

As soon as the estimated number of sea turtles or Atlantic sturgeon are observed or believed to be taken (*e.g.*, if the total was three turtles: three takes via surrogate or two observed impinged and one via surrogate, etc.), any additional entrainment of a sea turtle or Atlantic sturgeon will be considered to exceed the exempted level of take. We expect exceedance of the exempted amount of take to be unlikely given the conservative assumptions made in calculating this estimate. Lookouts will be present on the vessel and volumes of material removed will be continuously monitored during dredge operations. Additionally, the monitoring of the discharge baskets provides a means for collecting and identifying any biological material that is entrained on the dredges. Therefore, take levels can be detected and assessed throughout the project and, if needed, consultation can be reinitiated.

We will consider incidental take exceeded if the following condition is met:

- Reported take from hopper dredging without UXO screens as well as mechanical and cutterhead dredging together with estimated (based on volume dredged) and observed future take from dredging with a UXO screen in place exceeds either six loggerhead sea turtles, five loggerhead sea turtles plus one Kemp's ridley sea turtle, or three Atlantic sturgeon.

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 and the five DPSs of Atlantic sturgeon resulting from the proposed action (Table 27). In order to be exempt from prohibitions of section 9 of the ESA and regulations issued pursuant to section 4(d), the USACE must comply 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 incidental take resulting from the proposed action. Specifically, these RPMs and T&Cs will keep us informed of when and where sea turtle and Atlantic sturgeon interactions are taking place as well as how the HDCI study 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 action and how they represent only a minor change to the action.

In order to effectively monitor the consequences of the proposed action, it is necessary to monitor and document the amount of incidental take (*i.e.*, the number of sea turtles and Atlantic sturgeon captured, injured, or killed) and to assess any of these listed species that are captured during this monitoring. 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 27. RPMs, Terms and Conditions, and Justifications. Referenced forms and documents can be found on the NOAA GARFO website at URL https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs & T&Cs
RPMs Applicable for All Activities		
1. All Atlantic sturgeon captured must have a fin clip taken for genetic analysis. This sample must be transferred to a NMFS-approved laboratory capable of performing the genetic analysis.	1. You must ensure that fin clips are taken (according to the "Procedure for Obtaining Sturgeon Fin Clips" document **that can be found on our website**) of any Atlantic sturgeon captured during the project and that the fin clips are sent to a NMFS approved laboratory capable of performing genetic analysis. Fin clips must be taken prior to preservation of other fish parts or whole bodies. If only body parts are found and fins are not available, then take a sample of the tissue that is available. To the extent authorized by law, you are responsible for the cost of the genetic analysis.	These RPMs and T&Cs are necessary and appropriate to ensure the proper handling and documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. Genetic analysis must be conducted on Atlantic sturgeon samples to determine the appropriate DPS of origin and monitor the assumptions in this opinion and accurately record take of this species. These RPMs and T&Cs represent only a minor

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs & T&Cs
		change as compliance will not result in delay of the project or decrease in the efficiency of the dredging operations and will amount to only a minor cost.
2. Any dead sturgeon must be transferred to us or to an appropriately permitted research facility identified by us so that a necropsy can be undertaken to attempt to determine the cause of death. Sturgeon should be held in cold storage.	2. In the event of any lethal takes of Atlantic sturgeon (*e.g.*, dead sturgeon incidentally collected during dredging, or in the NY/NJ channels), any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with us.	These RPMs and T&Cs are necessary and appropriate to ensure the proper handling and documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. These RPMs and T&Cs represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the dredging operations.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs & T&Cs
3. Any dead sea turtles must be held until proper disposal procedures can be discussed with us. Turtles should be held in cold storage.	3. In the event of any lethal takes of sea turtles, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with us. 4. If a decomposed turtle or turtle part is captured or entrained during dredging operations, an incident report must be completed and the specimen must be photographed. Any turtle parts that are considered 'not fresh' (*i.e.*, they were obviously dead prior to the dredge take and you anticipate that they will not be counted towards the ITS) must be frozen and transported to a nearby stranding or rehabilitation facility for review. You must ensure that the observer submits the incident report for the decomposed turtle part, as well as photographs, to us within 24 hours of the take (see our "Take Report Form for ESA-Listed Species" **that can be found on our website)** and request concurrence that this take should not be attributed to the Incidental Take Statement. We shall have the final say in determining if the take should count towards the Incidental Take Statement.	These RPMs and T&Cs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. In some cases, when the cause of death is uncertain, a necropsy may be necessary to aid in the determination of whether or not a mortality should count toward the ITS. This is essential for monitoring the level of incidental take associated with the proposed action. These RPMs and T&Cs represent only a minor change as compliance will only result in an extremely small increase in cost and will not delay the project, or

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs & T&Cs
		decrease the efficiency of the dredging operations
4. All sturgeon captures, injuries, or mortalities in the immediate activity area must be reported to us within 24 hours.	5. In the event of any captures or entrainment of Atlantic sturgeon (lethal or non-lethal), you must follow the Sturgeon Take Standard Operating Procedures (SOPs) **that can be found on our website.** You must submit a completed Take Report Form for ESA-Listed Species within 24 hours of any take. **The form can be downloaded from our website**. The completed Take Report Forms, together with any supporting photos or videos must be submitted to nmfs.gar.incidental-take@noaa.gov with "Take Report Form" in the subject line. We shall have the final say in determining if the take should count towards the Incidental Take Statement. 6. If the cause of death is unknown (*e.g.*, dead sturgeon incidentally collected during dredging or trawlng in the NY/NJ channels) NMFS will have the mortality assigned to the incidental take statement if a necropsy determines that the death was	These RPMs and T&Cs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. In some cases, when the cause of death is uncertain, a necropsy may be necessary to aid in the determination of whether or not a mortality should count toward the ITS. This is essential for monitoring the level of incidental take associated with the proposed action. These RPMs and T&Cs represent only a minor change as compliance will not delay of the project or

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs & T&Cs
	due to injuries sustained from an interaction with dredge gear.	decrease in the efficiency of the dredging operations.
5. All sea turtle captures, injuries, or mortalities and any sea turtle sightings in the immediate dredging area must be reported to us within 24 hours.	7. In the event of any captures or entrainment of sea turtles (lethal or non-lethal), you must follow the Sea Turtle Take Standard Operating Procedures (SOPs) **that can be found on our website.**) You must submit a completed Take Report Form for ESA-Listed Species within 24 hours of any take. **The form can be downloaded from our website**. The completed Take Report Forms, together with any supporting photos or videos must be submitted to nmfs.gar.incidental-take@noaa.gov with "Take Report Form" in the subject line. We shall have the final say in determining if the take should count towards the Incidental Take Statement. 8. If the cause of death is unknown, dead sea turtles found along the coastline (*e.g.*, beaches) within two weeks of when dredge operations occurred in the channels and in an area where the carcass reasonably could have drifted from dredge operations, will have the mortality assigned to the	These RPMs and T&Cs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. In some cases, when the cause of death is uncertain, a necropsy may be necessary to aid in the determination of whether or not a mortality should count toward the ITS. This is essential for monitoring the level of incidental take associated with the proposed action. These RPMs and T&Cs represent only a minor change as compliance will not result in delay of the project or decrease in the efficiency of the dredging operations.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs & T&Cs
	incidental take statement if a necropsy determines that the death was due to injuries sustained from an interaction with dredge gear. Sea turtle injuries consistent with hopper dredge interactions may include: - crushing wounds/injuries; - partial carapace or body part; - jagged edges to injury; - internal organs completely or partially missing or displaced; - excoriated skin injuries; or - peeling or missing scutes, not related to decomposition, around injury area	
RPMs Applicable for All Dredge Activities		
6. We must be contacted prior to the commencement of dredging and again upon completion of the dredging activity.	9. You must contact us at nmfs.gar.incidental-take@noaa.gov three days before the commencement of each dredging activity and again within three days of the completion of the activity. This correspondence will serve both to alert us of the commencement and cessation of dredging activities and to give us an opportunity to provide you with any updated contact information or reporting forms.	These RPMs and T&Cs are necessary and appropriate because they serve to ensure that we are aware of the dates and locations of all dredging that may result in take. This will allow us to monitor the duration and seasonality of dredging activities as well as give us

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs & T&Cs
	At the start of dredging activities, you must include the total volume and area you anticipate removing, the location/project name where dredging will occur and the type of dredge to be used. At the end of the dredging event, you must report to us the actual volume and area removed, location/project name where dredging occurred, and the equipment used (type of dredge).	an opportunity to provide you with any updated species information or contact information for our staff. This is only a minor change because it is not expected to result in any delay to the project, it should not increase the cost of the dredging operation, and will merely involve occasional e-mails between you and our staff.
7. All dredges must be operated in a manner that will reduce the risk of interactions with listed species.	10. If listed species are present during dredging or material transport, vessels transiting the area must post a bridge watch, avoid intentional approaches closer than 100 yards when in transit, and reduce speeds to below 4 knots if bridge watch identifies a listed species in the immediate vicinity of the dredge as determined by the line of sight from the vessel bridge. The suction of the draghead will remain off until the draghead is properly seated on the bottom sediment. Prior to raising the	These RPMs and T&Cs are necessary and appropriate as they will require that dredge operators use best management practices, including slowing down to 4 knots should listed species be observed and turning the suction off while the draghead is off the bottom, that will minimize the likelihood of take. This represents only a minor change as following these

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs & T&Cs
	draghead, no suction will remain in the draghead or the dragarm.	procedures should not increase the cost of the dredging operation or result in any delays of reduction of efficiency of the dredging project.
RPMs Applicable for All Hopper Dredges		
8. You shall ensure that all hopper dredges are outfitted with state-of-the-art sea turtle deflectors on the draghead and operated in a manner that will reduce the risk of interactions with sea turtles.	11. All hopper dredges must be equipped with the rigid deflector draghead as designed by your Engineering Research and Development Center, formerly the Waterways Experimental Station (WES), or if that is unavailable, a rigid sea turtle deflector attached to the draghead. Deflectors must be checked and/or adjusted by a designated expert prior to a dredge operation to insure proper installation and operation during dredging. The deflector must be checked after every load throughout the dredge operation to ensure that proper installation is maintained. Since operator skill is important to the effectiveness of the WES-developed draghead, operators must be properly instructed in its use. Dredge inspectors must ensure that all measures to protect sea	These RPMs and T&Cs are necessary and appropriate as the use of draghead deflectors is accepted standard practice for hopper dredges operating in places and at times of year when sea turtles are known to be present and has been documented to reduce the risk of entrainment for sea turtles, thereby minimizing the potential for take of these species. This represents only a minor change as it will only result in an extremely small increase in cost, all of the hopper dredges likely to be used for this project already have draghead deflectors,

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs & T&Cs
	turtles are being followed during dredge operations.	dredge operators are already familiar with their use, and the use will not affect the efficiency of the dredging operation. Additionally, the current dredging is conducted with draghead deflectors in place.
RPMs for when UXO Screening Not In Place on Hopper Dredge		
9. For all hopper dredge operations where UXO screening is not in place, a NMFS-approved observer must be present on board the hopper dredge any time it is operating. You shall ensure that dredges are equipped and operated in a manner that provides endangered/threatened species observers with a reasonable opportunity for detecting interactions with listed species and that provides for handling, collection, and resuscitation of turtles injured during project activity. Full cooperation with the endangered/threatened species observer program is essential for compliance with the ITS.	12. You must ensure that all contracted personnel involved in operating hopper dredges receive thorough training on measures of dredge operation that will minimize takes of sea turtles. Contracted observers shall have training that shall include measures discussed in the Monitoring Specifications for Hopper and Mechanical Dredges document **that can be found on our website.** 13. When UXO screening is not in place, observer coverage on hopper dredges must be sufficient for 100 percent monitoring of hopper dredging operations. This monitoring coverage must involve the placement of a NMFS-approved observer on board the dredge for every day that dredging is occurring. You must ensure that	These RPMs and T&Cs are necessary and appropriate because they require that you have sufficient observer coverage to ensure the detection of any interactions with listed species. This is necessary for the monitoring of the level of take associated with the proposed action. The inclusion of these RPMs and T&Cs is only a minor change as you included some level of observer coverage in the original project description and the increase in coverage

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs & T&Cs
	your dredge operators and/or any dredge contractor adhere to the Monitoring Specifications for Hopper and Mechanical Dredges with trained NMFS-approved observers, in accordance with the attached Observer Protocol and Observer Criteria in the Monitoring Specifications for Hopper and Mechanical Dredges document. No observers can be deployed to the dredge site until you have written confirmation from us that they have met the qualifications to be a NMFS-approved observer as outlined in the Monitoring Specifications for Hopper and Mechanical Dredges document **that can be found on our website**. If substitute observers are required during dredging operations, you must ensure that our approval is obtained before those observers are deployed on dredges. 14. You shall require of the dredge operator that, when the observer is off watch, the cage shall not be opened unless it is clogged. You shall also require that if it is necessary to clean the cage when the observer is off watch, any aquatic biological material is left in the cage for the observer to document and clear out when	(*i.e.*, the addition of any months/activities that were not previously subject to observer coverage) will represent only a small increase in the cost of the project and will not result in any delays. These also represent only a minor change as in many instances the instructions and guidance serve to clarify the duties of the inspectors or observers.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs & T&Cs
	he/she returns on duty. In addition, the observer shall be the only one allowed to clean off the overflow screen.	
10. You shall ensure that all measures are taken to protect any turtles or sturgeon that survive entrainment in a hopper dredge.	15. The procedures for handling live sea turtles must be followed in the unlikely event that a sea turtle survives entrainment in the dredge (see Sea Turtle Handling and Transfer Instructions for Dredging Operations document **that is downloadable on our website**). Any live sturgeon must be photographed, weighed and measured if possible, and released immediately overboard while the dredge is not operating. You must make arrangements with a NMFS-approved facility that agrees to receive any sea turtles injured during dredging. 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. This plan must be developed in cooperation with us and is subject to approval by us. This plan must be in place and approved before October 1, 2022.	These RPMs and T&Cs are necessary and appropriate as they will require that dredge operators use best management practices that will minimize the likelihood of take. This represents only a minor change as following these procedures should not result in any delays of reduction of efficiency of the dredging project. Further, they are necessary and appropriate to ensure that any sea turtles or sturgeon that survive entrainment in a hopper dredge are given the maximum probability of remaining alive and not suffering additional injury or subsequent mortality through inappropriate handling. This represents only a minor change as

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs & T&Cs
		following these procedures will not result in any delays to the proposed project and may represent only a small increase in the cost of the project.
RPMs for UXO Screening on Hopper Dredge		
11. You shall ensure that for all dredge operations where UXO screening is in place, a lookout/bridge watch, knowledgeable in listed species identification, will be present on board the hopper dredge at all times to inspect the draghead each time it is removed from the water.	16. The lookout will inspect the draghead while it is turned off for impinged sea turtles or Atlantic sturgeon each time it is brought up from completing a dredge cycle. Should a sea turtle or Atlantic sturgeon be found impinged on the draghead, the incident should be recorded on the Dredge Observer Form (**available for download from our website**) and we must contacted within 24 hours (via nmfs.gar.incidental-take@noaa.gov).	These RPMs and T&Cs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. These RPMs and T&Cs represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the dredging operations.

12.0 CONSERVATION RECOMMENDATIONS

In addition to section 7(a)(2), which requires agencies to ensure that proposed projects will not jeopardize the continued existence of listed species, section 7(a)(1) of the ESA places a responsibility on all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species." Conservation Recommendations are discretionary activities designed to minimize or avoid adverse consequences 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 and Atlantic sturgeon:

1. To the extent practicable, the USACE should avoid dredging during times of year when listed species are likely to be present. While sturgeon could be present year-round, sea turtles are only expected to be present in the action area from May through November.

2. To facilitate future management decisions on listed species occurring in the action area, the USACE should enter their data into ODESS to: a) create a history of use of the geographic areas affected; and, b) document endangered/threatened species presence/interactions with project operations.

3. The USACE should support ongoing and/or future research to determine the abundance and distribution of sea turtles and Atlantic sturgeon in New York and New Jersey waters.

4. Population estimates are lacking for Atlantic sturgeon. You should continue to support studies to assist in gathering the necessary information to develop a population estimate for the NYB DPS.

5. The USACE should continue to investigate, support, and/or develop additional technological solutions to further reduce the potential for sea turtle or Atlantic sturgeon takes in hopper dredges.

6. The USACE should consider devising and implementing some method of significant economic incentives to hopper dredge operators, such as financial reimbursement based on their satisfactory completion of dredging operations, or a certain number of cubic yards of material removed, or hours of dredging performed, *without taking turtles or sturgeon*. This may encourage dredging companies to research and develop "turtle or sturgeon friendly" dredging methods, more effective deflector dragheads, pre-deflectors, top-located water ports on dragarms, etc.

7. You should conduct studies to evaluate the effectiveness of new technologies to monitor species interactions with hopper and cutterhead dredges when UXO screens are in place.

8. You should support efforts to report and keep track of sturgeon carcasses in the NY/NJ channels. These reporting efforts provide important information to evaluate causes of sturgeon mortalities within the NY/NJ channels and along the NY/NJ coasts. Support could include the development, in cooperation with state agencies, of a central reporting database

that standardize across states the procedures for reporting and keeping track of observations of sturgeon carcasses.

13.0 REINITIATION OF CONSULTATION

This concludes formal consultation on the NY/NJ HDCI study. 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 taking specified in the incidental take statement is exceeded; (2) new information reveals consequences 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 a consequence to 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 USACE must immediately request reinitiation of formal consultation.

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15.0 Appendix A.

Historical Sturgeon Take Records from Dredging Operations 1990 - Mar 2012