

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

AGENCY: U.S. Maritime Administration
U.S. Army Corps of Engineers, Philadelphia District

ACTIVITY CONSIDERED: MARAD Grants for Improvements to the Port of Salem
and USACE Permit Authorization
GARFO-2024-02358

CONDUCTED BY: National Marine Fisheries Service
Greater Atlantic Regional Fisheries Office

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APPROVED BY: 
Julie Crocker
Acting Assistant Regional Administrator
for Protected Resources

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1 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 construction and operation of the Port of Salem (Port). The U.S. Department of Transportation (DOT) Maritime Administration (MARAD) is planning to award funds from the 2021 Infrastructure for Rebuilding America (INFRA) Grant Program to the South Jersey Port Corporation (SJPC) for construction of port infrastructure and rehabilitation of the Port. In addition, the Army Corps of Engineers (USACE) is proposing to issue a permit pursuant to Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act (NAP-2025-00182-46) for construction and repair of Port infrastructure. The applicant, South Jersey Port Corporation (SJPC), proposes to repair and expand the capabilities of the Port located in the City of Salem, Salem County, New Jersey (NJ) along the mouth of the Salem River, a tributary to the Delaware River. SJPC proposes to expand the Port's existing sand transport operation that is mainly used for New York (NY) City concrete production. In addition, the redeveloped Port may be used for shipment of general cargo and bulk material. The Port is expected to operate, in support of the activities described above, for 30 years (2026 - 2055). MARAD and the applicant estimate that the proposed project will result in an increase in vessel traffic in the Delaware River over the 30-year life of the project.

MARAD is the lead federal agency for purposes of this section 7 consultation; the other action agency is the USACE. This Opinion considers effects of the actions proposed by these federal action agencies and described below on ESA-listed species and designated critical habitat that occur in the action area (as defined in Section 3.0 *Description of the Proposed Action* of this Opinion). We will maintain a complete administrative record of this consultation at our NMFS Greater Atlantic Regional Fisheries Office.

2 ESA CONSULTATION HISTORY

MARAD submitted a biological assessment (BA) and its initial request for informal consultation to NMFS Greater Atlantic Region on April 29, 2024. We responded with comments and questions on the incoming BA on May 23, 2024. MARAD submitted a revised BA on August 5, 2024. We sent additional comments and questions to MARAD on August 28, 2024 and highlighted in our response that we did not agree with the effects analysis for vessel traffic related to the Port operations after construction is complete. On September 6, 2024, we sent follow-up questions to MARAD related to vessel traffic during future operations. We met with MARAD on September 12, 2024 to discuss the project and clarified that given a USACE permit for the Port construction was necessary, significant efficiencies would be gained by completing one ESA section 7 consultation that addresses all proposed federal actions associated with the project (see 50 CFR 402.07). MARAD submitted a revised BA on September 13, 2024 that incorporated additional vessel traffic information based on our guidance. On September 16, 2024, we sent questions to MARAD related to inconsistencies between statements made in the September 6 meeting and information included in the BA. We met with MARAD, the project

applicant (SJPC), and the project consultant (Environmental Research and Consulting, Inc.) on September 19, 2024, to further discuss the BA. We met with MARAD and USACE on October 22, 2024; at this meeting it was established that consistent with 50 CFR 402.07, MARAD would serve as the lead action agency for this consultation and that USACE would be a co-action agency. MARAD requested initiation of formal consultation and submitted a revised BA (dated November 21, 2024) on December 10, 2024. We responded with additional comments and questions on January 7, 2025. MARAD met with us on February 25, 2025 to discuss additional information that was needed to initiate formal consultation. MARAD submitted a final BA on March 24, 2025 (dated March 10, 2025). We deemed the information submitted by MARAD on March 24, 2025 sufficient to assess the effects of the proposed action on ESA-listed species and designated critical habitat and that the information constituted the best scientific and commercial data available (50 CFR §402.14(c)-(d)); ESA formal Section 7 consultation was initiated on that date. Our April 7, 2025 letter to MARAD confirmed that formal consultation was initiated on March 24, 2025. However, following that date, there were changes to the BA.

On May 12, 2025, we met with MARAD, USACE, SJPC, and the project consultant to discuss the potential for project vessel overlap with whales and the need for us to consider new abundance information for Atlantic sturgeon in the consultation. We recommended that MARAD incorporate best management practices (BMP) associated with reducing risk of vessel strikes as part of the proposed action. Also, the USACE confirmed their intent to be included as a co-action agency in this consultation and were awaiting a permit application from the applicant. We confirmed the USACE's role in this consultation and the need for the USACE to have a federal action in order to consult via email on May 15, 2025 and again on June 2, 2025.

On June 24, 2025, we received a final version of the revised BA with updated information, including the inclusion of the BMPs and removal of wind-support as part of the proposed action because it was deemed not reasonably certain to occur.

On July 3, 2025, SJPC submitted a permit application to the USACE. On August 26, 2025, we met with MARAD and USACE to discuss the status of USACE's federal action; at this meeting the USACE confirmed that the proposed action described in the BA was consistent with the proposed action being considered by USACE. The USACE published a Public Notice on September 2, 2025 (NAP-2025-00182-46), with a public comment period through October 2, 2025. USACE has indicated that after the public comment period closed, they would notify us if there are any changes to the proposed action based on consideration of public comments. On October 1, 2025, there was a lapse in annual appropriations for the Department of Commerce (DOC), and therefore, the DOC was shut down and NOAA's NMFS employees were not able to meet the previously agreed upon deadline of November 3, 2025. NOAA's NMFS employees returned to work on November 13, 2025 after the DOC was funded. As such, the deadline for the issuance of this Opinion has been extended to February 2, 2026, in order to incorporate all necessary information and to complete all necessary clearance by NMFS staff and counsel.

Consideration of the 2024 ESA Section 7 Regulations

On April 5, 2024, NMFS and the U.S. Fish and Wildlife Service (FWS) (the Services) published joint final revisions to the 2019 Section 7 regulations in the Federal Register (89 FR 24268). These updates to the regulations governing interagency consultation (50 CFR part 402) were effective on May 6, 2024. We are applying the 2024 regulations to this consultation. The 2024 regulatory changes, like those from 2019, were intended to improve and clarify the consultation process, and, with one exception from 2024 (offsetting reasonable and prudent measures), were not intended to result in changes to the Services' existing practice in implementing section 7(a)(2) of the ESA (89 FR 24268; 84 FR 45015). On November 19, 2025, the Services announced four proposed updates to the ESA regulations. As these proposed rules are not finalized, the 2024 regulations apply to this consultation. We have considered the prior rules and affirm that the substantive analysis and conclusions articulated in this Opinion and its Incidental Take Statement would not have been any different under the 2019 regulations or pre-2019 regulations.

3 DESCRIPTION OF THE PROPOSED ACTIONS ON WHICH CONSULTATION WAS REQUESTED

The proposed federal actions considered in this consultation are funding by MARAD and permit authorization by USACE to the SJPC to support the redevelopment of the Port. The scope of the proposed action on which consultation was requested includes the redevelopment and the operation of the Port. These two components and their related activities are described below.

3.1 Site Location

The Port is located on the Salem River, at 30 West Broadway in the City of Salem, Salem County, NJ (Figure 1), two miles (3.2 km) upriver of its confluence with the lower tidal Delaware River at river mile (RM) 58.4 (river kilometer (RKM) 93.9).

Figure 1. Port of Salem location (Environmental Research and Consulting, Inc. 2025)



3.2 Port Redevelopment

The purpose of the proposed project is to improve and expand the capabilities of the existing Port. Construction drawings for the proposed in-water work are provided as Appendix A. The proposed in-water work that will occur within the Port construction area will include:

- Construction of a 460 foot (ft) sheet pile bulkhead, supported by 36 16-inch (in) steel pipe piles, and placement of 3,770 square feet (ft²) (0.087 acres) of backfill below the Mean High Water Line (MHWL) landward of the sheet pile bulkhead to restore the previous wharf configuration;
- Construction of a 400 ft by 40 ft (16,000 ft²; 0.37 acre) concrete high deck equipped with a concrete seawall and rubber fenders, supported by 144 16-in steel pipe piles waterward of the proposed bulkhead;
- Deepening of the berth by mechanical bucket dredge from a minimum of -16 ft below Mean Low Water (MLW) to -22 ft below MLW plus an allowable two feet of over-dredge, resulting in approximately 7,000 cubic yards (cy) of dredging across 56,800 ft² (1.30 acres); and
- Construction of a new 24-in stormwater outfall and stormwater polishing system that

will discharge through the new sheet pile bulkhead.

3.2.1 Pile Driving

A vibratory hammer will be used to drive 180 16-in diameter steel pipe piles to refusal. A cushioned impact hammer will be used to drive the piles to their final design depth. Cushion blocks will consist of multiple layers of plywood approximately 12 inches thick. A vibratory hammer will be used to drive 216 27.5-inch AZ steel sheet piles to construct the 460 ft sheet pile bulkhead. The sheet piles will be installed in pairs to reduce the overall installation time. A reduced energy “soft-start” will be used for all pile driving.

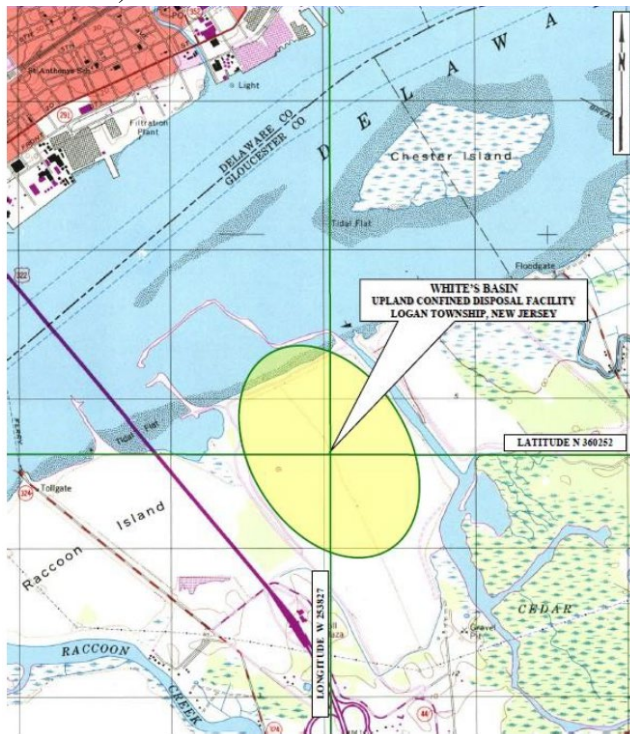
3.2.2 Dredging

Mechanical bucket dredging will occur within an approximately 1.30 acre (56,800 ft²) area of the Salem River immediately outshore of the proposed bulkhead from an existing depth of approximately -18 ft MLW to a depth of -22 ft MLW plus 2-foot allowable over-dredge. Dredging will generate approximately 7,000 cy of dredged material that will be transported by tug and scow to White’s Basin Upland Confined Disposal Facility (CDF) (referred to herein as White’s Basin CDF) in Logan Township, NJ, where it will be bottom dumped and later pumped to the upland CDF.

3.2.3 Dredged Material Placement

Dredged material will be placed at White’s Basin CDF (located at approximately RM 82, RKM 132) located in Logan Township, NJ (Figure 2). The facility is owned and operated by Weeks Marine. Temporary construction vessels will travel 23.6 miles (38 km) within the Federal Navigation Channel of the Delaware River from the confluence of the Salem River upriver to the White’s Basin CDF to dispose of dredged material.

Figure 2. White's Basin CDF in Logan Township, NJ (Environmental Research and Consulting, Inc. 2025)



3.2.4 Stormwater Outfall

A new 24-inch diameter stormwater outfall will be placed at the site. Stormwater at the site will be managed by a single water quality structure, the Jellyfish Filter Stormwater Treatment System (<https://www.conteches.com/stormwater-management/filtration/jellyfish-filter/>). The treatment system will remove approximately 80 percent of TSS, floatables, trash, oils, and a high percentage of particulate-bound pollutants including phosphorus, nitrogen, metals, and hydrocarbons. The system will be designed to control the runoff from a 2-year storm (1.25 in in two hours) and will have a backflow prevention valve to prevent river water from backing up into the system.

3.2.5 Project Vessels

Various self-propelled and non-self-propelled project vessels (Table 1) will be used during construction. The vessels will complete a total of 14 one-way trips from the Port to White's Basin CDF: 6 self-propelled vessel trips and 8 non-self-propelled vessel trips. In-water pile driving will be conducted from one barge-mounted crane, one material barge, a tug, and a skiff to transport workers. Dredging will utilize one barge-mounted bucket dredge, one scow to hold the dredged material, a tug to maneuver the barge, and a skiff for workers. The same tug and skiff will support both pile driving and dredging operations. The tug and barges will move at speeds less than 6 knots. All in-water construction, and therefore project vessel operation, will occur during July 1 through March 14.

Table 1. Temporary Construction Vessels for the Proposed Project

Vessel Type	Self-Propelled?	Total Number of One-Way Trips	Length (ft)	Beam (ft)	Draft (ft)
Tug	Yes	4	97	33	12
Crane barge	No	2	150	60	5
Material barge	No	2	300	100	7
Bucket dredge barge	No	2	340	78	8
Scow	No	2	180	50	12 (loaded), 7 (unloaded)
Skiff	Yes	2	22	8	2

3.3 Port Operation

3.3.1 Vessels

Vessel trips to and from the Port will continue to support existing sand transport operations to Pier J in Brooklyn, NY for concrete production (there are currently 64 one-way trips per year consisting of tug/barge, see Table 2). The approximate route of the barges associated with these sand transport operations is shown below in Figure 4. Although these vessel trips (64 one-way trips per year) have been ongoing in the Delaware River and considered as part of the baseline in previous NMFS Opinions for the Delaware River Main Channel Deepening and maintenance dredging project (the most recent of which was issued in November 2019 (Hayes *et al.* 2019)), no analysis of the effects of those vessel trips to and from this Port were previously completed. Furthermore, there is new information about vessel interactions with ESA species that was not previously considered. Therefore, we will analyze the potential effects to species from the ongoing 64 annual one-way vessel trips from the Port to Pier J, Brooklyn, NY in this Opinion. Based on an average of 64 one-way vessel trips per year by tugs and barges, over the projected 30-year operating life of the Port, 1,920 one-way self-propelled vessel trips are expected to occur. The current sand transport operations are expected to continue; thus, vessel traffic associated with the continued use of the Port for transport of sand to Pier J into the future will be considered as part of the action.

Table 2. Annual Total Vessel Trips during Port Operation

Vessel Activity	Number of One-Way Trips per Year	Vessel Type	Destination
Current Sand Transport Operations	64	Tug (Max. L96' x W33' x D17.9') with Barge (Max. L330'6" x W78" x D20'5")	Pier J, Brooklyn, NY

Expansion of Sand Transport Operations	70	Tug (Max. L96' x W33' x D17.9') with Barge (Max. L330'6" x W78" x D20'5")	Pier J, Brooklyn, NY
Cargo / Bulk Material Transport	24	Handymax (Max. L350' x D20') vessels or smaller	Unknown

As described in the BA, SJPC intends to expand current sand operations at the Port. This is expected to result in an increase of tug and barge vessel traffic in the Delaware River by up to an additional 70 one-way self-propelled vessel trips per year. The applicant also intends to bring in additional tenants and uses beyond sand transportation operations, potentially including general cargo and bulk material transport. These future operations are prospective; therefore, the origins and destinations for vessels general cargo and bulk material transport are not known at this time. As described in the BA, the vessels associated with future operations will be of the Handymax type or smaller, with a maximum length of approximately 350 ft, and are expected to include tugs and barges transporting personnel and small parts. As described in the BA, SJPC predicts that expanded operations would result in a maximum of 24 one-way trips per year to and from the mouth of Delaware Bay to the Port of Salem for general cargo and bulk material transport (Table 2). Therefore, the applicant estimates that expansion of the sand transport operation and possible future cargo and bulk material transport will result in an increase of 94 one-way vessel trips per year over current vessel use of the Port. Over the 30-year operating life of the Port, the expansion of sand operations and general cargo and bulk material transport is expected to increase vessel traffic by 2,820 self-propelled one-way vessel trips (i.e., 94 one-way trips/year for 30 years), with a total of 4,740 one-way trips to/from the Port of Salem over the 30-year life (i.e., 64 one-way trips that will continue to occur and 94 new one-way trips annually).

In summary, There will be an additional 14 temporary one-way vessel trips in the Delaware River from the Port to White's Basin CDF for construction of the Port: 6 self-propelled vessel trips and 8 non-self-propelled vessel trips. Total vessel traffic in the Delaware River and Delaware Bay will increase by 94 one-way self-propelled vessel trips annually or 2,820 one-way self-propelled vessel trips over the 30-year project life due to the anticipated expanded use of the Port; this is in addition to the 64 one-way trips annually as existing sand transport operations continue (1,920 trips total over 30-years). The majority of the operational vessel trips will occur as part of the sand transport operation to Pier J in Brooklyn, NY (4,020 one-way self-propelled vessel trips over the 30-year life of the project, a total of 134 one-way barge and tug vessel trips annually). Based on the available information, we anticipate that these vessels will transit from the Port in the Salem River, down the Delaware River, through the Delaware Bay, along the coast of NJ in the Atlantic Ocean, through the Lower and Upper NY Bay, and up the East River to Pier J in Brooklyn, NY (Figure 4) traveling in identified fairways and navigational channels consistent with navigational best practices.

A total of 24 one-way vessels trips (Handymax vessel or smaller) are anticipated to occur annually (720 one-way vessel trips over the 30-year life of the project) as part of the future cargo and bulk material transport. Given that the tenants for these potential future operations are not known, the destination for these trips is entirely unknown. As such, the only portion of the vessel route that is known is transit between the Port in the Salem River, down the Delaware River, through the Delaware Bay and the Delaware Bay entrance. Beyond the mouth of the Delaware Bay, the transit route and destination is entirely unknown. This is addressed further in our consideration of the action area below.

3.4 Best Management Practices

During construction and operation of the Port, the applicant has committed to implementing measures to avoid, minimize, or mitigate adverse impacts to threatened and endangered species in the action area. These measures are considered part of the proposed action and are designed to address impacts that may result from construction and operation of the Port:

- All in-water construction will occur during the non-restricted period of July 1 through March 14 (or alternative period as defined by the USACE);
- Pile driving will employ a soft start and cushioned hammer;
- Dredging will utilize a closed clamshell bucket. Full depth cuts will be taken wherever possible to completely fill the dredge bucket with sediment and minimize the number of times the bucket is lowered into and raised from the water;
- The speed and motion of the dredge bucket will be controlled by a trained operator to avoid excessive disturbance to sediment or release of material;
- The dredge bucket will be completely emptied of its contents into the scow before reentering the water. No side casting of material shall occur;
- Dredged material will not be dewatered enroute to the disposal site,
- Regardless of vessel size, vessel operators will reduce vessel speed to 10 knots (18.5 km/hr) or less while operating in any Seasonal Management Area (SMA), Dynamic Management Area (DMA)/Slow Zones triggered by visual or acoustic detection of North Atlantic right whales, with appropriate exemptions for crew and vessel safety,
- Maintain vigilant watch for protected species during transit and execute vessel slow down and avoidance procedures when sightings occur,

- Report sightings of North Atlantic right whales to (866-755-6622), the U.S. Coast Guard via channel 16, or through the Whale Alert app. Information to include in the sightings report is listed [on this website](#),
- Brief all crew members on the identification of protected species, reporting protocols (see BMP above), along with regulations ([50 CFR 224.105](#)) and best practices for avoiding collisions;
- All underway vessels operating at any speed must have a dedicated visual observer on duty at all times to monitor for protected species within a 180-degree direction of the forward path of the vessel (90 degrees port to 90 degrees starboard). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements; For vessels operating at speeds greater than 10 knots, that observer/lookout must have no other duties during the period the vessel is traveling at speeds greater than 10 knots; Alternative monitoring technology, such as night vision and thermal cameras, must be available and used to ensure effective watch at night and in any other low visibility conditions (*e.g.*, rain, fog);
- Maintain 200 m distance from all whales, and 500 m from North Atlantic right whale;
- If a large whale is identified within the forward path of any vessel (1,000 m), the vessel operator will steer a course away from the whale at 10 knots (18.5 km/hr) or less until the minimum separation distance has been established. Vessels may also shift to idle if feasible;
- If a large whale is sighted within 200 m of the forward path of a vessel, the vessel operator will reduce speed to under 4 knots (7.45 km/hr) and steer a course away from the whale. If stationary, the vessel will not engage engines until the large whale has moved beyond 500 m;
- If a sea turtle is sighted within the operating vessel's forward path, the vessel operator will slow down to 4 knots (unless unsafe to do so) and steer away as possible. The vessel may resume normal operations once the vessel has passed the individual;
- From May 1 to November 30 when sea turtles are known to occur in the mid-Atlantic, vessels will avoid transiting through areas of visible jellyfish aggregations or floating vegetation (*e.g.*, Sargassum lines or mats). In the event that operational safety prevents avoidance of such areas, vessels should slow to 4 knots or less while transiting through such areas;

- Check for information regarding mandatory or voluntary ship strike avoidance areas and daily information regarding North Atlantic right whale sighting locations before the trip starts and during the trip as information is available using the WhaleMap website (<https://whalemap.org/>), NOAA weather radio, U.S. Coast Guard NAVTEX and channel 16 broadcasts, Notices to Mariners, or the Whale Alert app; and,
- Check the sea turtle sighting hotline (www.seaturtlesightings.org) prior to each trip and report any observations of sea turtles in the vicinity of the planned transit to all vessels.

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). Effects of the action are defined in 50 CFR 402.02 as "all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action."

For this consultation, the action area is determined by construction activities, vessel traffic during construction and operation of the Port, and effects of these activities. The action area consists of two subareas: 1) the Salem River adjacent to the existing Port where construction activities will take place, referred to as the "construction area," and 2) areas that will be transited by vessels during construction and/or operation of the Port, referred to as the "vessel transit area."

The construction area for the Port is located at approximately 39°34'33.40" N, 75°28'40.18" W. This area includes the 1.30 acres of dredging, 0.37 acres where the concrete deck will be constructed, 0.087 acres of backfill behind the sheet pile bulkhead, and the approximately 61 acres of the Salem River that may be temporarily affected by suspended sediment generated by dredging.

The vessel transit area includes:

- Approximately 101 acres (3.2 km²) within the Salem River Federal Navigation Channel of the Salem River from the Port to the Delaware River (58.4 RM, 93.9 RKM) where vessels will transit during construction and operation;
- Approximately 2,707 acres (38 km²) within the Delaware River Federal Navigation Channel from the confluence with the Salem River upriver to the White's Basin CDF (RM 82, RKM 132) where construction vessels will transit to deposit dredged material;
- Approximately 6,397 acres (93.9 km²) within the Delaware River Federal Navigation Channel from the mouth of the Salem River downstream to the mouth of the Delaware

Bay (RM 0, RKM 0) where all vessels will transit during operation of the Port (Figure 3); and,

- Approximately 194 nm (359 km²) within the Atlantic Ocean in waters along the coast of NJ from the mouth of the Delaware Bay to Pier J in Brooklyn, NY where vessels transiting to Pier J are expected to transit (Figure 4). These vessels are expected to transit the aforementioned route from the Port to the mouth of Delaware Bay, and will continue on within coastal waters off of NJ (approximately five miles off the coast, in the Atlantic Ocean), through Lower and Upper NY Bay to Pier J in Brooklyn, NY located within the lower East River. These vessels will travel approximately 396 nm (456 km²) one-way from the Port to Pier J.

In the Delaware River and Delaware Bay, the action area for all vessel traffic related to Port operation occupies approximately 9,205 acres, which includes the construction area and the vessel transit area. The action area includes the construction area, the area where vessel trips for transport of construction vessels and vessels for Port operation will transit. This will encompass all of the in-water areas where effects of the action will occur.

In the BA, the potential for up to 24 one-way annual vessel transits are described in association with the proposed expanded use of the Port beyond sand transportation (720 one-way trips over 30 years). Beyond a reasonable determination that all of these vessels will travel within existing Federal navigation channels between the mouth of Delaware Bay and the Port of Salem, vessel routes are unknown and would be dependent on the origin/destination and depend, on a trip-by-trip basis, on future contracts and procurements as well as weather and sea-state conditions, other vessel traffic, and any maritime hazards. Because the origin, destination, and vessel transit routes are unknown, we are not able to identify what areas outside Delaware Bay will be affected directly or indirectly by the Federal action; that is, while we recognize that there will be vessel trips outside of the Delaware Bay by these 24 one-way vessel trips each year that visit the Port of Salem that would not occur but for the approval of this project, we cannot identify what areas vessel transits will occur beyond the Delaware Bay. Although these vessel transits may be caused by the proposed action, without specific information including the ports of destination and routes of vessel transit, we cannot predict that specific consequences of the vessel trips past the mouth of the Delaware Bay on listed species are reasonably certain to occur, and they are therefore not considered effects of the proposed action (see 50 CFR 402.17(a)-(b)). Therefore, the action area is limited to the area described above, including the project area and the vessel transit area for all construction and operational vessels between the Port of Salem and the mouth of Delaware Bay and the route between the mouth of Delaware Bay and Pier J in Brooklyn, NY for the sand operation vessels.

Figure 3. Vessel transit area for construction vessels to and from the dredge placement site in the Delaware River and Delaware Bay (Environmental Research and Consulting, Inc. 2025)



Figure 4. Vessel routes for sand operations to and from Pier J, Brooklyn, NY (Environmental Research and Consulting, Inc. 2025)



4 STATUS OF THE SPECIES

We have determined that the action being considered in this Opinion may affect the following endangered or threatened species under our jurisdiction (Table 3):

Table 3. ESA-listed species in the Action Area

ESA-Listed Species	Latin Name	Distinct	Status	Federal	Recovery
Giant Manta Ray	<i>Manta birostris</i>	Range-wide	Threatened	83 FR 2916	N/A
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Range-wide	Threatened	83 FR 4153	N/A
Sei Whale	<i>Balaenoptera borealis</i>	Range-wide	Endangered	35 FR 18319	(NMFS 2011a)
Blue Whale	<i>Balaenoptera musculus</i>	Range-wide	Endangered	35 FR 18319	(NMFS 2020c)
Sperm Whale	<i>Physeter macrocephalus</i>	Range-wide	Endangered	35 FR 18319	(NMFS 2010b)
North Atlantic Right Whale	<i>Eubalaena glacialis</i>	Range-wide	Endangered	73 FR 12024	(NMFS 2005)
Fin Whale	<i>Balaenoptera physalus</i>	Range-wide	Endangered	35 FR 18319	(NMFS 2010a)
Loggerhead Turtle	<i>Caretta caretta</i>	Northwest Atlantic	Threatened	76 FR 58868	(NMFS and U.S. FWS 2008)
Leatherback Turtle	<i>Dermochelys coriacea</i>	Range-wide	Endangered	35 FR 8491	(NMFS and U.S. FWS 1992)
Green Turtle	<i>Chelonia mydas</i>	North Atlantic	Threatened	81 FR 20057	(NMFS and U.S. FWS 1991)
Kemp's Ridley Turtle	<i>Lepidochelys kempii</i>	Range-wide	Endangered	35 FR 18319	(NMFS <i>et al.</i> 2011)
Atlantic Sturgeon	<i>Acipenser oxyrinchus oxyrinchus</i>	Gulf of Maine; NY Bight; Chesapeake Bay; Carolina; South Atlantic	Endangered except for Gulf of Maine DPS (threatened)	77 FR 5880 and 77 FR 5914	N/A

Shortnose Sturgeon	<i>Acipenser brevirostrum</i>	Range-wide	Endangered	32 FR 4001	(NMFS 1998)

Designated critical habitat for Atlantic sturgeon is present in the action area.

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

The proposed project being considered in this Opinion is not likely to adversely affect the following ESA-listed species and designated critical habitat: giant manta ray, oceanic whitetip shark, sei whale, blue whale, sperm whale, North Atlantic right whale, fin whale, North Atlantic right whale critical habitat, and Atlantic sturgeon critical habitat. The rationale for this “not likely to adversely affect” determination is presented below.

4.1.1 Giant Manta Ray

The giant manta ray inhabits temperate, tropical, and subtropical waters worldwide, between 35° N and 35° S latitudes. In the western Atlantic Ocean, this includes South Carolina south to Brazil and Bermuda. Off the U.S. Atlantic coast, nearshore distribution is limited to areas off the Florida coast; otherwise, distribution occurs in offshore waters at the shelf edge. Occasionally, giant manta rays are observed as far north as Long Island (Miller 2017, Farmer et al. 2022); however, these sightings are in offshore waters along the continental shelf edge and the species is considered rare in waters north of Cape Hatteras. Distribution of giant manta rays is limited by their thermal tolerance (19-22°C off the U.S. Atlantic coast) and influenced by depth. As noted by Farmer *et al.* (2022a), cold winter air and sea surface temperatures in the western North Atlantic Ocean likely create a physiological barrier to manta rays that restricts the northern boundary of their distribution. Giant manta rays frequently feed in waters at depths of 200 to 400 m (656 to 1,312 ft) (NMFS 2019a). The depths where vessels will be transiting off of the NJ coast from Delaware Bay to Brooklyn, NY for sand transport operations are not expected to exceed 37 m (120 ft) in depth, therefore, no portion of the action area is expected to overlap with giant manta ray feeding.

Farmer *et al.* (2022b) summarized results of NYSERDA surveys carried out from nearshore to offshore marine environments of NY, with temporal coverage during the spring/summer of 2016–2019 and fall/winter of 2016–2018. Of the 21,539 rays identified in the surveys, seven were giant manta rays. Farmer et al. (2022) reports that despite comprehensive coast to shelf survey coverage, giant manta ray sightings were exclusively in August on the continental shelf edge. Giant manta rays travel long distances during seasonal migrations and may be found in upwelling waters at the shelf break south of Long Island, where they could potentially occur within the waters of the United States Exclusive Economic Zone (U.S. EEZ). According to the

OBIS-SEAMAP database¹, one giant manta ray was recorded in the vessel transit portion of the action area off the coast of NJ adjacent to Barnegat Township in 1979 (Roberts *et al.* 2016).

Given the distribution of giant manta rays, we have considered the potential for effects of vessels transiting off of the NJ coast from Delaware Bay to Brooklyn, NY for sand transport operations related to Port operations. Giant manta rays can be frequently observed traveling just below the surface and will often approach or show little fear toward humans or vessels (Coles 1916), which may also make them vulnerable to vessel strikes (Deakos 2010). Vessel strikes can injure or kill giant manta rays, decreasing fitness or contributing to non-natural mortality (Couturier *et al.* 2012); Deakos *et al.* 2010); however, vessel strikes are considered rare. Information about interactions between vessels and giant manta rays is limited. We have some reports of vessel strike, including a report of five giant manta rays struck by vessels from 2016 through 2018; individuals had injuries (i.e., fresh or healed dorsal surface propeller scars) consistent with a vessel strike. These interactions were observed by researchers conducting surveys from Boynton Beach to Jupiter, Florida (J. Pate, Florida Manta Project, pers. comm. to M. Miller, NMFS OPR, 2018) and it is unknown where the manta was at the time of the vessel strike. The geographic area considered to have the highest risk of vessel strikes for giant manta ray is nearshore coastal waters and inlets along the east coast where recreational vessel traffic is concentrated, therefore, giant manta rays may be transiting through the action area where vessel routes occur. However, given the few instances of confirmed or suspected strandings of giant manta rays attributed to vessel strike injury, the risk of giant manta rays being struck by vessels is considered low. This lack of documented mortalities could also be the result of other factors that influence carcass detection (i.e., wind, currents, scavenging, decomposition etc.); however, giant manta rays appear to be able to be fast and agile enough to avoid most moving vessels, as anecdotally evidenced by videos showing rays avoiding interactions with high-speed vessels (Barnette 2017). The speed and maneuverability of giant manta rays, the slow operating speed of project vessels transiting through the portion of the action area where giant manta rays occur and the dispersed nature of giant manta ray distribution where these vessels will operate, any effects of the proposed action extremely unlikely to occur. Therefore, the proposed action is not likely to adversely affect the giant manta ray.

4.1.2 Oceanic Whitetip Shark

The oceanic whitetip shark is usually found offshore in deep waters of the open ocean, on the outer continental shelf, or around oceanic islands in deep water greater than 184 m (Bonfil *et al.* 2008, Young *et al.* 2017). As noted in Young *et al.* (2017), the species has a clear preference for open ocean waters between 10°N and 10°S, but can be found in decreasing numbers out to latitudes of 30°N and 35°S, with abundance decreasing with greater proximity to continental shelves. In the western Atlantic, oceanic whitetips occur from Maine to Argentina, including the Caribbean and Gulf of America (Young *et al.* 2017). In the central and eastern Atlantic, the

¹ <https://seamap.env.duke.edu/species/180528>; last accessed April 9, 2025.

species occurs from Madeira, Portugal south to the Gulf of Guinea, and possibly in the Mediterranean Sea. The species can be found in water temperatures between 15 °C and 28 °C, but it exhibits a strong preference for the surface mixed layer in waters with temperatures above 20 °C (Bonfil *et al.* 2008) and is considered a surface-dwelling shark. Little is known about movements or possible migration paths (Young *et al.* 2017). Given that oceanic whitetip sharks are typically found offshore in deep waters of the open ocean, it is extremely unlikely that oceanic whitetip shark are present within the action area where vessels transiting offshore of NJ (five miles from the coast within depths up to 37 m (120 ft)) will occur. Therefore, the proposed action is not likely to adversely affect the oceanic whitetip shark.

4.1.3 Sei Whale

Sei whales occur in subtropical, temperate, and subpolar marine waters across the Northern and Southern Hemispheres (Cooke 2018, NMFS 2011a). For management purposes, in the Northern Hemisphere, the United States recognizes four sei whale stocks: Hawaii, Eastern North Pacific, and Nova Scotia (NMFS 2011a). They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed on a range of prey types, including: plankton (copepods and krill), small schooling fishes, and cephalopods. Throughout their range, sei whales occur predominantly in deep water; they are most common over the continental slope, shelf breaks, and deep ocean basins situated between banks (NMFS 2011a). According to the OBIS-SEAMAP database (Roberts *et al.* 2016), within the last 20 years, one sei whale sighting was reported off of Long Island, NY, in the vicinity of the vessel transit portion of the action area, in 2005, but this is considered to be extremely rare. Given that sei whales mostly inhabit continental shelf and slope waters far from the coastline, sei whales are not expected to be present where vessels routes for sand transport operations are expected to occur offshore of NJ (five miles from the coast within depths up to 37 m (120 ft)) and any effects of the proposed action extremely unlikely to occur. Therefore, the proposed action is not likely to adversely affect the sei whale.

4.1.4 Blue Whale

In the North Atlantic Ocean, the range of blue whales extends from the subtropics to the Greenland Sea. As described in Hayes *et al.* (2020; the most recent stock assessment report), blue whales have been detected and tracked acoustically in much of the North Atlantic with most of the acoustic detections around the Grand Banks area of Newfoundland and west of the British Isles. Photo-identification in eastern Canadian waters indicates that blue whales from the St. Lawrence, Newfoundland, Nova Scotia, New England, and Greenland all belong to the same stock, while blue whales photographed off Iceland and the Azores appear to be part of a separate population (CETAP 1982; Wenzel *et al.* 1988; Sears and Calambokidis 2002; Sears and Larsen 2002). The largest concentrations of blue whales are found in the lower St. Lawrence Estuary (Lesage *et al.* 2018), Comtois *et al.* 2010) which is outside of the action area. Blue whales do not regularly occur within the U.S. EEZ and typically occur further offshore in areas with depths of 100 m or more (Waring *et al.* 2010). Within the last 20 years, no blue whale sightings have

been recorded in the action area where vessel traffic related to Port operations will occur, according to the OBIS-SEAMAP database (Roberts et. al 2016). Furthermore, Waring et al. (2010) concluded that the blue whale is best considered as an occasional visitor in U.S. EEZ waters. Given that blue whales typically occur further offshore in areas with depths of 100 m or more, blue whales are not expected to be present where vessels routes for sand transport operations are expected to occur offshore of NJ (five miles from the coast within depths up to 37 m (120 ft)) and effects of the proposed action extremely unlikely to occur. Therefore, the proposed action is not likely to adversely affect the blue whale.

4.1.5 Sperm Whale

Globally there is one species of sperm whale, *Physeter macrocephalus*. Sperm whales occur in all major oceans of the Northern and Southern Hemispheres (NMFS 2010b). For management purposes, in the Northern Hemisphere, the United States recognizes six sperm whale stocks: California/Oregon/Washington, Hawaii, North Pacific, North Atlantic, Northern Gulf of Mexico², and Puerto Rico and the U.S. Virgin Islands (NMFS 2010b).

The sperm whale is the largest toothed whale and distinguishable from other whales by its extremely large head, which takes up 25 to 35% of its total body length and a single blowhole asymmetrically situated on the left side of the head near the tip. The average lifespan of sperm whales is estimated to be at least 50 years (Whitehead 2009). They have a gestation period of one to one and a half years, and calves nurse for approximately two years, though they may begin to forage for themselves within the first year of life (Tønnesen *et al.* 2018). Sexual maturity is reached between 7 and 13 years of age for females with an average calving interval of four to six years. Male sperm whales reach full sexual maturity in their 20s. Sperm whales mostly inhabit areas with a water depth of 600 m or more, and are uncommon in waters less than 300 m deep. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed primarily on squid; other prey includes octopus and demersal fish (including teleosts and elasmobranchs). Given that sperm whales typically inhabit areas with a water depth of 600 m or more, sperm whales are not expected to be present where vessels routes for sand transport operations are expected to occur offshore of NJ (five miles from the coast within depths up to 37 m (120 ft)) and effects of the proposed action extremely unlikely to occur. Therefore, the proposed action is not likely to adversely affect the sperm whale.

4.1.6 North Atlantic Right Whale

North Atlantic right whales are large baleen whales. Their primary food sources are zooplankton, including copepods, euphausiids, and cyprids. Right whales commonly feed at or just below the water's surface and at depth. Right whales primarily occur in coastal or shelf waters, although movements over deep waters are known to have occurred. In the mid-Atlantic, adult and juvenile North Atlantic right whales occur throughout the continental shelf and slope

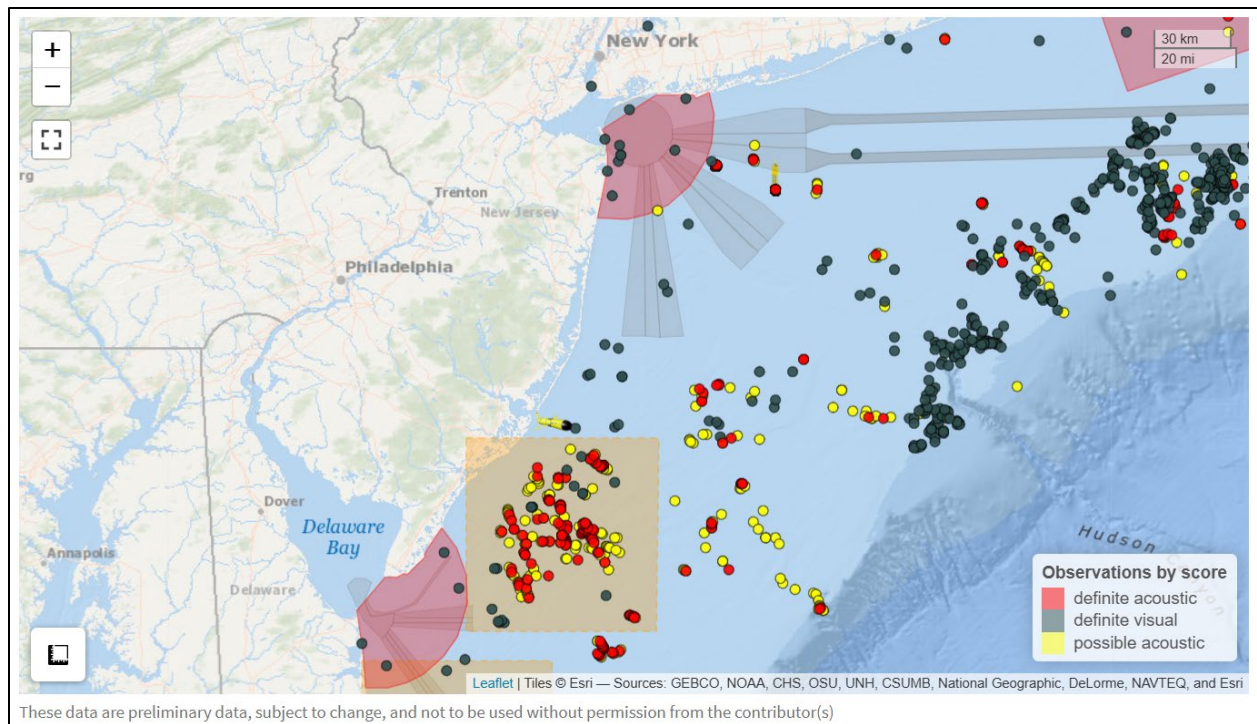
² Gulf of America is referred to in the listing as Gulf of Mexico (NMFS 2010b)

waters, possibly off shore of NJ and Virginia. Whales begin moving north along the coast in the vicinity of Delaware Bay and the NY Bight during November to April while on their way to northern foraging and aggregation areas. Right whales are commonly found foraging from January to October and overwintering from November to January in waters in and around Massachusetts Bay and north along the east coast into Canadian waters. 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.

Right whales could be present in the action area in NY/NJ nearshore and coastal waters of the Atlantic Ocean as they migrate to and from calving and foraging grounds year-round. Right whale sightings have been documented at the mouth of the Delaware Bay and in a few rare occasions within the Bay. No right whales have been observed inland of the COLREGS Demarcation Line at Delaware Bay since 2002 (NMFS 2017e). Right whales are most likely to occur in waters off the NJ coast between November and April as they migrate between northern foraging and southern calving grounds, but could be present year-round (NMFS 2017d). Given the lower salinity and shallower depths throughout the action area in the Delaware River compared to offshore marine waters, right whales are not present in the lower Delaware River.

Sightings and satellite tracking data along the east coast indicate that endangered large whales such as right whales rarely venture into bays, harbors, or inlets (Southall and Scholik-Schlomer 2007). However, although unlikely, it is possible that migrating adult and juvenile whales may be seasonally present within the Delaware Bay, the Upper and Lower NY Bay, and the East River. Whalemap, the online interactive mapping website for NARW sightings, indicated that one NARW was recorded in the mouth of the Upper NY Bay and in the East River from the January 1, 2003 to June 16, 2023 dataset (Figure 5) (Johnson *et al.* 2021).

Figure 5. NARW sightings in the action area from January 2003 through June 2023 (Johnson et al. 2021).



4.1.7 Fin Whale

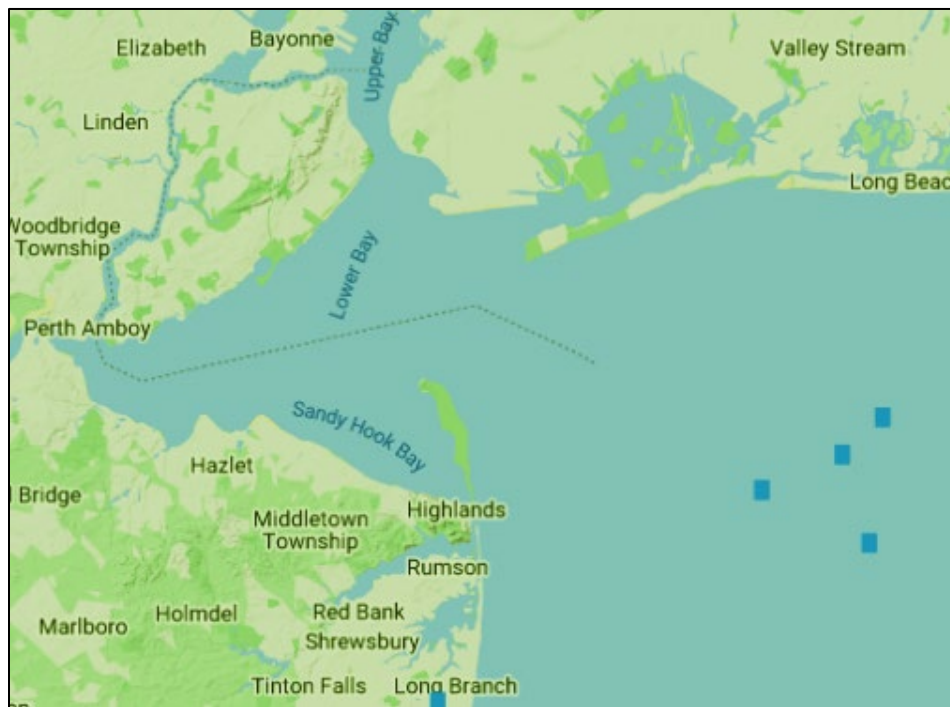
Fin whales are found in deep, offshore waters of all major oceans, primarily in temperate to polar latitudes, and less commonly in the tropics. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed, although some fin whales appear to be residential to certain areas. Fin whales occupy both deep and shallow waters and are likely the most abundant large cetacean in New York/New Jersey waters. Fin whale presence and behavior in the action area is best understood in the context of their range. Fin whale presence in the North Atlantic is limited to waters north of Cape Hatteras, NC. Fin whales are believed to use the North Atlantic water primarily for feeding and more southern waters for calving. Movement of fin whales from the Labrador/Newfoundland region south into the West Indies during the fall have been reported (Clark 1995). The U.S. Mid-Atlantic from October through January is a possible offshore calving area (Hain *et al.* 1992). In general, fin whales in the central and eastern Atlantic tend to occur most abundantly over the continental slope and on the shelf seaward of the 200-m isobath (Rørvik *et al.* 1976 in NMFS 2010). In contrast, off the eastern United States they are centered along the 100-m isobath but with sightings well spread out over shallower and deeper water, including submarine canyons along the shelf break (Kenney 1986), Hain *et al.* 1992). Fin whales are migratory, moving seasonally into and out of feeding areas, but the overall migration pattern is complex and specific routes are unknown (NMFS 2018).

The northern Mid-Atlantic Bight represents a major feeding ground for fin whales as the physical and biological oceanographic structure of the area aggregates prey. This feeding area extends in a zone east from Montauk, Long Island, NY, to south of Nantucket (LaBrecque *et al.* 2015,

Kenney and Vigness-Raposa 2010; NMFS 2010a) and is a location where fin whales congregate in dense aggregations and sightings frequently occur (Kenney and Vigness-Raposa 2010); this does not overlap with the action area. Fin whales in this area feed on krill (*Meganyctiphanes norvegica* and *Thysanoessa inermis*) and schooling fish such as capelin (*Mallotus villosus*), herring (*Clupea harengus*), and sand lance (*Ammodytes* spp.) (Borobia et al. 1995) by skimming the water or lunge feeding. This area is used extensively by feeding fin whales from March to October. Several studies suggest that distribution and movements of fin whales along the east coast of the United States is influenced by the availability of sand lance (Kenney and Winn 1986, Payne 1990).

Acoustic studies in Estabrook *et al.* (2022) detected fin whales in the U.S. Mid-Atlantic every month of the year in their study period from 2017 to 2019. The results of these acoustic studies are consistent with the observations in Zoidis *et al.* (2021) where fin whales were sighted at least once in each month of the calendar year across the 3 years and in each survey season, throughout the study area across all habitat zones. A query of the Ocean Biodiversity Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) online mapping tool indicates that fin whales occur in relative low numbers in the NY Bight waters, to the east and outside of the action area (Figure 6) (Halpin *et al.* 2009).

Figure 6. Sightings of fin whales in the New York Bight from 2005 to 2022 (Halpin *et al.* 2009).



4.1.7.1 North Atlantic Right Whale and Fin Whale Presence in the Action Area

Fin and right whales occur in New York/New Jersey nearshore and coastal waters of the Atlantic

Ocean as they migrate to and from calving and foraging grounds, and along the continental shelf and slopes of the Mid-Atlantic (NMFS 2017c). 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 *et al.* 2021). We expect right whales to be moving through the action area year-round, making seasonal migrations, and possibly foraging when copepod patches of sufficient density to trigger feeding behavior are present. Calving North Atlantic right whales are not anticipated to occur in the action area. Therefore, adult and juvenile North Atlantic right whales could be present year-round within the action area along the NJ coast. They may also be present in the Upper or Lower NY Bay and the Delaware Bay. Fin whales are typically found in deep, offshore waters and transit in the open seas, away from the coast (NMFS 2010a). However, they may occupy both deep and shallow waters in and around Delaware Bay and the NY Bight. Fin whales may use the nearshore, coastal waters of the action area as they migrate to and from calving and foraging grounds. There is evidence of wintering areas in mid-shelf areas east of NJ. Fin whale calving may take place offshore in mid-Atlantic waters from October to January. Fin whales are likely the most abundant large cetacean in NY/NJ waters. They are most abundant in spring, summer, and fall, but may have some presence during the winter months. Therefore, adult and juvenile fin whales could be present year-round within the action area along the NJ coast. They may also be present in the Upper or Lower NY Bay and the Delaware Bay. Given the low salinity and shallow depths, right and fin whales are not expected to be present in the lower Delaware River or the Salem River.

4.1.7.2 *Consequences of Vessel Activity on North Atlantic Right Whales and Fin Whales*

Operational vessels for sand transportation activities will transit along the coast of NJ from the mouth of the Delaware Bay to the mouth of the Lower NY Bay for a total of 134 one-way trips per year over the 30-year project life. Construction vessels supporting dredging and pile driving activities will travel within the Salem River and the Delaware River and are not expected transit the East River, Upper NY Bay, Lower NY Bay, and along the NJ coast. Thus, whales will not be exposed to these construction vessels. Ports of destinations and origin for the 24 annual operational vessel trips related to general cargo and bulk material transport are not known at this time, therefore, we only consider their routes from the Port to the mouth of the Delaware Bay and may overlap with whale presence.

Operational vessel routes for sand transportation and general cargo and bulk material transportation activities overlap with North Atlantic right whales and fin whales. Listed whales use portions of the action area throughout the year, specifically where operational vessels transit along the coast of NJ from the mouth of the Delaware Bay to the mouth of the Lower NY Bay. Right whales are most likely to occur in waters off the NJ and NY coast between November 1 and April 30 as they migrate between northern foraging and southern calving grounds (NMFS 2017c). Adult and juvenile right whales could theoretically be present in the action area in or at the mouth of the Upper NY Bay, Lower NY Bay, Delaware

Bay, but they have very rarely been observed in these waters. According to WhaleMap³, in the last five years, January 1, 2020 to December 31, 2024, a right whale was visually detected eight times within five miles of off NJ, which is within the proposed operational vessel route. All of the detections occurred within the vicinity of the mouth of the Delaware Bay (n= 1) and at the mouth of Lower NY Bay (n = 6), with one visual detection of a right whale occurring at The Narrows, the location where the Upper NY Bay meets the Lower NY Bay, which is considered extremely rare. Given that depths are shallower than marine waters where their food resources are present, it is unlikely that right whales are present in the East River and Delaware River.

Adult and juvenile fin whales could be present in the action area in or at the mouth of the Upper NY Bay, Lower NY Bay, Delaware Bay, but they have never been observed in these waters. Given that depths are shallower than marine waters where their food resources are present, it is unlikely that fin whales are present in the East River and Delaware River. Between January 2020 and December 2024, five fin whales were visually detected within five miles of the New Jersey coastline. Fin whales are typically found in deep, offshore waters and transit in the open seas, away from the coast (NMFS 2010a). For both fin whales and right whales, most detections, visual and acoustic, were ten miles or more from the coastline of NJ. Large whales are typically not common in the nearshore environment and are rarely expected to overlap with the Port operational vessel routes, which will occur approximately five miles from the coastline.

Injuries and mortalities from vessel strikes are a threat to right and fin whales. Reports from 2008 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. We identified any records of mortality of listed whales consistent with vessel strike that were first detected in waters of NY and NJ⁴, the coastal area where vessels will transit between the Port and Brooklyn, NY. Since 2008, there have been a total of six fin whale and one North Atlantic right whale mortalities likely caused by vessel strikes in the action, specifically waters near the mouth of the Delaware Bay, in waters along the NJ coast, and in waters near to the mouth of the Lower NY Bay (Henry 2022, Henry *et al.* 2017, Henry *et al.* 2015) Hayes *et al.* 2024). The annual average of vessel strikes between 2012 and 2016 in U.S. waters was 1.4 for fin whales (Hayes *et al.* 2019). 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

³ <https://whalemap.org/WhaleMap/>, last accessed 7/2/2025

⁴ We note that the location of where a vessel strike occurs is not always known and the location the animal is first documented may not be the location where the strike occurred.

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. 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 of a vessel strike decreases to less than 50 percent, and at 10 knots or less, the probability is further reduced to approximately 30 percent. Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003, Laist *et al.* 2001). Therefore, vessel strikes that injure or kill whales are most likely occur when vessels travel at speeds of 10 knots or more (Laist *et al.* 2001, Pace and Silber 2005, Vanderlaan and Taggart 2007).

A recent study by Garrison *et al.* (2025) demonstrates that vessel size in addition to vessel speed is also an important factor when considering the probability of lethality from vessel strikes on large whales. The study uses a vessel strike encounter risk model to evaluates the vessel strike risk to large whales by vessel size. Garrison *et al.* (2025) concludes that slower vessel speeds reduce the likelihood of a lethal strike for all size vessels. The study also concludes that the risk of a lethal strike from a slow-moving vessel less than 108 m (approximately 350 ft in length) is less than the risk posed by large vessels. Vessel size, in addition to vessel speed, is an important consideration in determining the severity of vessel strikes on large whales.

As described above in the *Best Management Practices* section, MARAD and USACE propose to implement specific measures related to vessel speed reduction. These include speed restrictions for vessels greater than or equal to 19.8 m (65 ft) in overall length. Vessels greater than or equal to 19.8 m (65 ft) will operate at 10 knots or less when within any active Seasonal Management Area (SMA) or Dynamic Management Area (DMA). 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 460 m (500 yards) of the vessel. For all other whale species, a 100 yard buffer would be maintained. In addition, all underway vessels will have a lookout to monitor for protected species, with that lookout having no other duties when the vessel is transiting. Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003; Laist *et al.* 2001). Vanderlaan and Taggart (2006) showed that at speeds below 11.8 knots, the probability of a ship strike decreases drastically. Based on the best available scientific evidence, a maximum speed of 10 knots, as measured as “speed over ground,” in certain times and locations, is the most effective and practical approach to reducing the threat of ship strikes to right whales (50 CFR Part 224). Furthermore, Garrison *et al.* (2025) concludes that slower vessel speeds reduce the likelihood of a lethal strike for all size vessels and that the risk of a lethal strike from a slow-moving vessel less than 108 m (approximately 350 ft in length) is less than the risk posed by large vessels. All operational vessels will be less than 108 m (350 ft) in length.

The measures maximize the likelihood that during all times of the year and in all weather conditions that if whale is in the vicinity of a vessel, the whale is detected. Furthermore, measures to avoid vessel strike are incorporated as part of MARAD and USACE's action and will be applicable to the vessels associated with the Port. Collisions with cargo vessels could occur, but reduced speeds (up to 10 knots) during transit lessens the probability of a ship strike resulting in lethal or serious injuries. Requirements to steer a course away from a whale may further reduce the risk of vessel-whale collisions.

Given the inshore (within five miles of the NJ coastline and within the Delaware Bay, Upper and Lower NY Bay) areas where vessel transits, the fact that vessels will travel at a speed of 10 knots or less, and the requirement that vessels keep a 100-500 yard distance from an observed whale, we find it extremely unlikely that a fin or North Atlantic right whale will be exposed to a vessel strike. The minimization measures that are specifically designed to reduce risk of project vessels striking a right or fin whale will further reduce that risk and make it extremely unlikely that a project vessel will strike a right or fin whale. Therefore, effects to North Atlantic right whales and fin whales from vessels related to Port operation are extremely unlikely to occur.

4.1.8 North Atlantic Right Whale Critical Habitat

On January 27, 2016, we issued a final rule designating critical habitat for North Atlantic right whales. Critical habitat includes Unit 1 located in the Gulf of Maine and Georges Bank Region and Unit 2 off the coast of North Carolina, South Carolina, Georgia and Florida. The action area where vessels will transit for sand mining operations does not overlap with Unit 1 or Unit 2 of North Atlantic right whale critical habitat. Therefore, we have determined that the proposed action will have no effect on North Atlantic right whale critical habitat.

4.1.9 Atlantic Sturgeon Critical Habitat

On August 17, 2017, we issued a final rule to designate critical habitat for the threatened Gulf of Maine DPS of Atlantic sturgeon, the endangered NY Bight DPS of Atlantic sturgeon, the endangered Chesapeake Bay DPS of Atlantic sturgeon, the endangered Carolina DPS of Atlantic sturgeon, and the endangered South Atlantic DPS of Atlantic sturgeon (82 FR 39160). The rule was effective on September 18, 2017. The action area overlaps with the Delaware River critical habitat unit designated for the NY Bight DPS.

The conservation objective identified in the final rule is to increase the abundance of each DPS by facilitating increased successful reproduction and recruitment to the marine environment. We designated four critical habitat units to achieve this objective for the NY Bight DPS: (1) Connecticut River from the Holyoke Dam downstream for 140 RKMs to where the main stem river discharges at its mouth into Long Island Sound; (2) Housatonic River from the Derby Dam downstream for 24 RKMs to where the main stem discharges at its mouth into Long Island Sound; (3) Hudson River from the Troy Lock and Dam (also known as the Federal Dam)

downstream for 246 RKMs to where the main stem river discharges at its mouth into NY City Harbor; and, (4) Delaware River at the crossing of the Trenton-Morrisville Route 1 Toll Bridge, downstream for 137 RKMs to where the main stem river discharges at its mouth into Delaware Bay. In total, these designations encompass approximately 547 km (340 mi) of aquatic habitat.

As identified in the final rule, the physical features that are essential to the conservation of the species and that may require special management considerations or protection are:

- 1) Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0 to 0.5 ppt range) for settlement of fertilized eggs, refuge, growth, and development of early life stages;
- 2) Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development;
- 3) Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support:
 - (i) Unimpeded movement of adults to and from spawning sites;
 - (ii) Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and
 - (iii) Staging, resting, or holding of subadults or spawning condition adults.Water depths in main river channels must also be deep enough (e.g., at least 1.2 m) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river.
- 4) Water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support:
 - (i) Spawning;
 - (ii) Annual and interannual adult, subadult, larval, and juvenile survival; and
 - (iii) Larval, juvenile, and subadult growth, development, and recruitment (e.g., 13 °C to 26 °C for spawning habitat and no more than 30 °C for juvenile rearing habitat, and 6 milligrams per liter (mg/L) dissolved oxygen (DO) or greater for juvenile rearing habitat).

The ESA Section 4(b)(2) Report for Atlantic sturgeon critical habitat (NMFS (National Marine Fisheries Service) 2017) provides background information on the current status and function of the four critical habitat units designated for the NY Bight DPS, and summarizes their ability to support reproduction, survival, and juvenile development, and recruitment. Information on the status of the Delaware River critical habitat unit can be found below.

As we described above, the Delaware River Critical Habitat Unit extends from the Trenton-

Morrisville Route 1 Toll Bridge at approximately RKM 214.5 (RM 133.3), downstream to where the main stem river discharges into Delaware Bay at approximately RKM 78 (RM 48.5). The action area includes the Federal Navigation Channel downstream to the mouth of the river with the Delaware Bay at RKM 78 (RM 48.5) and upstream to the White's Basin CDF (RM 82, RKM 132) and thus overlaps with critical habitat. The action area encompasses the confluence of the Salem River with the Delaware River (RM 58.4, RKM 93.9) where construction and vessels related to Port operation will transit. The Port is located in the Salem River, which does not contain designated critical habitat for Atlantic sturgeon. Construction activities at the Port will not overlap with critical habitat and, therefore, will not be considered further. The portion of the action area overlapping with critical habitat within the Delaware River contains PBFs 1, 2, 3, and 4.

In this analysis, we consider the direct and indirect effects of the construction activities and operation of the Port on each of four physical and biological features (PBF) of the critical habitat. For each PBF, we identify the activities that may affect the PBF. For each feature that may experience effects of the action, we then determine whether those effects to the feature are adverse, insignificant, extremely unlikely or entirely beneficial. In making this determination, we consider the action's potential to affect how each PBF supports the species conservation needs in the action area. Part of this analysis is consideration of whether the action will have effects to the ability of Atlantic sturgeon to access the feature, temporarily or permanently, and consideration of the effects of the action on the action area's ability to develop the feature over time.

4.1.9.1 Physical and Biological Feature 1

Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0–0.5 ppt range) for settlement of fertilized eggs, refuge, growth, and development of early life stages

In considering effects to PBF 1, we consider whether the proposed action will have any effects on areas of hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0–0.5 ppt range) for settlement of fertilized eggs, refuge, growth, and development of early life stages. Therefore, we consider how the action may affect hard bottom substrate and salinity and how any effects may change the value of this feature in the action area. We also consider whether the action will have effects on access to this feature, temporarily or permanently and consider the effect of the action on the action area's ability to develop the feature over time.

Because salinity shifts daily, seasonally and annually, it is not possible to identify exactly where the break between PBF 1 and PBF 2 will be at any given time. However, we can use available salinity information to identify the general reaches where salinity is typically at 0.5 ppt or below. The Delaware River Basin Commission (DRBC) defines the salt front as the area in the river

where the water registers 250 milligrams per liter (0.25 ppt) chloride concentration. Due to its dynamic nature, the location of the salt front fluctuates depending on several variables, namely the tidal inflow and streamflow, as well as scheduled water releases from five reservoirs used to push back the location of the salt front. These variations can cause a specific salinity value or range to move upstream or downstream by as much as 16 km (~10 mi) in a day due to semi-diurnal tides, and by more than 32 km (~20 miles) over periods ranging from a day to weeks or months due to storm and seasonal effects on freshwater inflows (USACE 2009). DRBC reports the median location of the salt front to be from RKM 107.8 to RKM 122.3 (RM 67 to RM 76) (DRBC 2017). The border between PBF 1 and PBF 2 is where salinity is 0.5 ppt. Given the dynamic nature of salinity near the salt front, the availability of data on salinity levels of 0.25 ppt and not 0.5 ppt and the very small area where there would be a difference in salinity between 0.25 and 0.5 ppt, it is reasonable to use the furthest downstream extent of the median range of the location of the salt front (0.25 ppt) as a proxy for the downstream border of PBF 1 in the Delaware River. For this Opinion, we consider the area upstream of RKM 122.3 (RM 76) to have salinity levels consistent with the requirements of PBF 1. The action area within PBF 1 includes the Federal Navigation Channel between RKM 122.3 (RM 76) and White's Basin CDF at RKM 132 (RM 82).

Within the freshwater reaches of the Delaware River designated as critical habitat, PBF 1 occurs where there is hard bottom substrate for settlement of fertilized eggs, refuge, growth, and development of early life stages. We estimate the freshwater area of critical habitat in the Delaware River (all of which is in the action area) to be 28,436 acres. From tagging and tracking studies, we know that Atlantic sturgeon spawning may occur upstream of the salt front over hard bottom substrate between Claymont, DE/Marcus Hook, PA (Marcus Hook Bar), approximately RKM 125 (RM 77.7), and the fall line at Trenton, NJ, approximately RKM 212 (RM 131.7) (Breece et al. 2013; Simpson 2008). Within that range, DiJohnson et al. 2015 provided evidence for suitable spawning habitat made of outcrops of bedrock and non-depositional, mixed grained material (i.e., hard but not stationary), occurs both within the navigation channel and along the northern edge of the channel near the Eddystone Range (~RKM 133-138/RM 82.6-85.7).

Activities that occur within the portion of the Delaware River that contains PBF 1 include vessel traffic in the Federal Navigation Channel. Here we consider whether that activity may affect PBF 1 and if so, whether those possible effects are insignificant, extremely unlikely, entirely beneficial or adverse.

During construction, project vessels will transport dredge material to the upriver disposal site, White's Basin CDF, and will use the Federal Navigation Channel (total of 14 one-way vessel trips) within PBF 1. Vessels related to Port operation will not transit areas with PBF 1. The vast majority of the substrate in the Federal Navigation Channel from Philadelphia to the Sea (i.e., mouth of the Delaware Bay) are soft. Vessel propellers can scour the riverbed, however, for the propeller jet to scour the coarse substrate of PBF 1, where present, the vessels need to be close to

the bottom. We anticipate that vessels will remain within the Federal Navigation Channel, where 6 to 7.6 m (19.7 to 25 ft) of clearance between the hull and the bottom is available. Even when traveling outside of the Federal Navigation Channel, we expect that vessels will remain in areas with depths that provide enough clearance above the riverbed to avoid scouring the bottom. Vessels with a clearance of ≥ 6 m (19.7 ft), which includes most tugs, scows, and tow vessels, should have little impact on the riverbed (PIANC 2008). Further, we expect that vessels will travel in the Federal Navigation Channel at a constant speed, which causes less shear stress on the riverbed than during maneuvering (PIANC 2008, (Stoschek *et al.* 2014). Therefore, we do not anticipate that the propeller jet of the vessels will scour the river bottom during construction of the Port.

Given the considerations above, the effects of the project on the value of PBF 1 in the action area will be too small to be meaningfully measured, evaluated, or detected. Therefore, any effects to the value of PBF 1 to the conservation of the species are insignificant.

4.1.9.2 *Physical and Biological Feature 2*

Transitional salinity zone with soft substrate for juvenile foraging and physiological development

Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development can be found within the action area, therefore PBF 2 is present. As described previously, there is no clear salinity gradient within the Delaware River estuary. However, the river from RKM 93.9 to RKM 120.54 (RM 58.4 to RM 74.9) is characterized as oligohaline (0.5 to 5 ppt) and from RKM 49.8 to RKM 91.9 (RM 30.9 to RM 57.1) as mesohaline (5 to 18 ppt). A historic salinity transition zone occurs from RKM 91.9 to RKM 93.9 (RM 57.1 to 58.4) and DRBC (2017) identifies RKM 107.8 to RKM 122.3 (RM 67 to RM 76), as the median range for the salt front.

In the Delaware River, for this Opinion, we consider PBF 2 to occur from approximately RKM 78 (RM 48.5) (where the final critical habitat rule describes the mouth of the river) to between RKM 107.8 and RKM 122.3 (RM 67 to RM 76), or the median range of the salt front. As described, salinity levels in the river are dynamic, and the salt front is defined by a lower concentration (0.25 ppt) than the lower level of PBF 2 (0.5 ppt), but the transitional zone between RKM 107.8 and RKM 122.3 (RM 67 to RM 76) is a reasonable approximation given the lack of real time data. PBF 2 is present within the Delaware River at its confluence with the Salem River (RM 58.4, RKM 93.9), therefore, PBF 2 overlaps with vessel routes related to Port operations. In addition, the project vessel routes to White's Basin CDF at RKM 132 (RM 82) within the Federal Navigation Channel from RKM 78 to RKM 122.3 (RM 48.5 to RM 76) overlap with PBF 2. We estimate the total area of critical habitat (bank-to-bank in the mainstem of the river between RKM 78 and 122.3/RM 48.5 and 76) to be 37,362 acres. The action area

within PBF 2 consists of the Federal Navigation Channel. We estimate that within the Federal Navigation Channel, PBF 2 is present in an area of 2,943 acres between the mouth of the river (RKM 78/RM 48.5) and the upstream end of the PBF 2 (RKM 122.3/RM 76) (Table 4).

Table 4. Acreages of PBF 2 in the Delaware River

Feature	Acreage
River channel between RKM 78 and 122.3 bank to bank	37,362
Navigation Channel between RKM 78 and 122.3	2,943

Captured sturgeon and subsequent tracking studies have provided evidence that they use soft substrate habitat in the Delaware River with the salinity gradient matching the criteria for PBF 2. Detections of tagged juvenile Atlantic sturgeon have been documented in the lower tidal Delaware River, especially between the middle Liston Range (RKM 70/RM 43.5) to Tinicum Island (RKM 141/RM 87.6) (Calvo *et al.* 2010). Juveniles tracked in this study ranged in size. Older, larger juveniles (average 716 mm, range 505-947 mm) moved towards the Bay but were not detected below Liston Range. The smaller juveniles averaged 524 mm (range 485-566 mm). Based on the best available information on the distribution of juveniles in the Delaware River, we generally expect that juveniles will occur year-round in this area from RKM 78 to RKM 122.3 (RM 48.5 to RM 76). Foraging is expected to occur over soft substrates that support the benthic invertebrates that juvenile Atlantic sturgeon eat. Juveniles are thought to forage year-round with the lightest foraging during the winter. The most active foraging in these areas likely occurs in the spring to fall months. Later in the fall, larger, late-stage juveniles likely move into more saline waters in the lower Delaware River estuary (without leaving the estuary altogether, as that would indicate a transition to the subadult life stage), while the younger juveniles remain and either continue foraging, or move upstream to winter aggregation areas, such as those documented near Marcus Hook (ERC 2016, 2017, 2018, 2019, 2020a, b).

In considering effects to PBF 2, we consider whether the proposed action will have any effect on areas of soft substrate within transitional salinity zones between the river mouth and spawning sites for juvenile foraging and physiological development. In addition, we consider whether the action will have effects on the access to this feature, temporarily or permanently. We also consider the effects of the action on the action area's ability to develop the feature over time.

In order to successfully complete their physiological development, Atlantic sturgeon must have access to a gradual gradient of salinity from freshwater to saltwater. Atlantic sturgeon move along this gradient as their tolerance to salinity increases with age. They also need enough forage to support their energy demands and growth during their transition. The location of the Port is above the median range of the salt front; however, project vessels and operational vessels will use the Federal Navigation Channel where PBF 2 is present to transit downstream to

Delaware bay or upstream to White's Basin CDF at RKM 132 (RM 82). We estimate the area of bank-to-bank critical habitat from RKM 78-122.3 (RM 48.5-76) is 37,362 acres, of which approximately 2,943 acres are within the action area (i.e., the Federal Navigation Channel between RKM 78 and 122.3 (RM 48.5 and 76)) for the proposed project. We expect degraded habitat to be present in the Federal Navigation Channel due to existing propeller wash and dredging. Excluding the Federal Navigation Channel, when we subtract the action area from the total area of available PBF 2 in the river, the critical habitat area between RKM 78 and 122.3 (RM 48.5 and 76) amounts to 34,419 acres.

The strong swirling jet flow induced by a rotating ship propeller causes shear stress that can cause considerable scour to the riverbed (Breedveld *et al.* 2018, Hong *et al.* 2013, Hong *et al.* 2016, Karaki and van Hoften 1975). Construction and operational vessel traffic occurring within PBF 2 will be limited to the Federal Navigation Channel. Benthic disturbance associated with this vessel traffic could affect prey availability for foraging Atlantic sturgeon. The repeated disturbance that will occur due to vessel traffic during operation of the proposed Port may permanently disturb the soft substrate and the benthic community, reducing the quality of PBF 2 within the Federal Navigation Channel. We expect that the degraded habitat within the Federal Navigation Channel will be further degraded due to the effects of the action.

The Federal Navigation Channel supports heavy vessel traffic and the channel bottom is regularly impacted by prop wash. The benthic community primarily includes polychaete worms, isopods, and amphipods, which are common prey items for Atlantic sturgeon. Based on the best available information on the distribution of juveniles in the Delaware River, juveniles will mostly use the area in the spring to fall months. Late-stage juveniles may remain in fall while the younger juveniles may move to winter aggregation areas, such as those documented near Marcus Hook (ERC 2016, 2017). Thus, the Federal Navigation Channel provides PBF 2 that is suitable and valuable for conservation of the species, even if regular disturbance occurs.

It is difficult to determine the effect that this impact on PBF 2 will have for the value of PBF 2 to support the conservation of the species, particularly given that, as we note above, with thousands of deep draft vessels traveling up and down the Federal Navigation Channel, the channel bottom is regularly impacted by prop wash and accordingly, PBF2 within the channel is likely degraded. We must consider the function of soft substrate and how it supports juvenile foraging and physiological development in relation to the salinity of the reach where these activities occur. PBF 2 within the action area provides Atlantic sturgeon juveniles time and space to acclimate to increasing salinity before moving into the mesohaline zone, the polyhaline Delaware Bay, and eventually marine waters. A reduction in the amount and quality of soft bottom substrate in the action area means that there will be less aquatic habitat available for juvenile foraging and physiological development as juveniles transition to migrant subadults.

The vessel traffic during the construction and operation of the Port will negatively affect PBF 2,

and will contribute to the feature's inability to improve in value in the future, as repeated degradation of substrates by prop wash will interrupt the establishment and succession of benthic invertebrates in areas where juvenile Atlantic sturgeon would otherwise feed. However, the impacted areas of the Federal Navigation Channel represent a small, degraded portion of the available soft bottom substrate within the overall action area. Furthermore, the proportion of PBF 2 that may be impacted will be non-contiguous and only in portions of the Federal Navigation Channel where prop wash from project vessels impacts benthic habitat and prey availability. Considering these factors, as well as the naturally dynamic nature of these areas that may limit their ability to support foraging juvenile Atlantic sturgeon even if vessel traffic did not occur, the effects of vessel traffic within this small amount of available habitat on juvenile foraging or physiological development will be too small to be meaningfully measured, evaluated, or detected. Therefore, any effects to the value of PBF 2 to the conservation of the species are insignificant.

4.1.9.3 *Physical and Biological Feature 3*

Water absent physical barriers to passage between the river mouth and spawning sites

Water of appropriate depth and absent physical barriers to passage between the river mouth and spawning sites necessary to support: (i) Unimpeded movement of adults to and from spawning sites; (ii) Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and (iii) Staging, resting, or holding of subadults or spawning condition adults, are present throughout the extent of critical habitat designated in the Delaware River; therefore, PBF 3 is present within the action area.

Water depths in the main river channels are also deep enough (e.g., at least 1.2 m (4 ft)) to ensure continuous flow in the main channel at all times during which any sturgeon life stage is present in the river. Therefore, PBF 3 overlaps with the Federal Navigation Channel between RKM 78 to White's Basin CDF at RKM 132 (RM 48.5 to 82), where vessel traffic will occur. Physical barriers that may impede sturgeon passage include (but are not limited to) locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc. Sturgeon need to be able to make unimpeded movements up and downstream at all life stages. Adults must be able to stage before spawning and then move to and from the river mouth to spawning sites; subadults need to be able to enter the river for foraging opportunities; and juveniles must be able to move between appropriate salinity zones, foraging areas, and overwintering sites.

While there are some impediments to sturgeon movements (i.e., piers, pilings, etc. that sturgeon maneuver around within the river), there are no permanent barriers to movement within the action area. In addition to navigating around existing structures, sturgeon movements are also impacted by gear set in the river, vessel traffic, and in-water stressors from ongoing construction projects (e.g., turbidity from dredging, sound pressure waves from pile driving, etc.) and permitted outfalls (e.g., thermal plumes). Studies have shown that even in close proximity to

active dredging equipment, sturgeon pass through the area, while showing little to no sign of disturbance (Balazik *et al.* 2021, Moser and Ross 1995, Reine *et al.* 2014) and changes to water temperature from thermal plumes are normally temporary or intermittent.

In considering effects to PBF 3, we consider whether the proposed action will have any effect on water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: unimpeded movements of adults to and from spawning sites; seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary, and; staging, resting, or holding of subadults or spawning condition adults. We also consider whether the proposed action will affect water depth or water flow because shallow water can be a barrier to sturgeon movements, and an alteration in water flow could similarly affect the movements of sturgeon in the river, particularly early life stages that are dependent on downstream drift. Therefore, we consider effects of the action on water depth and water flow and whether the action results in barriers to passage that impede the movements of Atlantic sturgeon. We also consider whether the action will have effects on access to this feature, temporarily or permanently, and consider the effects of the action on the action area's ability to develop the feature over time.

No portion of the action area that is within critical habitat is dammed, and the movement of sturgeon is unimpeded to and from spawning sites. Unlike some southern rivers, given the extent of tidal flow, geomorphology and naturally deep depths of the Delaware River, it is not vulnerable to natural reductions in water flow or water depth that can result in barriers to sturgeon movements. At this time, we are not aware of any anthropogenic impacts that reduce water depth or water flow in a way that impact sturgeon movements. We are not aware of any complete barriers to passage for Atlantic sturgeon in the Delaware River. That is, we do not know of any structures or conditions that prevent sturgeon from moving up or downstream within the river. There are areas in the Delaware River critical habitat unit where sturgeon movements are affected by water quality (e.g., low DO, thermal plumes) and noise (e.g., during pile driving at ongoing in-water construction projects); however, impacts on movements are normally temporary and/or intermittent and we expect there always to be a zone of passage through the affected river reach. Activities that overlap with the portion of the Delaware River that contains PBF 3 include the site of the proposed Port and vessel transit routes. Here, we consider whether those activities may affect PBF 3 and, if so, whether those effects are adverse, insignificant, extremely unlikely, or entirely beneficial.

Dredging and pile driving activities will occur in the Salem River, which is not designated as Atlantic sturgeon critical habitat. Therefore, this portion of the proposed action will not overlap PBF 3. Vessel routes within the Delaware River will overlap with PBF 3, but increased vessel traffic will not change water depth or water flow and will not result in barriers to passage that impede the movements of Atlantic sturgeon to and from spawning grounds. Based on this

information, effects of the proposed action to PBF 3 are too small to be meaningfully measured, detected, or evaluated; and therefore, are insignificant.

4.1.9.4 *Physical and Biological Feature 4*

Water with the temperature, salinity, and oxygen values that, combined, provide for dissolved oxygen values that support successful reproduction and recruitment and are within the temperature range that supports the habitat function

Water between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that combined support spawning, survival, and larval, juvenile, and subadult development and recruitment may be present throughout the extent of critical habitat designated in the Delaware River (depending on the life stage). Therefore, PBF 4 is present within the action area.

Water quality factors such as temperature, salinity and dissolved oxygen (DO) are interrelated environmental variables, and in a river system such as the Delaware, are constantly changing from influences of the tide, weather, season, etc. DO concentrations in water can fluctuate given a number of factors including water temperature (e.g., cold water holds more oxygen than warm water) and salinity (e.g., the amount of oxygen that can dissolve in water decreases as salinity increases). As such, DO levels that support growth and development will be different at different combinations of water temperature and salinity. Similarly, the DO levels that we would expect Atlantic sturgeon to avoid would also vary depending on the particular water temperature, salinity, and life stage. As DO tolerance changes with age, the conditions that support growth and development, including the DO levels that may be avoided, also change (82 FR 39160; August 17, 2017).

In addition to natural fluctuations in water quality, a number of human activities directly affect the temperature, salinity, and oxygen values within the Delaware River. Water pollution, whether it be urban and rural runoff, combined sewer overflows (CSOs), accidental spills (e.g., Delaware River and Bay Oil Spill Advisory Committee 2010), or thermal plumes from nuclear generating stations (e.g., Salem and Hope Creek, section 6) impact the water quality parameters in PBF 4. Construction activity also affects water quality. Turbidity from dredging or vessel activity that affects soft substrate may decrease levels of light and impact temperature. Dredging has the potential to increase water depths and cause cooling at the bottom of the water column (i.e., deeper water receives less light). Changing environmental conditions will likely lead to changes in ambient water temperature and an upstream shift in the salt front resulting from rising sea levels. Increases in salinity may shift the distribution of juveniles and subadults. However, at this time, we do not have enough information to predict how changing environmental conditions would affect juvenile and subadult development and recruitment.

The most recent Delaware River and Bay Water Quality Assessment (DRBC 2020) concluded

that 96.9% of observations near the Chester, PA gage site in the lower Delaware River met daily mean water quality standards criteria and 98.7 percent of observations in the lower Delaware River and Delaware Bay met the instantaneous minimum criteria.

In considering effects to PBF 4, we consider whether the proposed action will have any effect on water temperature, salinity, and oxygen values that, combined, support: spawning; annual and interannual adult, subadult, larval, and juvenile survival; and larval, juvenile, and subadult growth, development, and recruitment, between the river mouth and spawning sites, especially in the bottom meter of the water column. Therefore, we also consider effects of the action on temperature, salinity and dissolved oxygen needs for Atlantic sturgeon spawning and recruitment. These water quality conditions are interactive and both temperature and salinity influence the DO saturation for a particular area. We also consider whether the action will have effects on the access to this feature, temporarily or permanently and consider the effects of the action on the action area's ability to develop the feature over time.

The proposed action will increase vessel traffic over baseline conditions, but vessels will not alter the salinity, DO, or temperature of water in the Delaware River. Therefore, we have determined that the proposed action will have no effect on PBF 4 of Atlantic sturgeon critical habitat.

Summary of the Effects of the Proposed Action on Atlantic sturgeon Critical Habitat

We have determined that proposed action will have effects to PBFs 1, 2, and 3 that are either so small that they are not able to be meaningfully measured, detected or evaluated and, therefore, insignificant and that the proposed action will have no effect on PBF 4. Thus, the proposed project is not likely to adversely affect critical habitat designated for Atlantic sturgeon.

4.2 Species Likely to be Adversely Affected by the Action

4.2.1 Status of Sea Turtles

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

4.2.1.1 Status of Loggerhead Sea Turtle - Northwest Atlantic Ocean DPS

Loggerhead sea turtles are circumglobally and are found in the temperate and tropical regions of the Atlantic, Indian, and Pacific Oceans. The loggerhead is distinguished from other turtles by its reddish-brown carapace, large head, and powerful jaws. The species was first listed as threatened under the ESA in 1978 (43 FR 32800, July 28, 1978). On September 22, 2011, the NMFS and U.S. FWS designated nine DPSs of loggerhead sea turtles, with the NWA DPS listed as threatened (76 FR 58868). The NWA DPS of loggerheads is found along eastern North America, Central America, and northern South America (Figure 7).

Figure 7. Range of the Northwest Atlantic DPS of loggerhead sea turtles



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

Life History

Nesting occurs on beaches where warm, humid sand temperatures incubate the eggs. Northwest Atlantic females lay one to seven clutches per year. Clutch sizes range from 95 to 130 eggs per nest (NMFS and U.S. FWS 2023). Females do not nest every year. The average remigration interval is three years. Emergence success rate varies by location, ranging from 40 to 75 percent (NMFS and U.S. FWS 2023). As with other sea turtles, temperature determines the sex of the turtle during the middle of the incubation period. Loggerheads spend the post-hatchling stage in pelagic waters. The juvenile stage is spent first in the oceanic zone and later in coastal waters. Some juveniles may periodically move between the oceanic zone and coastal waters (Bolten 2003, Conant *et al.* 2009, Mansfield 2006, Morreale and Standora 2005, Witzell 2002). 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, Donaton *et al.* 2019, Seney and Musick 2007).

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

Loggerhead hatchlings from the western Atlantic disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. Mitochondrial DNA (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 America, and Brazil (Masuda 2010). LaCasella *et al.* (2013) found that loggerheads, primarily juveniles, caught within the Northeast Distant (NED) waters of the North Atlantic mostly originated from nesting populations in the southeast U.S. and, in particular, Florida. They found that nearly all loggerheads caught in the NED came from the Northwest Atlantic DPS (mean = 99.2 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 (≤ 63 cm straight carapace length [SCL]) and large (> 63 cm SCL) loggerheads north and south of Cape Hatteras, North Carolina. North of Cape Hatteras, large turtles came mainly from southeast Florida (44 percent $\pm$ 15 percent) and the northern U.S. management units (33 percent $\pm$ 16 percent); small turtles came from central east Florida (64 percent $\pm$ 14 percent). South of Cape Hatteras, large turtles came mainly from central east Florida (52 percent $\pm$ 20 percent) and southeast Florida (41 percent $\pm$ 20 percent); small turtles came from southeast Florida (56 percent $\pm$ 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 (Conant *et al.* 2009, Heppell *et al.* 2005, NMFS SEFSC 2009, NMFS SEFSC 2001, Richards *et al.* 2011, TEWG 1998, 2000, TEWG 2009) have examined the stock status of loggerheads in the Atlantic Ocean, but none have been able to develop a reliable estimate of absolute population size. As with other species, counts of nests and nesting females are commonly used as an index of abundance and population trends, even though there are doubts about the ability to estimate the overall population size.

Based on genetic analysis of nesting subpopulations, the NWA DPS is divided into five recovery units: Northern, Peninsular Florida, Dry Tortugas, Northern Gulf of Mexico⁵, and Greater Caribbean (NMFS and U.S. FWS 2008). A more recent analysis using expanded mtDNA sequences revealed that rookeries from the Gulf and Atlantic coasts of Florida are genetically distinct (Shamblin *et al.* 2014). The recent genetic analyses suggest that the NWA DPS should be considered as ten management units: (1) South Carolina and Georgia, (2) central eastern Florida, (3) southeastern Florida, (4) Cay Sal, Bahamas, (5) Dry Tortugas, Florida, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin *et al.* 2012).

The Northwest Atlantic Ocean's loggerhead nesting aggregation is considered the largest in the world (Casale and Tucker 2017). In the most recent International Union for Conservation of Nature (IUCN) assessment, Ceriani and Meylan (2017) reported a 5 year average (2009-2013) of more than 83,717 nests per year in the southeast U.S. and Mexico (excluding Cancun (Quintana Roo), Mexico). These estimates included sites without long-term (≥ 10 years) datasets. Trends at the different index nesting beaches ranged from negative to positive. In a trend analysis of the 86 index sites, the overall trend for the NWA DPS was positive (+2 percent) (Ceriani and Meylan 2017). Uncertainties in this analysis include, among others, using nesting females as

⁵ Gulf of America is referred to as Gulf of Mexico in the listing NMFS and U.S. FWS. 2008. Recovery plan for the Northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*), Second revision. National Marine Fisheries Service, Office of Protected Resources: Silver Spring, Maryland. Available from <https://www.fisheries.noaa.gov/resource/document/recovery-plan-northwest-atlantic-population-loggerhead-sea-turtle-caretta-caretta>.

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). Based on updated data from 2016-2020, the NWA DPS hosts more than 110,000 nests annually (NMFS and U.S. FWS 2023). This estimate included more data than previous nesting summaries, and does not necessarily reflect an increasing nesting trend.

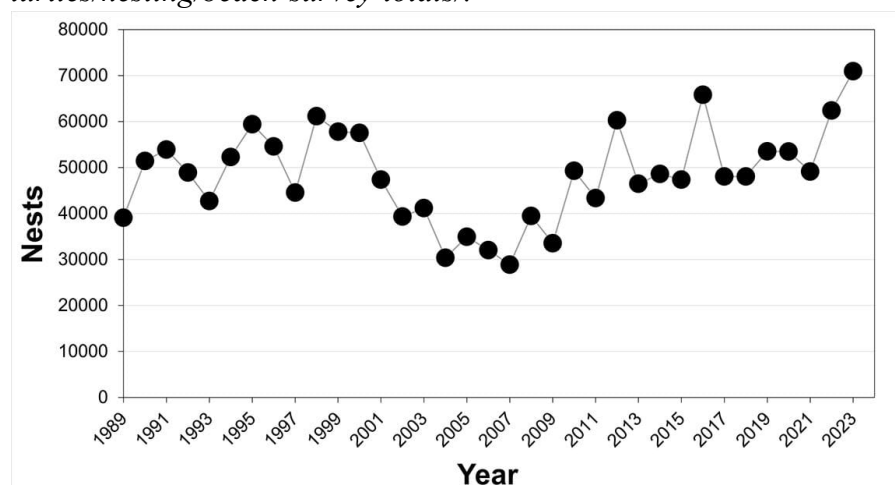
An overall estimate of nesting females for the DPS is not available because of reproductive parameter uncertainty (*e.g.*, variations in remigration intervals and clutch frequencies, data deficiencies). Some estimations have been made however. Using data from 2004-2008, the adult female population size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

The Peninsula Florida Recovery Unit (PFRU) and the Northern Recovery Unit represent approximately 87 percent and 10 percent, respectively of all nesting effort in the NWA DPS (NMFS and U.S. FWS Ceriani and Meylan 2017, 2008). As described above, FWRI's index nesting beach survey (INBS) collects standardized nesting data for sea turtles through an INBS. The nest counts on Florida's 27 core index beaches for loggerheads represent approximately 52 percent of known nesting in Florida. 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 PRFU 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 index beach nest counts from 1989 to 2023 ranged from a low of 28,876 in 2007 to a high of almost 71,000 in 2023 (Bolten *et al.* 2019, FFWCC 2024) (Figure 8). An increase in the number of loggerhead nests in the PFRU has been observed since 2007 and long-term nesting data from 1989-2023 reveal a complex pattern with three distinct phases: increasing (1989-1998), decreasing (1998-2007), and increasing (2007-2023) (FFWCC 2024) (Figure 9). At those index nesting beaches monitored for 30 years, the average annual growth rate is not significantly different from zero indicating a lack of trend in the data (Bolten *et al.* 2019). The recovery team

cautions that using short term trends in nesting abundance can be misleading and trends should be considered in the context of one generation (50 years for loggerheads) (Bolten *et al.* 2019).

Figure 8. Annual nest counts for loggerhead sea turtles on Florida core index beaches in peninsular Florida, 1989-2023. Source: <https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/>.



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). 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 and statistically significant (Bolten *et al.* 2019).

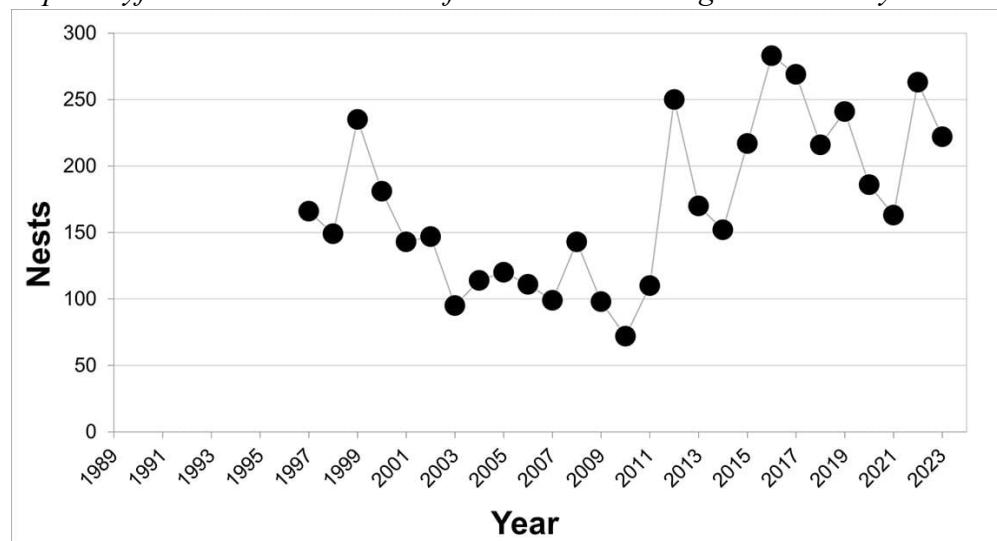
The Dry Tortugas Recovery Unit (DTRU) includes all islands west of Key West, Florida. A census on Key West from 1995 to 2004 (excluding 2002) estimated a mean of 246 nests per year, or about 60 nesting females (NMFS and U.S. FWS 2008). No trend analysis is available because there was not an adequate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

The Northern Gulf of Mexico⁶ 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

⁶ Gulf of America is referred to as Gulf of Mexico, as defined by the recovery unit

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 Unit⁶ is difficult because of changed and expanded beach coverage. However, Florida Panhandle beaches host the bulk of nesting for the NGMRU, and there are now over 20 years of Florida INBS data. A number of trend analyses have been conducted. From 1995 to 2005, the recovery unit exhibited a significant declining trend (NMFS and U.S. FWS Conant *et al.* 2009, 2008). 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. Nest numbers at Florida Panhandle index beaches have increased since 2010 (Bolten *et al.* 2019) (Figure 11). A longer-term analysis from 1997-2018 found that there has been a non-significant increase of 1.7 percent (Bolten *et al.* 2019).

Figure 9. Annual nest counts on index beaches in the Florida Panhandle, 1997-2023. Source: <https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/>.



The Greater Caribbean Recovery Unit (GCRU) encompasses nesting subpopulations in Mexico to French Guiana, the Bahamas, and the Lesser and Greater Antilles. The majority of nesting for this recovery unit occurs on the Yucatán Peninsula, in Quintana Roo, Mexico, with an annual range of 3,142 to 5,367 nests during the time period of 2016-2020 (NMFS and U.S. FWS 2023). Other significant nesting sites are found throughout the Caribbean, including Cuba, with approximately 250 to 300 nests annually (Ehrhart *et al.* 2003), and over 100 nests annually in Cay Sal in the Bahamas (NMFS and U.S. FWS 2008). In the trend analysis by Ceriani and

Meylan (2017), a 53 percent increase for this Recovery Unit was reported from 2009 through 2013. However, the five year review (NMFS and U.S. FWS 2023) noted that trend estimates for the GCRU are not available due to insufficient data.

Status

Fisheries bycatch is the highest threat to the Northwest Atlantic DPS of loggerhead sea turtles (Conant *et al.* 2009). Other threats include vessel strikes, marine debris, coastal development, habitat loss, contaminants, disease, and changing environmental conditions. 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.

Changing environmental conditions have been identified as a threat to loggerhead sea turtles found in the action area (Conant *et al.* 2009, NMFS *et al.* 2011, NMFS and U.S. FWS 2020, Seminoff *et al.* 2015). Loggerhead sea turtles are most likely to be affected by changing environmental conditions due to (1) changing air temperature at nesting beaches, which could impact sex ratios among hatchlings (e.g., Glen and Mrosovsky 2004, Hawkes *et al.* 2009); (2) a reduction or shift in available nesting beach habitat (Fuentes *et al.* 2020); (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; and (4) changes in water temperature, which could possibly lead to a northward shift in their range and changes in phenology (timing of nesting seasons, timing of migrations) (Weishampel *et al.* 2004).

A shift towards earlier onset of loggerhead nesting is 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). 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).

Despite site-specific vulnerabilities of the Northwest Atlantic Ocean loggerhead DPS, this DPS may be more resilient to changing conditions than other management units (Fuentes *et al.* 2013). Van Houtan and Halley (2011) recently developed 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, models 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 environmental variability and historical anthropogenic impacts. The nest count increases since 2008 may reflect a potential recovery response (Arendt *et al.* 2013).

Changes in water temperature may also alter the forage base and thus, foraging behavior of loggerhead sea turtles (Conant *et al.* 2009). Likewise, if changes in water temperature affected the prey base for loggerhead sea turtles, there may be changes in the abundance and distribution of these species in the action area. However, 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 loggerhead sea turtles over the foreseeable future.

Critical Habitat

NMFS designated critical habitat for the Northwest Atlantic DPS of loggerhead sea turtles in the 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 NWA DPS of loggerheads is to ensure that each recovery unit meets its recovery criteria alleviating threats to the species so that protections 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 two percent resulting in at least 14,000 nests annually for the Northern Recovery Unit; greater than or equal to one percent resulting in 106,100 nests annually for the Peninsular Florida Recovery Unit; greater than or equal to three percent resulting in at least 1,100 nests for the Dry Tortugas Recovery unit; and greater than or equal to three percent resulting in at least 4,000 nests annually for the Northern Gulf of Mexico⁶ Recovery Unit. For the Greater Caribbean Recovery Unit, the demographic criteria

specifies that the total annual number of nests at a minimum of three nesting assemblages, averaging greater than 100 nests annually, has increased over 50 years.

2. The increases in the number of nests for each recovery unit must be a result of corresponding increases in the number of nesting females.
3. A network of in-water sites across the foraging range is established and measure abundance. A composite estimate of relative abundance from these sites is increasing for at least one generation.
4. Stranding trends are not increasing at a rate greater than the in-water relative abundance trends for similar age classes for at least one generation.
5. Listing factor recover criteria include criteria related to maintenance and protection of nesting habitat; development and implementation of a strategy to protect marine habitats important to loggerheads; implementation of nest protection strategies; elimination of legal harvest; reduction of nest predation; implementing legislation to ensure long-term protection of loggerheads and their habitats; implementation of strategies to reduce fisheries bycatch, marine debris ingestion and entanglement, and vessel strikes.

The recovery objectives to meet these goals include:

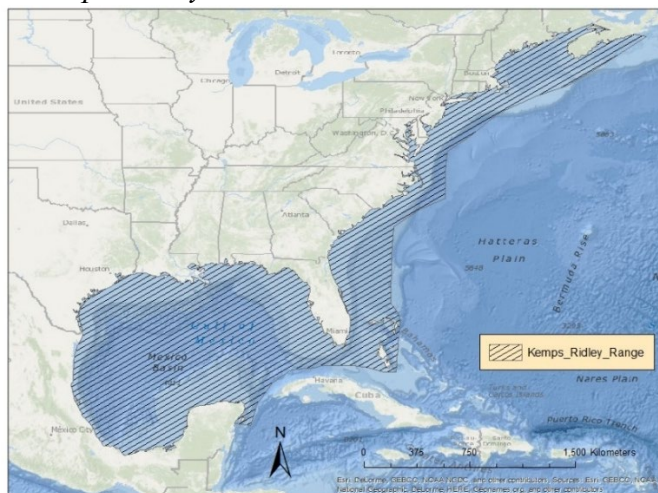
1. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.
2. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings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

4.2.1.2 *Status of Kemp's Ridley Sea Turtles*

The range of Kemp's ridley sea turtles extends from the Gulf of America to the Atlantic coast (Figure 10). 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 10. Range of the Kemp's ridley sea turtle



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

Life History

Kemp's ridley nesting is essentially limited to the western Gulf of America. Approximately 97 percent of the global population's nesting activity occurs on a 146 kilometer stretch of beach that includes Rancho Nuevo in Mexico (Wibbels and Bevan 2019). In the U.S., nesting occurs primarily in Texas and occasionally in Florida, Alabama, Georgia, South Carolina, and North Carolina (NMFS and U.S. FWS 2015). Nesting occurs from April to July in large arribadas (synchronized large-scale nesting). The average remigration interval is two years, although intervals of one and three years are not uncommon (NMFS *et al.* 2011, TEWG 1998, 2000). 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 (Epperly *et al.* 2013, NMFS and U.S. FWS 2015, Snover *et al.* 2007). Modeling indicates that oceanic-stage Kemp's ridley turtles are likely distributed throughout the Gulf of Mexico⁷ 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 Mexico⁷, eastern Gulf of Mexico⁷, and the western Atlantic (Putman *et al.* 2013).

⁷ Gulf of America referred to as Gulf of Mexico in Putman *et al.* 2013.

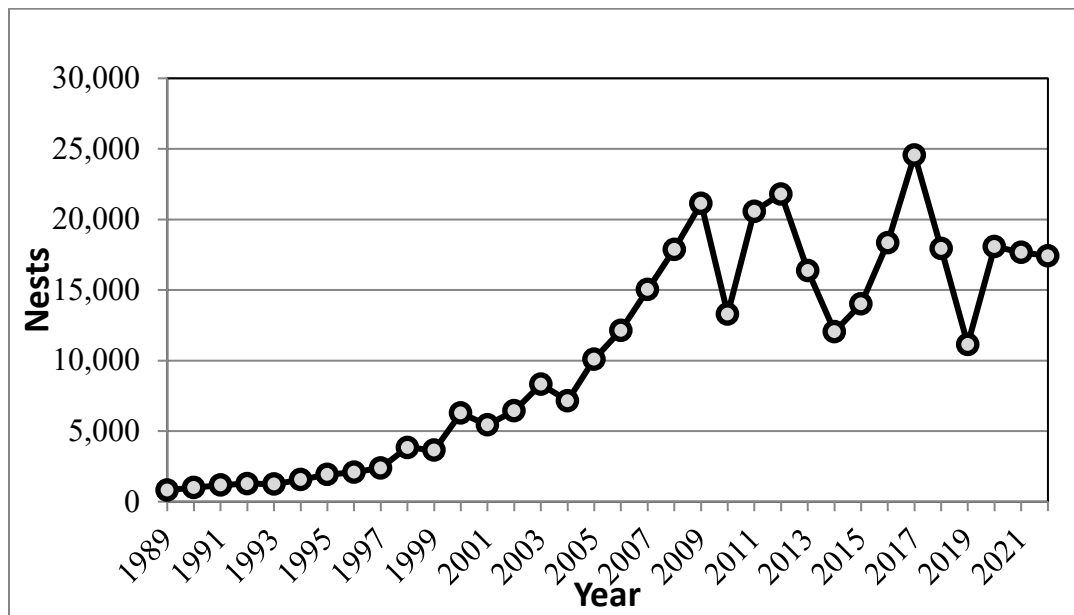
Several studies, including those of captive turtles, recaptured turtles of known age, mark-recapture data, and skeletochronology, have estimated the average age at sexual maturity for Kemp's ridleys between 5 to 16 years, though NMFS *et al.* (2011) determined the best estimate of age to maturity for Kemp's ridleys was 12 years. Skeletochronology analyzes growth marks in bones to obtain growth rates and age at sexual maturity estimates.

During spring and summer, juvenile Kemp's ridleys generally occur in the shallow coastal waters of the northern Gulf of America from south Texas to north Florida and along the U.S. Atlantic coast from southern Florida to the Mid-Atlantic and New England. The Northeast Fisheries Science Center (NEFSC) caught a juvenile Kemp's ridley during a June 2015 tagging project in deep water south of Georges Bank (NEFSC, unpublished data). In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter. As adults, many Kemp's ridleys remain in the Gulf of America, 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 37 m (120 ft) deep (Seney and Landry 2008, Shaver *et al.* 2005, 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 all the sea turtle species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. From 1980 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 was not expected to continue (NMFS and U.S. FWS Caillouet *et al.* 2018, 2015). Following a significant, unexplained one year decline in 2010, Kemp's ridley nests in Mexico increased to 21,797 in 2012 (Burchfield 2013). After another decline, nesting increased with a record high season in 2017, with 24,586 nests recorded (Figure 11). In 2022, 17,362 nests were recorded, but the most recent year of available nesting (2023) found 2,121 nests (Sea Turtle Early Restoration Project Team 2023). At this time, it is unclear whether the increases and declines in nesting seen over the past decade and a half represents a population oscillating around an equilibrium point, if the recent three years (2020-2022) of relatively steady nesting indicates that equilibrium point, or if nesting will decline or increase in the future. At this point, we can only conclude that the population has dramatically rebounded from the lows seen in the 1980s and 1990s, but we cannot ascertain a current population trend or trajectory.

Figure 11. Kemp's ridley nest totals from Mexican beaches 1989-2022 (Gladys Porter Zoo nesting database 2019, Sea Turtle Early Restoration Project Team 2023).



A small nesting population is also emerging in the United States, primarily in Texas, rising from 6 nests in 1996 to 42 in 2004 to a record high of 353 nests in 2017 (NPS Data). It is worth noting that nesting in Texas has somewhat paralleled the trends observed in Mexico, characterized by a significant decline in 2010, followed by fluctuating nesting, and most recently 284 nests in 2022 (Sea Turtle Early Restoration Project Team 2023).

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 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).

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. Currently, fishery interactions are the main threat to the species. Other threats include habitat destruction, oil spills, dredging, disease, cold stunning, and changing environmental conditions. 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.

Changing environmental conditions have been identified as a threat to Kemp's ridley sea turtles found in the action area (Conant *et al.* 2009, NMFS *et al.* 2011, NMFS and U.S. FWS 2020, Seminoff *et al.* 2015). Kemp's ridley sea turtles are most likely to be affected by changing environmental conditions due to (1) changing air temperature at nesting beaches, which could impact sex ratios among hatchling (e.g., Glen and Mrosovsky 2004, Hawkes *et al.* 2009); (2) shifts in available nesting beach habitat and increased risk of nest inundation (Pike 2013); (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 (Conant *et al.* 2009); and (4) changes in water temperature, which could possibly lead to a northward shift in their range and changes in phenology (timing of nesting seasons, timing of migrations) (Griffin *et al.* 2019).

Shifts in nesting activity of Kemp's ridleys has been observed. Nesting activity of Kemp's ridleys in Florida has increased over the past decade, suggesting the population may have some behavioral flexibility to adapt to changing environmental conditions (Pike 2013). Still, current models predict long-term reductions in sea turtle fertility as a result of changes; 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). Most of Kemp's ridleys 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.

Changes in water temperature may also alter the forage base and thus, foraging behavior of Kemp's ridley sea turtles (Conant *et al.* 2009). Likewise, if changes in water temperature affected the prey base for Kemp's ridley sea turtles, there may be changes in the abundance and distribution of these species in the action area.

Warming sea temperatures are likely to result in a shift in the seasonal distribution of Kemp's ridley 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, they could remain in the more northern areas later in the year. An increase in cold stunning of Kemp's ridley sea turtles in New England could pose an additional threat to population resilience (Griffin *et al.* 2019). Kemp's ridley sea turtles are 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).

Critical Habitat

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

Recovery Goals

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

Downlisting criteria include:

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

Delisting criteria include:

1. Average population of at least 40,000 nesting females per season over a six-year period distributed among nesting beaches.
2. Average annual recruitment of hatchlings over a six-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 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.

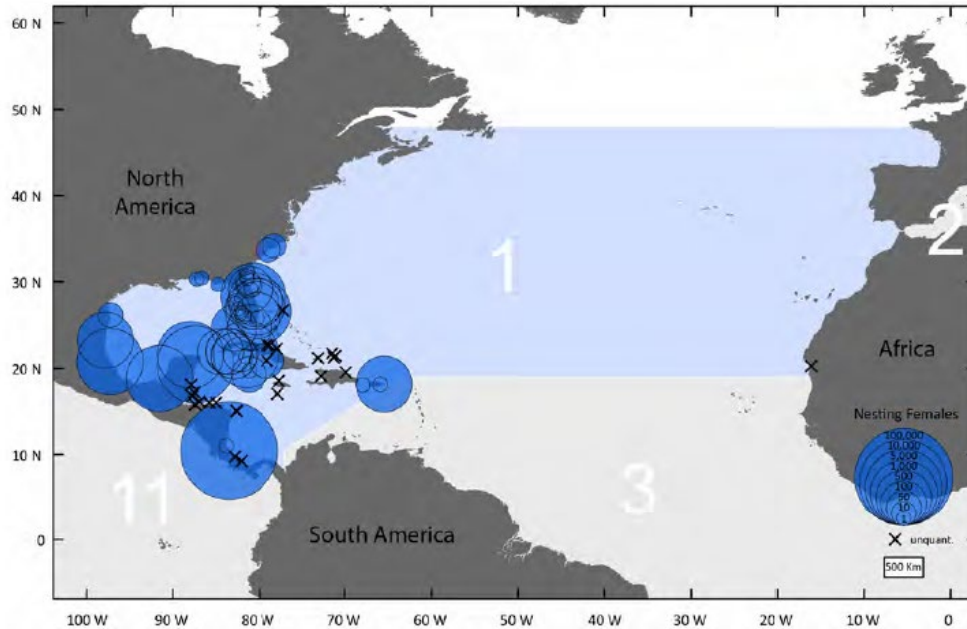
Major actions needed to meet the recovery goals include:

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 *Status of 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 one meter (3.3 ft). The species was listed under the ESA on July 28, 1978 (43 FR 32800) as endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed 11 DPSs of green sea turtles as threatened or endangered under the ESA (81 FR 20057). The North Atlantic DPS of green turtle is found in the North Atlantic Ocean and Gulf of America (Figure 12) 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 America, 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 12. Range of the North Atlantic DPS of green turtles (1), with location and abundance of nesting females (Seminoff et al. 2015).



Life history

Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, Quintana Roo), the U.S. (Florida) and Cuba (Figure 12) 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 U.S., females generally nest between May and September (Seminoff *et al.* 2015, Witherington *et al.* 2006). 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 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.

Green sea turtles are long-lived animals. Size and age at sexual maturity have been estimated using several methods, including mark-recapture, skeletochronology, and marked, known-aged individuals. 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 (Frazer and Ehrhart 1985, Goshe *et al.* 2010, Mendonça 1981). More recent estimates of age at sexual maturity are as high as 35–50 years (Avens and Snover 2013, Goshe *et al.* 2010), with lower ranges reported from known age turtles (15–19 years) from the Cayman Islands (Bell *et al.* 2005) and Caribbean Mexico (12–20 years) (Zurita *et al.* 2012). A study of green 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 85–100+ centimeters 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 Mexico⁸ 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 than 10 years of data collection in the North Atlantic DPS. The results were variable with some sites showing no trend and others increasing. All major nesting populations (using data through 2011-2012) demonstrated increases in abundance (Seminoff *et al.* 2015). However, more recent nesting numbers at Tortuguero, Costa Rica, the largest nesting assemblage for the North Atlantic DPS, have shown declining trends. Restrepo *et al.* (2023) modelled the long-term trend in annual clutch numbers from 1971 to 2021 and found that Tortuguero's clutch abundance trend increased steadily through 2000, then slowed gradually until 2008, after which the trend shifted downwards.

More recent data is available for the southeastern U.S. through Florida's index nesting beach survey. The index nest counts represent approximately 74 percent of known green turtle nesting in Florida (<https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/>).

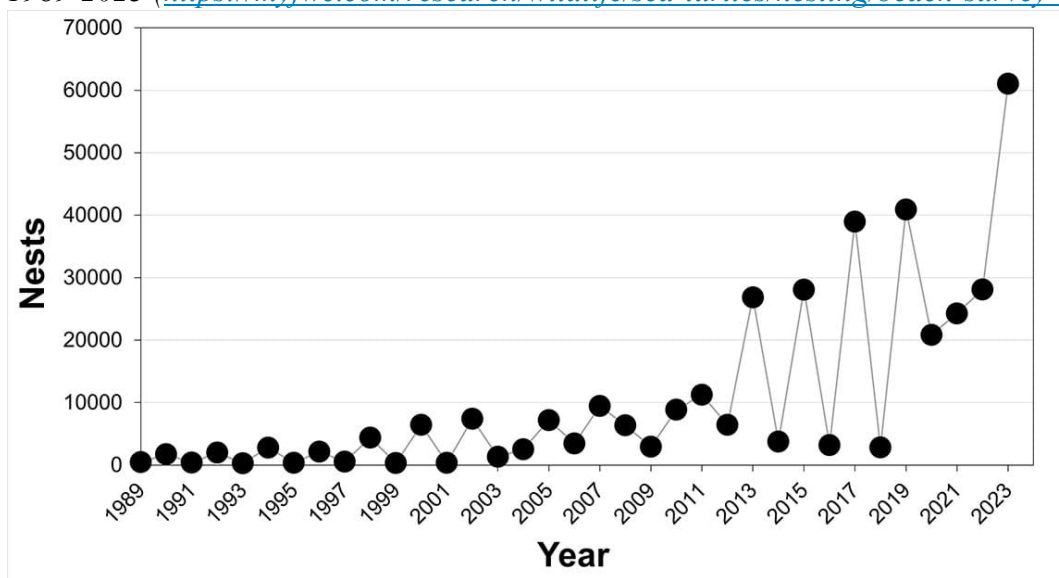
Nest counts at Florida's core index beaches have ranged from less than 300 to almost 61,000 in 2023. The nest numbers show a mostly biennial pattern of fluctuation (<https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/>; Figure 13). It should also be noted that green sea turtle nest counts have increased 120-fold since standardized

⁸ Gulf of America referred to as Gulf of Mexico in Shamblin *et al.* 2016.

nest counts began in 1989 – a trend that differs dramatically from that of the loggerheads that nest on the same beaches. Green sea turtles laid high numbers of nests at Florida core index beaches in 2017 and 2019, with a record high in 2023 (FFWCC 2024). This recent nesting data over the past decade suggests a potentially strong increasing trend in Florida nesting, although similar to loggerheads, using short term trends in nesting abundance can be misleading and trends should be considered in the context of one generation.

Overall, given high nesting in Florida but recent reports of lower nests at Tortuguero (Restrepo *et al.* 2023), the nesting status in the North Atlantic DPS is considered mixed. Due to fluctuating nest counts across major nesting beaches in recent years, a larger time series of data is needed to discern longer term trends.

Figure 13. Number of green sea turtle nests counted on core index beaches in Florida from 1989-2023 (<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 principal cause of the population's decline. Apparent increases in nester abundance in some areas of the North Atlantic DPS in recent years are encouraging, but the nesting declines in the DPS's largest nesting assemblage (Tortuguero) are of concern. Nesting data 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.

Changing environmental conditions have been identified as a threat to green sea turtles found in the action area (Conant *et al.* 2009, NMFS *et al.* 2011, NMFS and U.S. FWS 2020, Seminoff *et al.* 2015). Green sea turtles are most affected by changing environmental conditions due to (1) changing air temperature is impacting sex ratios among hatchlings (Laloë *et al.* 2016); (2) sea level rise and increased storms, which could result in a reduction or shift in available nesting beach habitat and increased risk of nest inundation (Baker *et al.* 2006, Daniels *et al.* 1993, Fish *et al.* 2005, Reece *et al.* 2013); (3) changes in the abundance and distribution of seagrass, which could result in changes in the foraging behavior and distribution of green sea turtles (Duarte 2002, Saunders *et al.* 2013, Short and Neckles 1999); and (4) changes in water temperature, which could possibly lead to a northward shift in their range and changes in phenology (timing of nesting seasons, timing of migrations).

Feminization of green sea turtle populations is a concern because 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). 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, changing environmental conditions are 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 changing environmental conditions 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 and modeling results also project that increased air temperature may result in the entire feminization of green sea turtles within the next century (Laloë *et al.* 2016). The extent to which green 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.

Changes in water temperature may also alter the forage base and thus, foraging behavior of sea turtles (Conant *et al.* 2009). If changes in water temperature affect seagrass in the action area, there may be changes in the abundance and distribution of these species 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 (Duarte 2002, Saunders *et al.* 2013, Short and Neckles 1999). If seagrasses in the action area decline, it is reasonable to expect that the number of foraging hard-shelled sea turtles, namely greens, would decline as well. However, we do not know the adaptive capacity of these individuals, or what level of temperature change would cause a shift in distribution, therefore, it is not possible to predict

changes to the foraging behavior of green sea turtles over the foreseeable future.

Critical Habitat

At present, critical habitat 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 for this consultation. Additional critical habitat has been proposed (88 FR 46572, July 19, 2023), which is also outside the action area for this consultation, those areas include nearshore waters along the coasts of North Carolina and Florida, as well as the offshore *Sargassum*-dominated drift communities in the Northwest Atlantic Ocean that mirror those critical habitat areas for loggerhead sea turtles.

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 to 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 kilometers) 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.

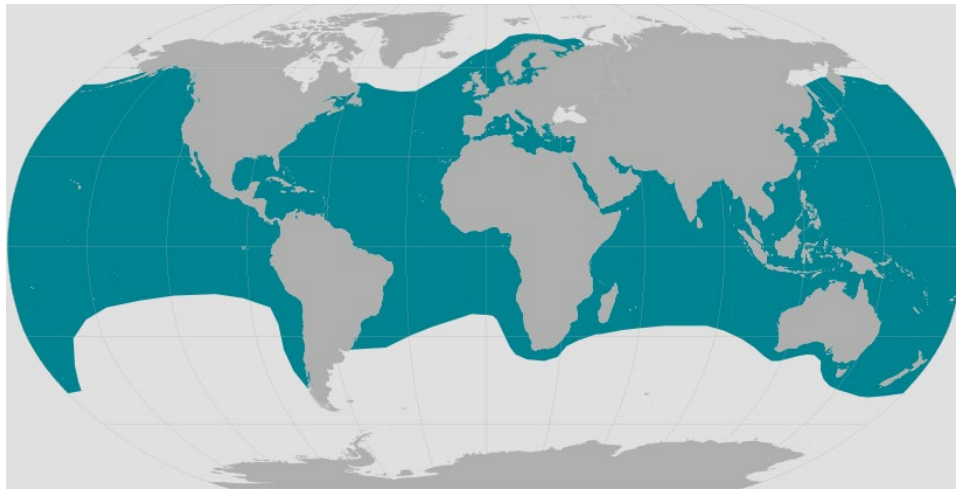
Major actions needed to help meet the recovery goals include:

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.

4.2.1.4 Status of Leatherback Sea Turtles

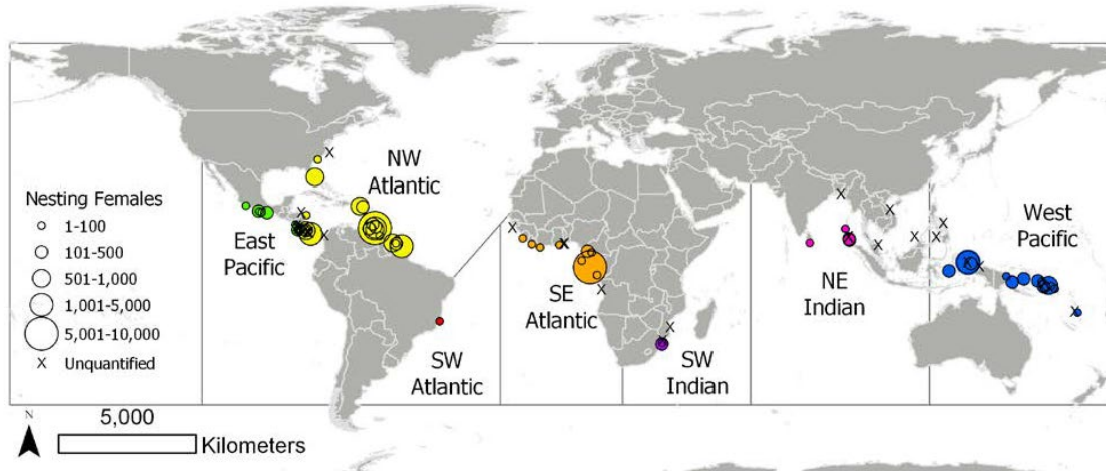
The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (Figure 14).

Figure 14. Range of the leatherback sea turtle
(<https://www.fisheries.noaa.gov/species/leatherback-turtle>).



Leatherbacks are the largest living turtle, reaching lengths of six ft 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 area is the Northwest Atlantic DPS. NMFS and U.S. FWS concluded that the seven subpopulations, which met the criteria for DPSs, all met the definition of an endangered species. As such, they determined that the listing of DPSs was not warranted and leatherbacks continue to be listed at the global level (85 FR 48332, August 10, 2020). Even though listing as DPSs was not appropriate, the analysis in this Opinion looks at the range-wide and subpopulation statuses of the species and the subpopulations we describe align with the seven DPSs considered in the 2020 status review. We used information available in the most recent five year review (NMFS and U.S. FWS 2013), the critical habitat designation (44 FR 17710, March 23, 1979), the 2020 status review (NMFS and U.S. FWS 2020), relevant literature, and recent nesting data from the Florida FWRI to summarize the life history, population dynamics, and status of the species, as follows.

Figure 15. Leatherback sea turtle DPSs and nesting beaches (NMFS and U.S. FWS 2020).



Life History

Preferred nesting grounds for leatherbacks are in the tropics (Figure 15), 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 (Eckert *et al.* 2012, Reina *et al.* 2002, Wallace *et al.* 2007). The average clutch frequency for the Northwest Atlantic DPS is 5.5 clutches per season (NMFS and U.S. FWS 2020). In the western Atlantic, leatherbacks lay about 82 eggs per clutch (Sotherland *et al.* 2015). Remigration intervals are 2-4 years for most populations (range 1-11 years) (Eckert *et al.* 2015, NMFS and U.S. FWS 2020); the remigration interval for the Northwest Atlantic DPS is approximately three years (NMFS and U.S. FWS 2020). The number of leatherback hatchlings that make it out of the nest on to the beach (*i.e.*, emergence success) is approximately 50 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.* 2020). Past estimates ranged from 5-29 years (Avens *et al.* 2009, Spotila *et al.* 1996). More recently, Avens *et al.* (2020) used refined skeletochronology to assess the age at sexual maturity for leatherback sea turtles in the Atlantic and the Pacific. In the Atlantic, the mean age at sexual maturity was 19 years (range 13-28) and the mean size at sexual maturity was 129.2 centimeters curved carapace length (CCL) (range 112.8-153.8). In the Pacific, the mean age at sexual maturity was 17 years (range 12-28) and the mean size at sexual maturity was 129.3 centimeters CCL (range 110.7-152.3) (Avens *et al.* 2020).

Leatherbacks have a greater tolerance for colder waters compared to all other sea turtle species due to their thermoregulatory capabilities (Paladino *et al.* 1990, Shoop and Kenney 1992, Wallace and Jones 2008). Evidence from tag returns, satellite telemetry, and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between temperate/boreal and tropical waters (Bond and James 2017, Dodge *et al.* 2015, Eckert *et al.* 2006, Fossette *et al.* 2014, James *et al.* 2005a, 2005b, 2005c, NMFS and U.S. FWS 1992). 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 jellyfish, sea nettles, and ctenophores (Dodge *et al.* 2011). Juvenile and small subadult leatherbacks may spend more time in oligotrophic (relatively low plant nutrient usually accompanied by high 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 (NMFS and U.S. FWS 2020, Shoop and Kenney 1992). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson *et al.* 2011).

Analyses of mtDNA from leatherback sea turtles indicates a low level of genetic diversity (Dutton *et al.* 1999). Using genetic data, combined with nesting, tagging, and tracking data, researchers identified seven global subpopulations: Northwest Atlantic, Southeast Atlantic, Southwest Atlantic, Northwest Indian, Southwest Indian, East Pacific, and West Pacific (Wallace *et al.* 2010). The 2020 status review concluded that the subpopulations identified by Wallace *et al.* (2010) are discrete populations and, then, evaluated whether any other populations exhibit this level of genetic discontinuity (NMFS and U.S. FWS 2020).

To evaluate the subpopulations and fine-scale structure in the Atlantic, Dutton *et al.* (2013) conducted a comprehensive genetic re-analysis of rookery stock structure. Samples from eight nesting sites in the Atlantic and one in the southwest Indian Ocean identified seven management units in the Atlantic and revealed fine scale genetic differentiation among neighboring populations. The mtDNA analysis failed to find significant differentiation between Florida and Costa Rica or between Trinidad and French Guiana/Suriname (Dutton *et al.* 2013). While Dutton *et al.* (2013) identified fine-scale genetic partitioning in the Atlantic Ocean, the differences did not rise to the level of marked separation or discreteness (NMFS and U.S. FWS 2020). Dutton *et al.* (2013) concluded that their nuclear and mtDNA results confirm the three

discrete populations in the Atlantic (Northwest Atlantic, Southwest Atlantic and Southeast Atlantic). 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).

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

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

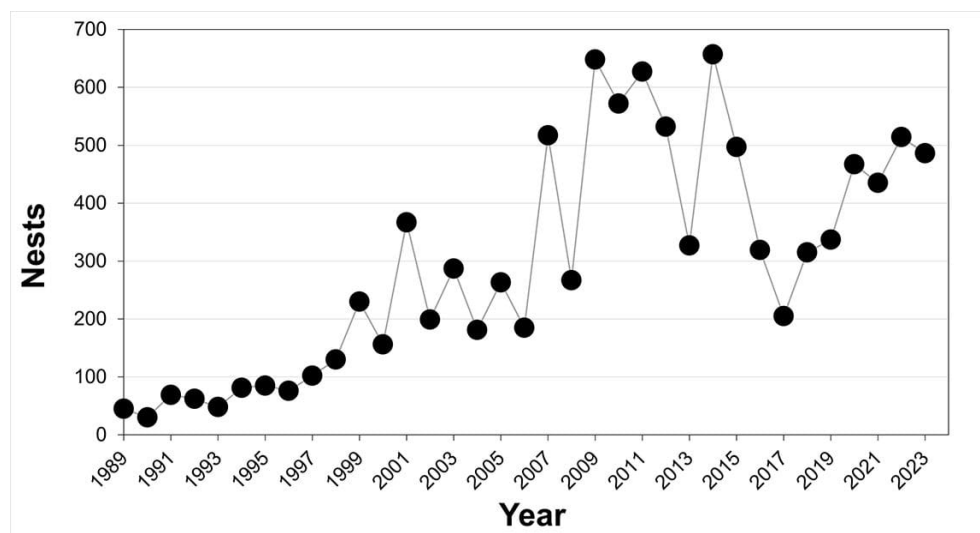
Previous assessments of leatherbacks concluded that the Northwest Atlantic population was stable or increasing (TEWG 2007, Tiwari *et al.* 2013b). However, based on more recent analyses, leatherback nesting in the Northwest Atlantic is showing an overall negative trend, with the most notable decrease 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 vessel 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) (Eckert 2013, Lum 2006).

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 U.S. From 1989-2023, leatherback nests at core index beaches in Florida (representing 30 percent of known leatherback nesting) have varied from a minimum of 30 nests in 1990 to a maximum of 657 in 2014 (Figure 16; <https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/>). Leatherback nesting on Florida's index beaches increased to 2014, then declined from 2014 to 2017, followed by an increase since 2018. While lower than the nest numbers documented during the 2009-2014 period, 486 nests were reported in 2023 (Figure 16) (FFWCC 2024). 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 FFWCC 2024, 2020).

Figure 16. Number of leatherback sea turtle nests counted on core index beaches in Florida from 1989-2023. (<https://myfwc.com/research/wildlife/sea-turtles/nesting/>)



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

Populations in the Pacific have shown dramatic declines at many nesting sites (Mazaris *et al.* 2017, Santidrián-Tomillo *et al.* 2017, Santidrián-Tomillo *et al.* 2007, Sarti Martínez *et al.* 2007, Tapilatu *et al.* 2013). 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 ten 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, changing environmental conditions, 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 Northwest Atlantic and worldwide is low.

Changing environmental conditions have been identified as a threat to leatherback sea turtles found in the action area (Conant *et al.* 2009, NMFS *et al.* 2011, NMFS and U.S. FWS 2020, Seminoff *et al.* 2015). Leatherback sea turtles are most likely to be affected by changing environmental conditions due to (1) changing air temperature at nesting beaches, which could impact sex ratios among hatchlings (Laloë *et al.* 2016); (2) sea level rise and increased storms, which could result in a reduction or shift in available nesting beach habitat and increased risk of nest inundation (Baker *et al.* 2006, Daniels *et al.* 1993, Fish *et al.* 2005, Reece *et al.* 2013); (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; and (4) changes in water temperature, which could possibly lead to a northward shift in their range and changes in phenology (timing

of nesting seasons, timing of migrations).

Some research suggests that leatherbacks may be more resilient to changing conditions in the Northwest Atlantic because of their wide geographic distribution, low nest-site fidelity, gigantothermy⁹ (Dutton *et al.* 1999, Fuentes *et al.* 2013, Robinson *et al.* 2009) and observed range expansion (McMahon and Hays 2006). However, modeling results show that changing environmental conditions 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) and more recent research by Lettrich *et al.* (2020) determined that in the Northwest Atlantic, the vulnerability of leatherback sea turtles to changing environmental conditions is very high.

As the climate continues to warm, feminization of sea turtle populations is a concern for leatherback sea turtles, which undergo temperature-dependent sex determination. Modeling results from Laloë *et al.* (2016) project the entire feminization of 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, Laloë *et al.* 2016, Patino-Martinez *et al.* 2012). Hatchling success has declined in St. Croix (Garner *et al.* 2017), though there is some evidence that the overall trend is not climate or precipitation related (Rafferty *et al.* 2017). Excess precipitation is known to negatively impact hatchling success in wet areas, but can have a positive effect in dry climates (Santidrián-Tomillo *et al.* 2015). In Grenada, increased rainfall (another effect of climate change) was found to have a cooling influence on leatherback nests, so that more male producing temperatures (less than 29.75°C) were found within the clutches (Houghton *et al.* 2007). There is also evidence for very wet conditions inundating nests or increasing fungal and mold growth, reducing hatching success (Patino-Martinez *et al.* 2014). Very dry conditions may also affect embryonic development and decrease hatchling output. Leatherbacks have a tendency towards individual nest placement preferences, with some clutches deposited in the cooler tide zone of beaches and have relatively weak nesting site fidelity; this may mitigate the consequences of long-term changes in climate on sex ratios (Fuentes *et al.* 2013, Kamel and Mrosovsky 2004).

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 leatherback sea turtles, there may be changes in the abundance and distribution of these species in the action area. Rising water temperatures, and associated changes in marine physical oceanographic systems (*e.g.*, salinity, oxygen levels, and circulation), may also impact the

⁹ Gigantothermy refers to the leatherback’s ability to use its large body size, peripheral tissues as insulation, and circulatory changes in thermoregulation Paladino, F.V., O’Connor, M.P., and Spotila, J.R. 1990. Metabolism of leatherback turtles, gigantothermy, and thermoregulation of dinosaurs. *Nature* **344**(6269): 858-860..

distribution/abundance of leatherback prey (*i.e.*, jellyfish) and in turn, impact the distribution and foraging behavior of leatherbacks (Attrill *et al.* 2007, Brodeur *et al.* 1999, NMFS 2013, Purcell 2005, Richardson *et al.* 2009). 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.

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

Delisting criteria:

1. Adult female population increases for 25 years after publication of the recovery plan, as evidenced by a statistically significant trend in nest numbers at Culebra, Puerto Rico; St. Croix, 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 America 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 been 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 2016):

1. Reduce fisheries interactions.

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

4.2.1.5 *Other Factors outside the Action Area Affecting the Status of Sea Turtles*

The April 20, 2010, explosion of the Deepwater Horizon oil rig affected sea turtles in the Gulf of America. While the spill occurred outside the action area, it impacted 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 America. Sea turtles were exposed to oil when in contaminated water or habitats; by breathing oil droplets, oil vapors, and smoke; by ingesting oil-contaminated water and prey; and potentially by maternal transfer of oil compounds to embryos. Response activities and shoreline oiling also directly injured sea turtles, disrupting and deterring sea turtle nesting in the Gulf (DWH NRDA Trustees 2016).

During direct at-sea capture events, more than 900 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, with the goal of preventing hatchlings from entering the oiled waters of the northern Gulf. More than 28,000 eggs were moved to an incubation facility in Cape Canaveral, Florida, where they were incubated until emergence and release. Approximately 14,000 hatchlings were released off the Atlantic coast of Florida, 95 percent of which were loggerheads (<https://www.fisheries.noaa.gov/national/marine-life-distress/sea-turtles-dolphins-and-whales-10-years-after-deepwater-horizon-oil>).

Direct observations of the 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 greens) were also injured by response activities (DWH NRDA Trustees 2016). Despite uncertainties and some unquantified injuries to sea turtles (*e.g.*,

injury to leatherbacks, unrealized reproduction), the Trustees conclude that this assessment adequately quantifies the nature and magnitude of injuries to sea turtles caused by the DWH oil spill and related activities. Other impacts assessed include reproductive failure and adverse health 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 (Mitchellmore *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 Mexico¹⁰ 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 Mexico¹⁰ 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.

4.2.2 Status of Atlantic Sturgeon

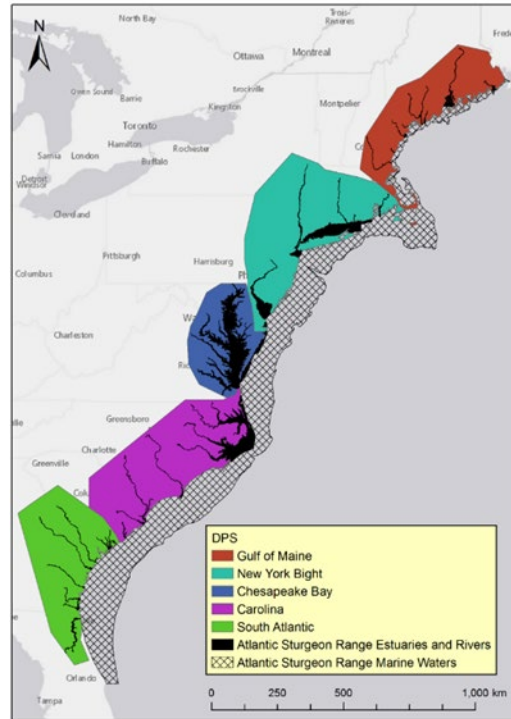
This section describes the Atlantic sturgeon listing, provides life history information that is

¹⁰ Gulf of America referred to as Gulf of Mexico in DWH NRDA Trustees 2016.

relevant to all DPSs of Atlantic sturgeon and then provides information specific to the status of each DPS of Atlantic sturgeon. Below, we also provide a description of which Atlantic sturgeon DPSs are likely to occur in the action area and provide information on the use of the action area by 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 17). 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. 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. The conservation objective identified in the final rule is to increase the abundance of each DPS by facilitating increased successful reproduction and recruitment to the marine environment. The action area overlaps with critical habitat designated for the New York Bight DPS, as analyzed above.

Figure 17. Representative distribution of rivers of origin for ESA listed Atlantic sturgeon DPSs



Information available from the 2007 Atlantic sturgeon status review (ASSRT 2007), 2017 ASMFC benchmark stock assessment (ASMFC 2017) and 2024 updates, final listing rules (77 FR 5880 and 77 FR 5914; February 6, 2012), material supporting the designation of Atlantic sturgeon critical habitat (NMFS 2017a), and Five-Year Reviews completed for the Gulf of Maine, New York Bight, and Chesapeake Bay DPSs (NMFS 2022a, b, c) and Carolina and South Atlantic DPSs (NMFS 2023a, 2023b) were used to summarize the life history, population dynamics, and status of the species. This information is linked in Table 5 and incorporated into this status by reference.

Table 5. Atlantic sturgeon resources incorporated by reference.

2007 Atlantic Sturgeon Status Review	Final Listing Rules	2017 ASMFC Benchmark Stock Assessment	Material Supporting the Designation of Atlantic Sturgeon Critical Habitat	Five-Year Reviews	<u>Critical Habitat Listing</u>
(ASSRT 2007)	(77 FR 5880 and	(ASMFC 2017b)	(NMFS 2017b)	Gulf of Maine, New York Bight,	82 FR 39160

	77 FR 5914 ; February 6, 2012)			and Chesapeake Bay DPSs (NMFS 2022a, b, c) and Carolina and South Atlantic DPSs (NMFS 2023a, b)	

Life History

Atlantic sturgeon are a late maturing, anadromous species (ASSRT 2007, Balazik *et al.* 2010, Hilton *et al.* 2016, Sulak and Randall 2002). Sexual maturity is reached between the ages of five 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 2017b).

Atlantic sturgeon spawn in freshwater (ASSRT 2007, NMFS 2017b) at sites with flowing water and hard bottom substrate (Bain *et al.* 2000, Balazik *et al.* 2012a, Gilbert 1989, Greene *et al.* 2009, Hatin *et al.* 2002, Mohler 2003, Smith and Clugston 1997, Vladykov and Greeley 1963). Water depths of spawning sites are highly variable, but may be up to 27 m (88.5 ft) (Bain *et al.* 2000, Crance 1987, Leland 1968, Scott and Crossman 1973). 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 (Caron *et al.* 2002, Collins *et al.* 2000, Smith 1985) and two to five years in females (Stevenson and Secor 1999, Van Eenennaam *et al.* 1996, Vladykov and Greeley 1963). Some Atlantic sturgeon river populations may have up to two spawning seasons comprised of different spawning adults (Balazik *et al.* 2017b, Balazik and Musick 2015, Collins *et al.* 2000, Denison *et al.* 2023), although the majority likely have just one, either in the spring or fall.¹¹ There is evidence of spring and fall spawning for the South Atlantic DPS (77 FR 5914, February 6, 2012, Collins *et al.* 2000b, NMFS and USFWS 1998b) (Collins *et al.* 2000b, NMFS and USFWS 1998), spring spawning for the Gulf of Maine and New York Bight DPSs (NMFS 2017a), and fall spawning for the Chesapeake and Carolina DPSs (Balazik *et al.* 2012a, Smith *et al.* 1984). Telemetry and empirical data suggest that there may be two potential spawning runs in the James River: 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, Balazik *et al.* 2017a).

Following spawning, males move downriver to the lower estuary and remain there until

¹¹ 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).

outmigration in the fall (Bain 1997, Bain *et al.* 2000, Balazik *et al.* 2012c, Breece *et al.* 2013, Dovel and Berggren 1983, Greene *et al.* 2009, Hatin *et al.* 2007, Ingram *et al.* 2019, Smith 1985, Smith *et al.* 1982). Females move downriver and may leave the estuary and travel to other coastal estuaries until outmigration to marine waters in the fall (Bain 1997, Bain *et al.* 2000, Balazik *et al.* 2012a, Breece *et al.* 2013, Dovel and Berggren 1983a, Greene *et al.* 2009, Hatin *et al.* 2002, NMFS 2017a, Smith 1985, Smith *et al.* 1982). Atlantic sturgeon deposit eggs on hard bottom substrate. They hatch into the yolk sac larval stage approximately 94 to 140 hours after deposition (Mohler 2003, Murawski and Pacheco 1977, Smith *et al.* 1980, Van Den Avyle 1984, Vladykov and Greeley 1963) are demersal, and seek cover in the bottom substrate. They inhabit the same riverine or estuarine areas where they were spawned (Bain *et al.* 2000, Kynard and Horgan 2002). Once the yolk sac is absorbed (eight to twelve days post-hatching), sturgeon become post yolk sac larvae. Shortly after, they drift downstream and become young of year and then juveniles. The juvenile stage can last months to years in the brackish waters of the natal estuary (ASSRT 2007, Calvo *et al.* 2010, Collins *et al.* 2000a, Dadswell 2006, Dovel and Berggren 1983b, Greene *et al.* 2009, Hatin *et al.* 2007, Holland and Yelverton 1973, Kynard and Horgan 2002, Mohler 2003, Schueller and Peterson 2010, Secor *et al.* 2000, Waldman *et al.* 1996). Upon reaching the sub-adult phase, individuals enter the marine environment, mixing with adults and sub-adults from other river systems (Bain 1997, Dovel and Berggren 1983a, Hatin *et al.* 2007, McCord *et al.* 2007) (NMFS 2017a). Once sub-adult Atlantic sturgeon have reached maturity/the adult stage, they will remain in marine or estuarine waters, only returning far upstream to the spawning areas when they are ready to spawn (ASSRT 2007, Bain 1997, Breece *et al.* 2016, Dunton *et al.* 2012, Dunton *et al.* 2015, Savoy and Pacileo 2003).

The life history of Atlantic sturgeon can be divided up into seven general categories as described in Table 6 below (adapted from ASSRT 2007).

Table 6. General descriptions of Atlantic sturgeon life history stages.

The size ranges are only guidelines for the life stages, which are more dependent on behavior (e.g., if a sturgeon is measured to be <760 mm total length, but is reported to have traveled in offshore marine waters, it is most likely a subadult and not a juvenile). See https://media.fisheries.noaa.gov/dam-migration/ans_life_stage_behavior_descriptions_20191029_508.pdf for more information

Age Class	Typical Size	General Duration	Representative Description
Egg	~2 mm – 3 mm diameter (Van Eenennaam <i>et al.</i> 1996)	Hatching occurs ~3-6 days after egg deposition and fertilization (ASSRT 2007)	Fertilized or unfertilized

Age Class	Typical Size	General Duration	Representative Description
Yolk-sac larvae (YSL)	~6mm – 14 mm (Bath et al. 1981)	8-12 days post hatch (ASSRT 2007) (p. 4))	Negative photo-taxis, nourished by yolk sac
Post yolk-sac larvae (PYSL)	~14mm – 37mm (Bath et al. 1981)	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 < one 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

The ASMFC evaluated the status of Atlantic sturgeon in 2017 using fisheries- dependent and - independent sources in order to inform a variety of population parameters. One index of population abundance for Atlantic sturgeon in Northeast U.S. waters has been derived from the Northeast Area Monitoring and Assessment Program (NEAMAP) trawl surveys, first by Kocik et al. (2013) [for the period of 2007-2012] and most recently by Boucher (2025) [for the period of 2007-2023].¹² The Review Panel for the ASMFC (2017) stock assessment encouraged use of this index, in addition to others discussed in the stock assessment, to assess trends in Atlantic sturgeon abundance. It currently meets the recommended minimum standard of 15 years for use in a trend analysis. For our analyses, we are relying on the population estimates derived from the NEAMAP swept area biomass which takes into account a 50 percent catchability rate (i.e., net

¹² Since fall 2007, the NEAMAP trawl surveys (spring and fall) have been conducted from Cape Cod, Massachusetts to Cape Hatteras, North Carolina in nearshore Atlantic Ocean waters at depths up to 18.3 m (60 ft). Each survey employs a spatially stratified random design with a total of 35 strata and 150 sampling stations.

efficiency x availability). We consider that the NEAMAP surveys sample an area utilized by Atlantic sturgeon but do not sample all the locations and times where Atlantic sturgeon are present. We also consider that the trawl net captures some, but likely not all, of the Atlantic sturgeon present in the sampling area. Atlantic sturgeon that occur in estuaries or rivers, and also north of Cape Cod or south of Cape Hatteras, are not included in the population index. As the estimates from Boucher (2025) are derived directly from empirical data with fewer assumptions than have been required to model Atlantic sturgeon populations to date, we believe these estimates are the best available information. Based on the latest population estimates in Boucher (2025), the overall minimum swept-area abundance of Atlantic sturgeon in nearshore U.S. Atlantic waters from Cape Cod to Cape Hatteras is estimated to be 45,113 fish, using the average estimates from the spring and fall surveys across the years of 2008-2023, the time period which encompasses all years included in Boucher (2025) for which both a spring and fall survey were conducted.

Although NEAMAP only covers the Mid-Atlantic region, we consider its resulting estimates to represent the best available index of abundance in the marine environment and to be reliable for use as a proxy for broader regional abundance estimates. Based on genetic frequencies of occurrence in the sampled area, this regional population estimate was subsequently partitioned by DPS using the ‘Mid-Atlantic (MID) Offshore’ percentage breakdowns in Kazyak *et al.* (2021), as that study region most closely aligns with the NEAMAP survey area (Table 7). It is important to note that the NEAMAP-based estimates do not include young of year fish and juveniles in the rivers. The NEAMAP surveys are conducted in ocean waters that include the preferred depth ranges of sub-adult and adult Atlantic sturgeon and take place during seasons that coincide with known Atlantic sturgeon coastal migration patterns in the ocean.

Table 7. Summary of minimum swept area population estimates of Atlantic sturgeon based upon the NEAMAP survey swept area model.

DPS	Estimated Ocean Population Abundance
Gulf of Maine	727
NY Bight	24,963
Chesapeake Bay	10,332
Carolina	2,617
South Atlantic	6,154
Canada	320
Total	45,113

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 (2017b) 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. The population growth rates reported from that PVA ranged from -1.8 percent to 4.9 percent (ASMFC 2017b). In the ASMFC (2024) stock assessment update, nine fishery-independent surveys were developed into indices of relative abundance for Atlantic sturgeon. Most indices either had no trend over the time series or were increasing. The individual indices were then combined to develop a coastwide index of relative Atlantic sturgeon abundance. The coastwide index was variable from 1990-2022 but had been steadily increasing since 2013 (ASMFC 2024).

The genetic diversity of Atlantic sturgeon throughout its range has been well-documented (ASSRT 2007, Bowen and Avise 1990, Kazyak *et al.* 2021, O'Leary *et al.* 2014, Ong *et al.* 1996, Waldman *et al.* 1996, Waldman and Wirgin 1998, White *et al.* 2021a). 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 (Fritts *et al.* 2016, Savoy *et al.* 2017, Wirgin *et al.* 2002) indicate that Atlantic sturgeon typically return to their natal river to spawn, despite extensive mixing in coastal waters.

Based on fishery-independent, fishery dependent, tracking, and tagging data, Atlantic sturgeon appear to primarily occur inshore of the 50 m (164 ft) depth contour (Dunton *et al.* 2012, Dunton *et al.* 2010, Erickson *et al.* 2011, Laney *et al.* 2007, O'Leary *et al.* 2014, Stein *et al.* 2004a, b, Waldman *et al.* 2013, Wirgin *et al.* 2015a, 2015b). However, they are not restricted to these depths and excursions into deeper (e.g., 75 m (250 ft)) continental shelf waters have been documented (Colette and Klein-MacPhee 2002, Collins and Smith 1997, Erickson *et al.* 2011, Stein *et al.* 2004a, b, Timoshkin 1968). 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, Hilton *et al.* 2016, Oliver *et al.* 2013, Post *et al.* 2014, Wippelhauser 2012). 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 (66 ft), 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 m (66 ft) (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 m (82 ft) (Bain *et al.* 2000, Dunton *et al.* 2010, Erickson *et al.* 2011, Laney *et al.* 2007, O'Leary *et al.* 2014, Oliver *et al.* 2013, Savoy and Pacileo 2003, Stein *et al.* 2004a, b, Waldman *et al.* 2013, Wippelhauser 2012, 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 refugia, wintering sites, or marine foraging areas (Dunton et al. 2010, Erickson et al. 2011, Stein et al. 2004b).

Status

Atlantic sturgeon were once present in 38 river systems and, of these, spawned in 35 (ASSRT 2007). They are currently present in 36 rivers and are probably present in additional rivers that provide sufficient forage base, depth, and access (ASSRT 2007). The benchmark stock assessment evaluated evidence for spawning tributaries and sub-populations of U.S. Atlantic sturgeon in 39 rivers. They confirmed (eggs, embryo, larvae, or young of year observed) spawning in ten rivers, considered spawning highly likely (adults expressing gametes, discrete genetic composition) in nine rivers, and suspected (adults observed in upper reaches of tributaries, historical accounts, presence of resident juveniles) spawning in six rivers. Spawning in the remaining rivers was unknown (ten) or suspected historical (four) (ASMFC 2017). The decline in abundance of Atlantic sturgeon has been attributed primarily to the large U.S. commercial fishery, which existed for the Atlantic sturgeon through the mid-1990s. Based on management recommendations in the ISFMP, adopted by the Commission in 1990, commercial harvest in Atlantic coastal states was severely restricted and ultimately eliminated from most coastal 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, b). In 1999, NMFS closed the U.S. EEZ to Atlantic sturgeon retention, pursuant to the ACA (64 FR 9449; February 26, 1999). However, many state fisheries for sturgeon were closed prior to this.

As described in the listing rules and in the 2022 and 2023 5-year reviews, the most significant threats to Atlantic sturgeon are incidental catch, dams that block access to spawning habitat in southern rivers, poor water quality, dredging of spawning areas, water withdrawals from rivers, and vessel strikes. Climate change related impacts on water quality (e.g., temperature, salinity, dissolved oxygen, contaminants) also have the potential to affect Atlantic sturgeon populations using impacted river systems.

ASMFC 2017 indicates that based on historic removals and estimated effective population size, all five Atlantic sturgeon DPSs are depleted relative to historical levels. However, the 2017 stock assessment does provide some evidence of population recovery at the coastwide scale, and mixed population recovery at the DPS scale (ASMFC 2017). The 2017 stock assessment also concluded that a variety of factors (i.e., bycatch, habitat loss, and ship strikes) continue to impede the recovery rate of Atlantic sturgeon (ASMFC 2017). Over the long term, changing environmental conditions may affect Atlantic sturgeon by affecting the location of spawning, distribution of prey, water temperature, and water quality.

Elevated temperatures could modify range and migratory patterns, cues for spawning migration

that result in an earlier spawning season, and thus, alter 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 changing conditions) and river flow (which could be affected), it is not possible to predict how any change in water temperature alone will affect the seasonal movements of sturgeon through the action area. 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 this 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 with prey distribution, it is likely that there would be minimal, if any, impact on the availability of food, and they would be able to continue to meet their foraging needs. Similarly, if sturgeon shifted to areas where different forage was available and were able to obtain sufficient nutrition from that new source of forage, any effects would also be minimal. The greatest potential for effects would be if sturgeon shifted spatially or temporally to areas where insufficient forage was available; however, the likelihood of this happening is unknown.

Increasing hypoxia, in combination with increasing temperature, affects juvenile 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 DO; climate conditions that reduce the amount of available habitat with these conditions could reduce the productivity of Atlantic sturgeon. However, there is significant uncertainty, due to a lack of specific scientific data, on the degree to which these effects may be experienced and the degree to which Atlantic sturgeon will be able to successfully adapt to any such changes. Any activities occurring within and outside the action area that contribute to changing environmental conditions are also expected to affect Atlantic sturgeon in the action area. While we can make some predictions on the likely effects of these changes on these species and critical habitat, without modeling and additional scientific data, these predictions remain speculative. Additionally, these predictions do not take into account the adaptive capacity of this species, which uses varied habitat types and forage, and may allow them to deal with change better than predicted.

Despite the depleted status, the Commission's assessment did include signs that the coastwide index is above the 1998 value (95 percent probability). Total mortality from the tagging model was very low at the coastwide level. Small sample sizes made mortality estimates at the DPS level more difficult. By DPS, the assessment concluded that there was a 51 percent probability that the Gulf of Maine DPS abundance has increased since 1998 but a 74 percent probability that

mortality for this DPS exceeds the mortality threshold used for the assessment. There is a relatively high (75 percent) probability that the New York Bight DPS abundance has increased since 1998, and a 31 percent probability that mortality exceeds the mortality threshold used for the assessment. There is also a relatively high (67 percent) probability that the Carolina DPS abundance has increased since 1998, and a relatively high probability (75 percent) that mortality for this DPS exceeds the mortality threshold used in the assessment. However, the index from the Chesapeake Bay DPS (highlighted red) only had a 36 percent chance of being above the 1998 value and a 30% probability that the mortality for this DPS exceeds the mortality threshold for the assessment. There was not enough information available to assess the abundance for the South Atlantic DPS relative to the 1998 moratorium, but the assessment did conclude that there was 40 percent probability that the mortality for this DPS exceeds the mortality threshold used in the assessment (ASMFC 2017). 5-Year reviews for each DPS, completed by NMFS in 2022 and 2023, summarize information that has become available since the listing. No changes to the classification for any DPS is recommended in the 5-year reviews (NMFS 2022 a, b, and c, NMFS 2023 a, b).

Recovery Goals for All DPSs

A Recovery Plan has not been completed for any DPS of Atlantic sturgeon. In 2018, NMFS published a Recovery Outline¹³ to serve as an initial recovery-planning document. In this, the recovery vision is stated, “Subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future.” The Recovery Outline also includes steps that are expected to serve as an initial recovery action plan. These include protecting extant subpopulations and the species’ habitat through reduction of threats; gathering information through research and monitoring on current distribution and abundance; and addressing vessel strikes in rivers, the effects of changing environmental conditions, and bycatch.

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.

4.2.1 Gulf of Maine DPS of Atlantic sturgeon

The Gulf of Maine DPS includes the following: all anadromous Atlantic sturgeons that are spawned in the watersheds from the Maine/Canadian border and, extending southward, all watersheds draining into the Gulf of Maine as far south as Chatham, MA. Within this range,

¹³ https://media.fisheries.noaa.gov/dam-migration/ats_recovery_outline.pdf; last accessed July 26, 2024.

Atlantic sturgeon historically spawned in the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT, 2007). Spawning occurs in the Kennebec River and may at least occasionally occur in the Androscoggin River below the Brunswick Dam (Wippelhauser et al. 2017). In the Kennebec River, Wippelhauser *et al.* (2017) confirms the location of spawning occurrence between RM 43.5 and 46.6 (RKM 70 and 75). Despite the presence of suitable spawning habitat in a number of other rivers (Penobscot, Merrimack, and Piscataqua (inclusive of the Cocheco and Salmon Falls) Rivers), there is no evidence of recent spawning in the remaining rivers. Large aggregations of Atlantic sturgeon have also been reported from the Saco River and estuary. However, no new information indicates that spawning is being established in the Saco River. It is not known whether sturgeon larvae could survive in the Saco River even if spawning were to occur because of the presence of the Cataract Dam at RM 6.2 (RKM 10) of the river (Little 2013), which limits access to the freshwater reach.

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 (ASSRT Altenritter *et al.* 2017b, 2007, Fernandes *et al.* 2010), which have been detected off of Delaware (Kazyak *et al.* 2021, Wirgin *et al.* 2015a) and as far south as Cape Hatteras. The large aggregation of Atlantic sturgeon in the Saco, although not known to be spawning, have been observed foraging in Saco River and Bay, primarily from May through October ((Novak *et al.* 2017, Wippelhauser *et al.* 2017), and some fish also overwinter in the Bay (Beardsall *et al.* 2013, Hylton *et al.* 2018, Little 2013), suggesting the river provides important habitat, particularly for subadults. Dadswell et al. (2016) describes characteristics of the seasonal aggregation of sturgeon in the Bay of Fundy. Detailed seasonal movements of Atlantic sturgeon, a number of which are likely Gulf of Maine DPS origin, to and from the Bay of Fundy are described in Beardsall et al. (2016).

There are no abundance estimates for the Gulf of Maine DPS or for the Kennebec River spawning population. However, we have estimated subadult and adult abundance in nearshore marine waters from Cape Cod to Cape Hatteras and concluded that, at a minimum, approximately 727 adult and subadult Atlantic sturgeon may comprise the DPS, based upon the NEAMAP survey swept area model (Boucher 2025). We expect this estimate (727 adult and subadults) to represent a minimum abundance for the total population based on stock assessments and that the NEAMAP trawls are mid-Atlantic centered. The ASSRT (2007) status review estimated that the number of spawning adults in the Gulf of Maine DPS was less than 300 per year, but that estimate was based on a comparison to the larger Hudson and Altamaha River spawning populations and not an actual number. 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 population viability is through determinations of effective population size (N_e)¹⁴, 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 a measure of parents in an idealized panmictic and stable population because it is only a measure of parentage, which is less than the total abundance of a population because not all adults successfully reproduce. Measure of effective population size is used to inform whether a population is at risk of inbreeding and loss of adaptive potential. Thus, the effective population size can be a key variable to evaluate population viability and extinction risk (Frankham *et al.* 2014, Hoban *et al.* 2020). As a general rule, a minimum N_e of 50 and a minimum of 500 have been widely used in conservation biology as thresholds to avoid inbreeding depression and maintain long-term evolutionary potential, respectively (Clarke *et al.* 2024, Franklin 1980, Jamieson and Allendorf 2012). However, other authors have suggested that minimum N_e thresholds of 100 and 1,000 are needed to maintain a populations' fitness and evolutionary potential (Frankham *et al.* 2014, Pérez-Pereira *et al.* 2022). The effective population size of the Gulf of Maine DPS has been assessed in three recent 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 percent CI=47.3-91.1)(ASMFC 2017b), 67 (95 percent CI=52.0–89.1) (Waldman *et al.* 2019), and 79.4 (95 percent CI=60.3-111.7)(White *et al.* 2021a).

The current status of the Gulf of Maine DPS is affected by historical and modern fisheries dating as far back as the 1800s (Squiers *et al.*, 1979; Stein *et al.*, 2004; ASMFC 2007). Incidental capture of Atlantic sturgeon in state and Federal fisheries continues today. As explained above, we have estimates of the number of subadults and adults that are killed as a result of bycatch in fisheries authorized under Northeast 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.

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, the Veazie Dam on the Penobscot River). There are strict regulations on the use of fishing gear in Maine

¹⁴ Effective Population Size (N_e) is defined as the size of a hypothetical ideal population (or the number of ideal individuals) that would experience the same rate of genetic drift as the population under consideration Wang, J., Santiago, E., and Caballero, A. 2016. Prediction and estimation of effective population size. *Heredity* 117(4): 193-206.

, Wright, S. 1969. *Evolution and the genetics of populations. 2. The theory of gene frequencies.* University of Chicago Press, Chicago, IL. Therefore, it is in most cases less than the total number of individuals in the population. See <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/effective-population-size>.

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 GOM DPS are not commonly taken as bycatch in areas south of Chatham, MA, with only 8 percent (e.g., 7 of the 84 fish) of interactions observed in the Mid Atlantic/Carolina 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).

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). NMFS has determined that the Gulf of Maine DPS is at risk of becoming endangered in the foreseeable future throughout all of its range 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.

In 2018, we announced the initiation of a 5-year review for the Gulf of Maine DPS. We reviewed and considered new information for the Gulf of Maine DPS that has become available since this DPS was listed as threatened in February 2012. We completed the 5-year review for the Gulf of Maine DPS in February 2022 (NMFS 2022a); the review includes a summary of additional information available since the listing determination, including information on life history and threats. Based on the best scientific and commercial data available at the time of the review, we concluded that no change to the listing status is warranted.

4.2.2 NY 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 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, ASMFC, 2017b). Spawning still occurs in the Delaware and Hudson Rivers. 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, several presumed age-0 Atlantic sturgeon were captured in the Connecticut River; the available information indicates that successful spawning took place in 2013 by a small number of adults. Genetic analysis of the juveniles indicates that the adults were likely migrants from the South Atlantic DPS (Savoy et al. 2017). As noted by the authors, this conclusion is counter to prevailing information regarding straying of adult Atlantic sturgeon. As these captures represent the only contemporary records of possible natal Atlantic sturgeon in the Connecticut River and the genetic analysis is unexpected, more information is needed to establish the frequency of spawning in the Connecticut River and whether there is a unique Connecticut River population of Atlantic sturgeon. 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 (see additional explanation in NMFS 2022b).

The abundance of the Hudson River Atlantic sturgeon riverine population prior to the onset of expanded exploitation in the 1800s is unknown but has been conservatively estimated at 10,000 adult females (Secor, 2002). Current abundance is likely at least one order of magnitude smaller than historical levels (Secor, 2002; ASSRT, 2007; Kahnle *et al.*, 2007), but no comprehensive estimate is known. As described above, an estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson River riverine population based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.*, 2007). Kahnle *et al.* (1998; 2007) also showed that the level of fishing mortality from the Hudson River Atlantic sturgeon fishery during the period of 1985-1995 exceeded the estimated sustainable level of fishing mortality for the riverine population and may have led to reduced recruitment. A decline in the abundance of young Atlantic sturgeon appeared to occur in the mid to late 1970s followed by a secondary drop in the late 1980s (Kahnle *et al.*, 1998; Sweka *et al.*, 2007; ASMFC, 2010). At the time of listing, catch-per-unit-effort (CPUE) data suggested that recruitment remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid-late 1980s (Sweka *et al.*, 2007; ASMFC, 2010). In examining the CPUE data from 1985-2007, there are significant fluctuations during this time. There appears to be a decline in the number of juveniles between the late 1980s and early 1990s while the CPUE is generally higher in the 2000s as compared to the 1990s. Recent analyses suggest that the abundance of juvenile Atlantic sturgeon belonging to the Hudson River spawning population has increased, with double the average catch rate for the period from 2012-2019 compared to the previous eight years, from 2004-2011 (Pendleton and Adams 2021). A study by Stich *et al.* (2025) found that relative abundance of juveniles increased from 2004 to 2015 prior to declining through 2022. Results also showed that detection-corrected indices for adult sturgeon indicated a consistent increase in relative abundance that was not readily apparent in raw catch indices (Stich *et al.* 2025).

There is limited new information on the spawning population abundance in the Hudson River since the time of listing; Kazyak et al. (2020) used side scan sonar technology in conjunction with detections of previously tagged Atlantic sturgeon to estimate a Hudson River spawning run

size of 466 sturgeon (95% CRI = 310-745) in 2014. Another method for assessing the number of spawning adults is through determinations of effective population size (the number of individuals that effectively participates in producing the next generation, as discussed above (See NMFS 2022b for more information. The estimates of effective population size for the Hudson River spawning population from separate studies and based on different age classes are relatively similar to each other: 198 (95% CI=171.7-230.7) based on sampling of subadults captured off of Long Island across multiple years, 156 (95% CI=138.3-176.1) based on sampling of natal juveniles in multiple years (O’Leary et al. 2014; Waldman et al. 2019), and 144.2 (95% CI=82.9-286.6) based on samples from a combination of juveniles and adults (ASMFC 2017).

As described in the Status Review and listing rule, in addition to capture in fisheries operating in Federal waters, bycatch and mortality also occur in state fisheries; however, the primary fishery (shad) that impacted juvenile sturgeon 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 effects of bridge construction. Impingement at water intakes, including the Danskammer, Roseton, and Indian Point power plants has been documented in the past. Recent information from surveys of juveniles (see above) 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.

There is no total abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800s indicate that this was historically a large population with an estimated 180,000 adult females prior to 1890 (Secor and Waldman, 1999; Secor, 2002). Sampling in 2009 to target young of year Atlantic sturgeon in the Delaware River (i.e., natal sturgeon) resulted in the capture of 34 young of year, ranging in size from 178 to 349 mm TL (Fisher, 2009) and the collection of 32 young of year Atlantic sturgeon in a separate study (Brundage and O’Herron in Calvo *et al.*, 2010). Genetics information collected from 33 of the 2009-year class young of year indicates that at least three females successfully contributed to the 2009-year class (Fisher, 2011). Therefore, while the capture of young of year in 2009 provides evidence that successful spawning is still occurring in the Delaware River, the relatively low numbers suggest the existing riverine population is limited in size. The Delaware Division of Fish and Wildlife (DFW) has conducted juvenile abundance surveys in the Delaware River in most years since 2010. The estimated abundance in 2014 was 3,656 (95% CI = 1,935–33,041) age 0-1 juvenile Atlantic (Hale et al. 2016). Estimates for the Delaware River spawning population by the same authors and using the same methods as described above for the Hudson River were: 108.7 (95% CI=74.7-186.1) and 40 (95% CI=34.7-46.2) for samples from subadults and natal juveniles, respectively (O’Leary et al. 2014; Waldman et al. 2019), and 56.7 (95% CI=42.5-77.0) based on samples from a combination of juveniles and adults (ASMFC 2017).

White *et al.* (2022) estimated the number of adults (N_s) in the Delaware River that successfully reproduced in order to create a cohort of offspring by using genetic pedigrees constructed from progeny genotypes. N_s estimates the number of successful breeders and is not synonymous with effective population size (N_e) or effective number of breeders (N_b) as these metrics describe genetic processes (e.g., inbreeding and genetic drift; Jamieson and Allendorf 2012, Waldman *et al.* 2019, Wang *et al.* 2016). White *et al.* (2022) estimated that N_s ranged from 42 (95 percent CI: 36-64) spawners in 2014 to 130 (95 percent CI: 116-138) spawners in 2017 during the years from 2013 to 2019. Because N_s only includes adults that generate at least one offspring during a single breeding season, it sets a lower bound on the size of the spawning run. Nevertheless, the genetics information indicates that at least 42 to 130 adults successfully contributed to the 2014- and 2017-year classes. White *et al.* (2022) concluded that bias in the data when sample size of offspring is small may result in the N_s being underestimated, as such, the N_s for Delaware River Atlantic sturgeon is likely between 125 and 250. Hale *et al.* (2016) estimated that 3,656 (95 percent CI = 1,935-33,041) early juveniles (young of year, age zero to one) utilized the Delaware River estuary as a nursery in 2014. Because White *et al.* (2021a) found that the differences in estimated N_e between Atlantic sturgeon populations roughly corresponded to the differences in total population size; the Hudson River has one of the largest estimates of N_e while the Delaware River has one of the smallest estimates.

While the White *et al.* (2021a) study did not address the status of short- and long-term viability of either population, the differences in estimated population size for the Hudson and Delaware River spawning populations and in N_e support the notion that the Hudson River spawning population is the more robust of the two spawning groups, as discussed in the 2022 Status Review and 2012 listing rule. This trend is further supported by genetic analyses that demonstrates Atlantic sturgeon originating from the Hudson River spawning population were more prevalent in mixed aggregations than sturgeon originating from the Delaware River spawning population, even when sampling occurred in areas and at times that targeted for adults belonging to the Delaware River spawning population (Wirgin *et al.* 2015a, Wirgin *et al.* 2018).

As mentioned, there is no overall abundance estimate for the New York Bight DPS. Using Boucher (2025), we have estimated adult and subadult abundance of the New York Bight DPS, based on the estimated abundance of Atlantic sturgeon in nearshore marine waters from Cape Cod to Cape Hatteras (Boucher 2025) and available information on the genetic composition of Atlantic sturgeon in those waters (Kazyak *et al.* 2021), to be at a minimum, approximately 24,963 Atlantic sturgeon, based upon the NEAMAP survey swept area model (Boucher 2025). 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.* 2012c, Hilton *et al.* 2016).

Some of the impacts from the threats that contributed to the decline of the New York Bight DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water

quality since passage of the Clean Water Act (CWA). In addition, there have been reductions in fishing effort in state and federal waters, which may result in a reduction in bycatch mortality of Atlantic sturgeon. Nevertheless, areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in state and federally managed fisheries, vessel strikes, and changing environmental conditions remain significant threats to the New York Bight DPS.

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.*, 2004; ASMFC 2007). Recent estimates of adults and subadults were based upon the NEAMAP ocean population estimates from Boucher (2025) and the latest bycatch assessment by Hocking (2024). 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. The mixed stock analysis in Kazyak *et al.* (2021) determined that 37.5 percent of the Atlantic sturgeon bycatch interactions in the Mid-Atlantic Bight region were fish from the NY Bight DPS, however, Kazyak *et al.* (2020b) found that 71.4 percent of the captures in the larger GARFO region (Maine to Virginia) were from the NY Bight DPS.

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. On December 1, 2022, the EPA issued a determination that revised Water Quality Standards are necessary for the Delaware River Estuary to meet the requirements of the Clean Water Act. Specifically, the EPA determined that the aquatic life designated uses and corresponding dissolved oxygen criterion in Zones 3, 4, and RKM 126.8 to 112.7 (RM 78.8 to 70.0) of Zone 5 of the Delaware River Estuary must be revised to protect the propagation of resident and migratory fish species, including

Atlantic and shortnose sturgeon, which are likely experiencing adverse effects under the currently applicable Water Quality Standards that were established in 1967.

Vessel strikes occur in the Delaware and Hudson rivers. A summary of recently available information is included in a recent assessment by NMFS (2022 b). 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. Research, including a study that intentionally placed Atlantic sturgeon carcasses along the Delaware River 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 coinvestigators (Balazik et al. 2012b, Balazik, pers. comm. in ASMFC 2017; Fox et al. 2020). Based on the reporting rates in their study, Fox et al. (2020) estimated that a total of 199 and 213 carcasses were present along the Delaware Estuary shoreline in 2018 and 2019, respectively. Delaware State University (DSU) collaborated with the Delaware Division of Fish and Wildlife (DDFW) in an effort to document vessel strikes in 2005. Approximately 200 reported carcasses with over half being attributed to vessel strikes based on a gross examination of wounds have been documented through 2019 (DiJohnson 2019). One hundred thirty-eight (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.

In 2018, we announced the initiation of a 5-year review for the New York Bight DPS. We reviewed and considered new information for the New York Bight DPS that has become available since this DPS was listed as endangered in February 2012. We completed the 5-year review for the DPS in February 2022 (NMFS 2022b); the review includes a summary of additional information available since the listing determination, including information on life history and threats. Based on the best scientific and commercial data available at the time of the review, we concluded that no change to the listing status is warranted.

4.2.3 Chesapeake Bay DPS of Atlantic sturgeon

The Chesapeake Bay DPS includes the following: all anadromous Atlantic sturgeon that spawn or are spawned in the watersheds that drain into the Chesapeake Bay and into coastal waters from the Delaware-Maryland border on Fenwick Island to Cape Henry, Virginia. The marine range of Atlantic sturgeon from the Chesapeake Bay DPS extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. 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). Recent data confirms that Chesapeake Bay Atlantic sturgeon are most prevalent in the marine environment throughout the Mid-Atlantic Bight from Delaware to Cape Hatteras (Kazyak *et al.* 2021).

At the time of listing, the James River was the only known spawning river for the Chesapeake Bay DPS (ASSRT, 2007; Hager, 2011; Balazik *et al.*, 2012). Since the listing, evidence has been provided of both spring and fall spawning populations for the James River, as well as fall spawning in the Pamunkey River, a tributary of the York River, and fall spawning in Marshyhope Creek, a tributary of the Nanticoke River (Hager *et al.*, 2014; Kahn *et al.*, 2014; Balazik and Musick, 2015; Richardson and Secor, 2016; Secor *et al.* 2021). 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 2017a; Kahn *et al.* 2019). However, information for these populations is limited and the research is ongoing.

Age to maturity for Chesapeake Bay DPS Atlantic sturgeon is unknown. However, Atlantic sturgeon riverine populations exhibit clinal variation with faster growth and earlier age to maturity for those that originate from southern waters, and slower growth and later age to maturity for those that originate from northern waters (75 FR 61872; October 6, 2010). There is currently no total abundance estimate for the Chesapeake Bay DPS; however, we have estimated subadult and adult abundance in nearshore marine waters from Cape Cod to Cape Hatteras and concluded that, at a minimum, approximately 10,332 Atlantic sturgeon of those two age classes comprise the DPS, based upon the NEAMAP survey swept area model (Boucher 2025). Tagging and research captures provided annual run estimates for the Pamunkey River from 2013 to 2018, and suggest a spawning run of up to 222 adults but with yearly variability, likely due to spawning periodicity (Kahn 2019). Research in the Nanticoke River system suggests a small adult population based on a small total number of captures (*i.e.*, 26 sturgeon) and the high rate of recapture across several years of study (Secor *et al.* 2022). By comparison, 373 different adult-sized Atlantic sturgeon (*i.e.*, total count does not include recaptures of the same fish and this is likely a minimum count) were captured in the James River from 2009 through spring 2014 (Balazik and Musick 2015). Most recently, Coleman *et al.* (2024) estimated that 32 (95 percent confidence interval [CRI] = 23-47) and 70 (95 percent CRI = 49-105) Atlantic sturgeon used the

Marshyhope Creek-Nanticoke River system in 2020 and 2021, respectively. In both years, high spawning run connectivity between Marshyhope Creek and the upper Nanticoke River was observed. Overall, run estimates supported previous hypotheses that this river system supports a very small population and that both Marshyhope Creek and the upper Nanticoke River serve as important areas for spawning activity (Coleman *et al.* 2024).

There are also several estimates of effective population (N_e) 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. They are: 62.1 (95 percent CI=44.3-97.2) based on sampling of subadults captured off of Long Island across multiple years; 32 (95 percent CI=28.8-35.5) based on sampling of natal juveniles and adults in multiple years (Waldman *et al.* 2019); 40.9 (95 percent CI=35.6-46.9) based on samples from a combination of juveniles and adults (ASMFC 2019); and 44 (95 percent CI=26-79) and 46 (95 percent 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 percent CI = 6.7-21.9) for the Nanticoke River system (Secor *et al.* 2022), and also a single estimate of 7.8 (95 percent CI=5.3-10.2) for the York River system based on samples from adults captured in the Pamunkey River (ASMFC 2017b).

Several threats play a role in shaping the current status of Chesapeake Bay DPS Atlantic sturgeon. Historical records provide evidence of the large-scale commercial exploitation of Atlantic sturgeon from the James River and Chesapeake Bay in the 19th century (ASMFC 1998a, ASSRT 2007, Bushnoe *et al.* 2005, Hildebrand and Schroeder 1928, Secor 2002, Vladyskov and Greeley 1963) as well as subsistence fishing and attempts at commercial fisheries as early as the 17th century (ASSRT 2007, Balazik *et al.* 2010, Bushnoe *et al.* 2005, Secor 2002). 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 (ASSRT 2007, Bushnoe *et al.* 2005, Holton and Walsh 1995). At this time, we do not have information to quantify this loss of spawning habitat.

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

Although there have been improvements in some areas of the Bay's health, the ecosystem remains in poor condition. In 2022, the Chesapeake Bay Foundation gave the overall health index of the Bay a grade of 32 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 2022). The score remained unchanged from 2020; however, of the 13 indicators assessed, three improved, three declined, and seven stayed the same. 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 unchanged score is largely a result of failures to make needed changes on farmland to reduce pollution, but noted improvements due to the promising results from oyster reef restoration, regulations allowing the striped bass population to rebuild by 2029, less phosphorous in the water and a smaller dead zone. 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 of Atlantic sturgeon have been observed in the James River (ASSRT ASMFC 2017b, 2007, Balazik *et al.* 2012d, NMFS 2022a). 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). New research, including a study conducted along the Delaware River that intentionally placed Atlantic sturgeon carcasses in areas used by the public, suggests that most Atlantic sturgeon carcasses are not found and, when found, many are not reported to NMFS or to our sturgeon salvage co-investigators (Balazik, pers. comm. in ASMFC 2017b, Balazik *et al.* 2012d, Fox *et al.* 2020). There has been an increased number of vessel struck sturgeon reported in the James River in recent years (ASMFC 2017b). However, it is unknown to what extent the numbers reflect increased carcass reporting.

In the marine and coastal range of the Chesapeake Bay DPS from Canada to Florida, fisheries bycatch in federally and state-managed fisheries poses a threat to the DPS, reducing survivorship of subadults and adults and potentially causing an overall reduction in the spawning population (ASMFC 2007, ASSRT 2007, Stein *et al.* 2004a). Of the 35 percent of Atlantic sturgeon incidentally caught in the Bay of Fundy, about 1% were Chesapeake Bay DPS fish (Wirgin *et al.* 2012). Studies have shown that Atlantic sturgeon can only sustain low levels of bycatch mortality (Boreman 1997; ASMFC TC 2007; Kahnle *et al.* 2007). The Chesapeake Bay DPS is currently at risk of extinction given (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect the potential for

population recovery.

In 2018, we announced the initiation of a 5-year review for the Chesapeake Bay DPS. We reviewed and considered new information for the Chesapeake Bay DPS that has become available since this DPS was listed as endangered in February 2012. We completed the 5-year review for the Chesapeake Bay DPS in February 2022 (NMFS 2022c); the review includes a summary of additional information available since the listing determination, including information on life history and threats. Based on the best scientific and commercial data available at the time of the review, we concluded that no change to the listing status is warranted.

4.2.4 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.

Rivers in the Carolina DPS considered to be spawning rivers include the Neuse, Roanoke, Tar-Pamlico, Cape Fear, and Northeast Cape Fear rivers, and the Santee-Cooper and Pee Dee river (Waccamaw and Pee Dee rivers) systems. 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. We have no information, current or historical, of Atlantic sturgeon using the Chowan and New Rivers in North Carolina. Recent telemetry work by Post et al. (2014) indicates that Atlantic sturgeon do not use the Sampit, Ashley, Ashepoo, and Broad-Coosawhatchie Rivers in South Carolina. These rivers are short, coastal plains rivers that most likely do not contain suitable habitat for Atlantic sturgeon. Fish from the Carolina DPS likely use other river systems than those listed here for their specific life functions.

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 period. 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 a potential extirpation in an additional system. The ASSRT estimated the remaining river populations within the DPS to have fewer than 300 spawning adults; this is thought to be a small fraction of historic population sizes (ASSRT 2007). There is currently no total abundance estimate for the Carolina DPS; however, we have estimated subadult and adult abundance in nearshore marine waters from Cape Cod to Cape Hatteras and concluded that, at a minimum, approximately 2,617 Atlantic sturgeon of those two age classes comprise the DPS, based upon

the NEAMAP survey swept area model (Boucher 2025).

There are also several estimates of effective population (N_e) size for Atlantic sturgeon that are spawned in Abermarle Sound and the Pee Dee River (spring and fall spawning runs). This information is tabulated in Table 8.

Table 8. Available Estimates of Effective Population Sizes (N_e) in the Carolina DPS.

River	Effective Population Size (N_e) (95% CI)	Sample Size	Collection Years	Reference
Albemarle Sound	14.2 (11.8-17.1)	37	1998-2008	ASMFC (2017b)
	19.0 (16.5–20.6)	88	1998, 2006-2011, 2013-2014	Waldman <i>et al.</i> (2019)
	29.5 (24.2-36.3)	71	1998, 2006-2009, 2012, 2015 2016	White <i>et al.</i> (2021a)
Pee	Fall Run – 82 (60.3-122.1)	50	2011, 2012, 2017-2019	White <i>et al.</i> (2021a)
Dee	Spring Run – 16.4 (12.8-20.6)	66	2012, 2017-2019	White <i>et al.</i> (2021a)

The Carolina DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e., being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dams, dredging, and degraded water quality is contributing to the status of the Carolina DPS. Dams have curtailed Carolina DPS Atlantic sturgeon spawning and juvenile developmental habitat by blocking over 60 percent of the historical sturgeon habitat upstream of the dams in the Cape Fear and Santee-Cooper River systems. Water quality (velocity, temperature, and dissolved oxygen) downstream of these dams, as well as on the Roanoke River, has been reduced, which modifies and curtails the extent of spawning and nursery habitat for the Carolina DPS. Dredging in spawning and nursery grounds modifies the quality of the habitat and is further curtailing the extent of available habitat in the Cape Fear and Cooper Rivers, where Atlantic sturgeon habitat has already been modified and curtailed by the presence of dams. Reductions in water quality from terrestrial activities have modified habitat utilized by the Carolina DPS. In the Pamlico and Neuse systems, nutrient-loading and seasonal anoxia are occurring, associated in part with concentrated animal feeding operations (CAFOs). Heavy industrial development and CAFOs have degraded water quality in the Cape Fear River. Water quality in the Waccamaw and Pee Dee rivers have been affected by industrialization and riverine sediment samples contain high levels of various toxins, including dioxins. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present

throughout the range of the Carolina DPS. The removal of large amounts of water from the system will alter flows, temperature, and DO. Existing water allocation issues will likely be compounded by population growth and potentially, by changing environmental conditions. Changing environmental conditions are also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower DO, all of which are current stressors to the Carolina DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the Carolina DPS. Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. 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 and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Carolina DPS Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, 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 Carolina DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily 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.).

In the 2023 5-year review for the Carolina DPS, NMFS Southeast Regional Office reviewed and considered new information for the DPS that has become available since this DPS was listed as endangered in February 2012. In the review, NMFS concluded that the Carolina DPS's demographic risk is "High" because of its productivity (i.e., relatively few adults compared to historical levels and irregular spawning success), abundance (i.e., riverine populations vary significantly and abundance is generally low in the DPS, overall), and spatial distribution (i.e., riverine populations and connectivity vary, creating inconsistent population coverage across the DPS and potentially limited ability to repopulate extirpated river populations). However, NMFS also concluded that the Carolina DPS' potential to recover is also "High" because man-made threats that have a major impact on the species' ability to persist have been identified (e.g., bycatch in federally-managed fisheries, dams blocking access to spawning habitat, dredging, vessel strikes), the DPS' response to those threats are well understood, management or protective

actions to address major threats are primarily under U.S. jurisdiction or authority, and management or protective actions are technically feasible even if they require further testing (e.g., gear modifications to minimize dredge or fishing gear interactions). The review includes a summary of additional information available since the listing determination, including information on life history and threats. Based on the best scientific and commercial data available at the time of the review, the review concluded that no change to the listing status is warranted. (NMFS 2023a).

4.2.5 South Atlantic DPS of Atlantic sturgeon

The South Atlantic DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto Rivers (ACE) Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida.

Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, St. Marys, and Satilla Rivers. Recent telemetry work by Post et al. (2014) indicates that Atlantic sturgeon do not use the Sampit, Ashley, Ashepoo, and Broad-Coosawhatchie Rivers in South Carolina. These rivers are short, coastal plains rivers that most likely do not contain suitable habitat for Atlantic sturgeon. Post et al. (2014) also found Atlantic sturgeon only use the portion of the Waccamaw River downstream of Bull Creek. Due to manmade structures and alterations, spawning areas in the St. Johns River are not accessible and therefore do not support a reproducing population.

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 the state prior to 1890. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the South Atlantic DPS. Currently, the Atlantic sturgeon spawning population in at least one river system within the South Atlantic DPS has been extirpated. The Altamaha River population of Atlantic sturgeon, with an estimated 343 adults spawning annually, is believed to be the largest population in the Southeast, yet is estimated to be only 6 percent of its historical population size. The ASSRT estimated the abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, to be less than one percent of what they were historically (ASSRT 2007). There is currently no total abundance estimate for the South Atlantic DPS; however, we have estimated subadult and adult abundance in nearshore marine waters from Cape Cod to Cape Hatteras and concluded that, at a minimum, approximately 6,154 Atlantic sturgeon of those two age classes comprise the DPS, based upon the NEAMAP survey swept area model (Boucher 2025).

The South Atlantic DPS was listed as endangered under the ESA as a result of a combination of

habitat curtailment and modification, overutilization (i.e., being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The stock assessment also estimated effective population sizes (N_e) when possible. For the South Atlantic DPS, the assessment reported N_e for the Edisto, Savannah, Ogeechee, and Altamaha rivers (Table 9). Additional estimates of N_e have been conducted since the completion of the assessment, including for additional river systems; Table 9 reports those estimates. White et al. (2021a) cautions that because the populations they considered were sampled at varying temporal scales and intensities and represented a mixture of single and mixed-cohort samples, the N_e estimates they report should be interpreted with reservation as they technically represent a value between true N_e and the effective number of breeders. They also state that while their estimates are valuable for comparing the general magnitude of difference among populations, they should not be used to make inferences about long-term population viability (White et al. 2021b).

Table 9. Available estimates of Effective Population Sizes (N_e) in the rivers of the South Atlantic DPS.

River	Effective Population Size (N_e) (95% CI)	Sample Size	Collection Years	Reference
Edisto	55.4 (36.8-90.6)	109	1996-2005	ASMFC (2017b)
	Fall Run – 48.0 (44.7-51.5)	1,154	1996-2004	Farrae <i>et al.</i> (2017)
	Fall Run (82 (60.3-122.1)	373	1996, 1998, 2001-2003, 2005	White <i>et al.</i> (2021b)
	Spring Run – 13.3 (12.1-14.6)	198	1998, 2003	Farrae <i>et al.</i> (2017)
	Spring Run – 16.4 (12.8-20.6)	123	1998, 2003	White <i>et al.</i> (2021b)
	60.0 (51.9-69.0)	145	1996, 1998, 2005	Waldman <i>et al.</i> (2018)
Savannah	126.5 (88.1-205)	98	2000-2013	ASMFC (2017b)
	123 (103.1-149.4)	161	2013, 2014, 2017	Waldman <i>et al.</i> (2018)
	154.5 (99.6-287.7)	134	2000, 2007, 2208, 2013, 2017, 2018	White <i>et al.</i> (2021b)
Ogeechee	32.2 (26.9-38.8)	115	2003-2015	ASMFC (2017b)
	26 23.9–28.2	200	2007-2009, 2014-2017	Waldman <i>et al.</i> (2018)
	23.9 (22.2-25.7)	197	2007-2009, 2014-2017	Fox <i>et al.</i> (2019)

River	Effective Population Size (N_e) (95% CI)	Sample Size	Collection Years	Reference
	Spring Run – 31.1 (24.3-40.2)	92	2003, 2007, 2009, 2014, 2015, 2016	White <i>et al.</i> (2021b)
	Fall Run – 56.5 (36.3-103.6)	55	2003, 2004, 2008, 2009, 2015, 2016	White <i>et al.</i> (2021b)
Altamaha	111.9 (67.5-216.3)	186	2005-2015	ASMFC (2017b)
	149 (128.7–174.3)	245	2005, 2011, 2014, 2016-2017	Waldman <i>et al.</i> (2018)
	142.1 (124.2-164.0)	268	2005, 2011, 2014-2017	Fox <i>et al.</i> (2019)
	141.7 (73.4-399)	189	2005, 2010, 2011, 2018	White <i>et al.</i> (2021b)
Satilla	21 (18.7–23.2)	68	2015-2016	Waldman <i>et al.</i> (2018)
	11.4 (9.1-13.9)	74	2010, 2014, 2016	White <i>et al.</i> (2021b)
St. Marys	1 (1.3–2.0)	14	2014-2015	Waldman <i>et al.</i> (2018)

The modification and curtailment of Atlantic sturgeon habitat resulting from dredging and degraded water quality is contributing to the status of the South Atlantic DPS. Maintenance dredging is currently modifying Atlantic sturgeon nursery habitat in the Savannah River and modeling indicates that the proposed deepening of the navigation channel will result in reduced DO and upriver movement of the salt wedge, curtailing spawning habitat. Dredging is also modifying nursery and foraging habitat in the St. Johns River. Reductions in water quality from terrestrial activities have modified habitat utilized by the South Atlantic DPS Non-point source inputs are causing low DO in the Ogeechee River and in the St. Marys River, which completely eliminates juvenile nursery habitat in summer. Low DO has also been observed in the St. Johns River in the summer. Sturgeon are more sensitive to low DO and the negative (metabolic, growth, and feeding) effects caused by low DO increase when water temperatures are concurrently high, as they are within the range of the South Atlantic DPS. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the South Atlantic DPS. Large withdrawals of over 240 million gallons per day (mgd) of water occur in the Savannah River for power generation and municipal uses. However, users withdrawing less than 100,000 gallons per day (gpd) are not required to get permits, so actual water withdrawals from the Savannah and other rivers within the range of the South Atlantic DPS are likely much higher. The removal of large amounts of water from the system will alter flows, temperature, and DO. Water shortages and “water wars” are already occurring in the rivers occupied by the South Atlantic DPS and will likely be compounded in the future by population growth and potentially by climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading,

pollution inputs, and lower DO, all of which are current stressors to the South Atlantic DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the South Atlantic DPS. The loss of large, mature subadults and adults as a result of bycatch impacts Atlantic sturgeon populations because they are a long-lived species, have an older age at maturity, have lower maximum fecundity values, and a large percentage of egg production occurs later in life. Little data exist on bycatch in the Southeast and high levels of bycatch underreporting are suspected. However, fisheries are known to incidentally catch Atlantic sturgeon throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, 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 and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the South Atlantic DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily 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.)

In the 2023 5-year review for the South Atlantic DPS, NMFS Southeast Regional Office reviewed and considered new information for the DPS that has become available since this DPS was listed as endangered in February 2012. In the review, NMFS concluded that the South Atlantic DPS' demographic risk is "High" because of its productivity (i.e., relatively few adults compared to historical levels and irregular spawning success), abundance (i.e., riverine populations vary significantly and abundance is generally low in the DPS, overall), and spatial distribution (i.e., riverine populations and connectivity vary, creating inconsistent population coverage across the DPS and potentially limited ability to repopulate extirpated river populations). However, NMFS also concluded that the South Atlantic DPS' potential to recover

is also “High” because man-made threats that have a major impact on the species’ ability to persist have been identified (e.g., bycatch in federally-managed fisheries, dams blocking access to spawning habitat, dredging, vessel strikes), the DPS’ response to those threats are well understood, management or protective actions to address major threats are primarily under U.S. jurisdiction or authority, and management or protective actions are technically feasible even if they require further testing (e.g., gear modifications to minimize dredge or fishing gear interactions). The review includes a summary of additional information available since the listing determination, including information on life history and threats. Based on the best scientific and commercial data available at the time of the review, the review concluded that no change to the listing status is warranted (NMFS 2023b).

4.3 Status of Shortnose Sturgeon

Shortnose sturgeon are fish that occur in rivers and estuaries along the East Coast of the U.S. and Canada (SSSRT (Shortnose Sturgeon Status Review Team) 2010). They have a head covered in bony plates, as well as protective armor called scutes extending from the base of the skull to the caudal peduncle. Other distinctive features include a subterminal, protractile tube-like mouth, and chemosensory barbels for benthic foraging (SSSRT (Shortnose Sturgeon Status Review Team) 2010). Sturgeon have been present in North America since the Upper Cretaceous period, more than 66 million years ago. The information below is a summary of available information on the species. More thorough discussions can be found in the cited references as well as the SSSRT Biological Assessment (2010).

Life History and General Habitat Use

There are differences in life history, behavior and habitat use across the range of the species. Current research indicates that these differences are adaptations to unique features of the rivers where these populations occur. For example, there are differences in larval dispersal patterns in the Connecticut River (MA) and Savannah River (GA) (Parker 2007). There are also morphological and behavioral differences. Growth and maturation occurs more quickly in southern rivers but fish in northern rivers grow larger and live longer. We provide general life history attributes in Table 10 below.

Table 10. General life history for shortnose sturgeon (range-wide)

Stage	Size (mm)	Duration	Behaviors/Habitat Used
Egg	3-4	13 days post spawn	stationary on bottom; Cobble and rock, fresh, fast flowing water
Yolk Sac Larvae	7-15	8-12 days post hatch	Photonegative; swim up and drift behavior; form aggregations with other YSL; Cobble and rock, stay at bottom near spawning site
Post Yolk Sac	15 – 57	12-40 days	Free swimming; feeding; Silt bottom,

Stage	Size (mm)	Duration	Behaviors/Habitat Used
Larvae		post hatch	deep channel; fresh water
Young of Year	57 – 140 (north); 57-300 (south)	From 40 days post-hatch to one year	Deep, muddy areas upstream of the salt wedge
Juvenile	140 to 450-550 (north); 300 to 450-550 (south)	1 year to maturation	Increasing salinity tolerance with age; same habitat patterns as adults
Adult	450-1,100 average; (max recorded 1,400)	Post-maturation	Freshwater to estuary with some individuals making nearshore coastal migrations

Shortnose sturgeon live on average for 30-40 years (Kynard *et al.* 2016). Males mature at approximately 5-10 years and females mature between age 7 and 13, with later maturation occurring in more northern populations (Kynard *et al.* 2016). Females typically spawn for the first time 5 years post-maturation (age 12-18; Dadswell 1979, Dadswell *et al.* 1984) and then spawn every 3-5 years (Kynard *et al.* 2016). Males spawn for the first time approximately 1-2 years after maturity with spawning typically occurring every 1-2 years (Kynard *et al.* 2016). Shortnose sturgeon are iteroparous (spawning more than once during their life) and females release eggs in multiple “batches” during a 24 to 36-hour period (total of 30,000-200,000 eggs). Multiple males are likely to fertilize the eggs of a single female.

Cues for spawning are thought to include water temperature, day length and river flow (Kynard *et al.* 2016, Kynard *et al.* 2012a). Shortnose sturgeon spawn in freshwater reaches of their natal rivers when water temperatures reach 9–15°C in the spring (Kynard *et al.* 2016). Spawning occurs over gravel, rubble, and/or cobble substrate (Kynard *et al.* 2016) in areas with average bottom velocities between 0.4 and 0.8 m/s. Depths at spawning sites are variable, ranging from 1.2-27 m (4-89 ft) (multiple references in SSSRT 2010). Eggs are small and demersal and stick to the rocky substrate where spawning occurs.

Shortnose sturgeon occur in waters between 0 – 34°C (Dadswell *et al.* 1984, Heidt and Gilbert 1978); with temperatures above 28°C considered to be stressful. Depths used are highly variable, ranging from shallow mudflats while foraging to deep channels up to 30 m (Dadswell *et al.* 1984, Kynard 2016). Salinity tolerance increases with age. Young of year must remain in freshwater; however, adults have been documented in the ocean with salinities of up to 30 ppt (Kynard *et al.* 2016). Dissolved oxygen affects distribution, with preference for DO levels at or above 5 mg/l and adverse effects anticipated for prolonged exposure to DO less than 3.2 mg/L (Kynard *et al.* 2016).

Shortnose sturgeon feed on benthic insects, crustaceans, mollusks, and polychaetes (Kynard *et*

al. 2016). Both juvenile and adult shortnose sturgeon primarily forage over sandy-mud bottoms, which support benthic invertebrates (Carlson and Simpson 1987, Kynard *et al.* 2016). Shortnose sturgeon have also been observed feeding off plant surfaces (Dadswell *et al.* 1984).

Following spawning, adult shortnose sturgeon disperse quickly down river to summer foraging grounds areas and remain in areas downstream of their spawning grounds throughout the remainder of the year (Kynard *et al.* 2016).

In northern rivers, shortnose aggregate during the winter months in discrete, deep (3-10m) freshwater areas with minimal movement and foraging (Buckley and Kynard 1985, Dadswell 1979, Dovel *et al.* 1992, Kynard *et al.* 2016, Kynard *et al.* 2012b). In the winter, adults in southern rivers spend much of their time in the slower moving waters downstream near the salt-wedge and forage widely throughout the estuary (Collins and Smith 1993, Weber *et al.* 1998). Pre-spawning sturgeon in some northern and southern systems migrate into an area in the upper tidal portion of the river in the fall and complete their migration in the spring (Kynard *et al.* 2016). Older juveniles typically occur in the same overwintering areas as adults while young of the year remain in freshwater (Jenkins *et al.* 1993).

Listing History

Shortnose sturgeon were listed as endangered in 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. Shortnose sturgeon are thought to have been abundant in nearly every large East Coast river prior to the 1880s (Kynard *et al.* 2016). Pollution and overfishing, including bycatch in the shad fishery, were listed as principal reasons for the species' decline. The species remains listed as endangered throughout its range. While the 1998 Recovery Plan refers to Distinct Population Segments (DPS), the process to designate DPSs for this species has not been undertaken. The SSSRT published a Biological Assessment for shortnose sturgeon in 2010. The report summarized the status of shortnose sturgeon within each river and identified stressors that continue to affect the abundance and stability of these populations.

Status

There is no current total population estimate for shortnose sturgeon range wide. Information on populations and metapopulations is presented below. In general, populations in the Northeast are larger and more stable than those in the Southeast (SSSRT (Shortnose Sturgeon Status Review Team) 2010). Population size throughout the species' range is considered to be stable; however, most riverine populations are below the historic population sizes and most likely are below the carrying capacity of the river (Kynard 1997, Kynard *et al.* 2016).

Population Structure

There are 19 documented populations of shortnose sturgeon ranging from the St. Johns River, Florida (possibly extirpated from this system) to the Saint John River in New Brunswick, Canada. There is a large gap in the middle of the species range with individuals present in the

Chesapeake Bay separated from populations in the Carolinas by a distance of more than 400 km (248.5 mi). Currently, there are significantly more shortnose sturgeon in the northern portion of the range.

Recent developments in genetic research as well as differences in life history support the grouping of shortnose sturgeon into five genetically distinct groups, all of which have unique geographic adaptations (see (Grunwald *et al.* 2008, King *et al.* 2001a, SSSRT (Shortnose Sturgeon Status Review Team) 2010, Waldman *et al.* 2002, Wirgin *et al.* 2005). These groups are: 1) Gulf of Maine; 2) Connecticut and Housatonic Rivers; 3) Hudson River; 4) Delaware River and Chesapeake Bay; and 5) Southeast. The Gulf of Maine, Delaware/Chesapeake Bay and Southeast groups function as metapopulations¹⁵. The other two groups (Connecticut/Housatonic and the Hudson River) function as independent populations. While there is migration within each metapopulation (i.e., between rivers in the Gulf of Maine and between rivers in the Southeast) and occasional migration between populations (e.g., Connecticut and Hudson), interbreeding between river populations is limited to very few individuals per generation; this results in morphological and genetic variation between most river populations (Grunwald *et al.* 2008, King *et al.* 2001b, SSSRT (Shortnose Sturgeon Status Review Team) 2010, Wirgin *et al.* 2005, Wirgin *et al.* 2002). Indirect gene flow estimates from mtDNA indicate an effective migration rate of less than two individuals per generation. This means that while individual shortnose sturgeon may move between rivers, very few sturgeon are spawning outside their natal river; it is important to remember that the result of physical movement of individuals is rarely genetic exchange.

Summary of Status of Northeast Rivers

In NMFS's Greater Atlantic Region, shortnose sturgeon are known to spawn in the Kennebec, Androscoggin, Merrimack, Connecticut, Hudson and Delaware Rivers. Shortnose sturgeon also occur in the Penobscot and Potomac Rivers; although it is unclear if spawning is currently occurring in those systems.

Gulf of Maine Metapopulation

Tagging and telemetry studies indicate that shortnose sturgeon are present in the Penobscot, Kennebec, Androscoggin, Sheepscot and Saco Rivers. Individuals have also been documented in smaller coastal rivers; however, the duration of presence has been limited to hours or days and the smaller coastal rivers are thought to be only used occasionally (Zydlewski *et al.* 2011). Since the removal of the Veazie and Great Works Dams (2013 and 2012, respectively), in the Penobscot River, shortnose sturgeon range from the Bay to the Milford Dam. Shortnose

¹⁵ A metapopulation is a group of populations in which distinct populations occupy separate patches of habitat separated by unoccupied areas (Levins 1969). Low rates of connectivity through dispersal, with little to no effective movement, allow individual populations to remain distinct as the rate of migration between local populations is low enough not to have an impact on local dynamics or evolutionary lineages (Hastings and Harrison 1994). This interbreeding between populations, while limited, is consistent, and distinguishes metapopulations from other patchy populations.

sturgeon now have access to their full historical range. Adult and large juvenile sturgeon have been documented to use the river. While potential spawning sites have been identified, no spawning has been documented. Foraging and overwintering are known to occur in the river. Nearly all pre-spawn females and males have been documented to return to the Kennebec or Androscoggin Rivers. Estimated seasonal adult abundance ranging from 636-1285 (weighted mean), with a low estimate of 602 (95%CI: 409.6-910.8) and a high of 1306 (95% CI: 795.6-2176.4) (Fernandes 2008; Fernandes *et al.* 2010; Dionne 2010 in Maine DMR 2010).

Kennebec/Androscoggin/Sheepscot

The estimated size of the adult population (>50cm TL) in this system, based on a tagging and recapture study conducted between 1977-1981, was 7,200 (95 percent CI = 5,000 - 10,800; Squiers *et al.* 1982). A population study conducted 1998-2000 estimated population size at 9,488 (95 percent CI = 6,942 -13,358; Squiers 2003)(Squiers 2003) suggesting that the population exhibited significant growth between the late 1970s and late 1990s. Spawning is known to occur in the Androscoggin and Kennebec Rivers. In both rivers, there are hydroelectric facilities located at the base of natural falls thought to be the natural upstream limit of the species. The Sheepscot River is used for foraging during the summer months. Altenritter *et al.* (2017a) found that a large proportion of female shortnose sturgeon tagged in the Penobscot River migrated to the Kennebec River during probable spawning windows. They also found that shortnose sturgeon in the Penobscot River were larger and had a higher condition factor than shortnose sturgeon in the Kennebec River. Based on this, they speculated that, “increased abundance and resource limitation in the Kennebec River may be constraining growth and promoting migration to the Penobscot River by individuals with sufficient initial size and condition.” These individuals then return to spawn in the Kennebec River at larger size that could potentially result in increased reproductive potential compared to nonmigratory females. Thus, migrants could experience an adaptive reproductive advantage relative to nonmigratory individuals. Further, Altenritter *et al.* (2017b) noted that although migrants to the Penobscot River may be a small proportion of the Kennebec River population, they could disproportionately contribute to regional recruitment and facilitate population resilience to disturbance.

Merrimack River

The historic range in the Merrimack extended to Amoskeag Falls (Manchester, NH, RKM 116; Piotrowski 2002); currently shortnose sturgeon cannot move past the Essex Dam in Lawrence, MA (RKM 46). A current population estimate for the Merrimack River is not available. Based on a study conducted 1987-1991, the adult population was estimated at 32 adults (20–79; 95% confidence interval; B. Kynard and M. Kieffer unpublished information). However, recent gill-net sampling efforts conducted by Kieffer indicate a dramatic increase in the number of adults in the Merrimack River. Sampling conducted in the winter of 2009 resulted in the capture of 170 adults. Preliminary estimates suggest that there may be approximately 2,000 adults using the Merrimack River annually. Spawning, foraging and overwintering all occur in the Merrimack

River.

Tagging and tracking studies demonstrate movement of shortnose sturgeon between rivers within the Gulf of Maine, with the longest distance traveled between the Penobscot and Merrimack rivers. Genetic studies indicate that a small, but statistically insignificant amount of genetic exchange likely occurs between the Merrimack River and these rivers in Maine (King *et al.* 2013). The Merrimack River population is genetically distinct from the Kennebec-Androscoggin-Penobscot population (SSSRT 2010). In the fall of 2014, a shortnose sturgeon tagged in the Connecticut River in 2001 was captured in the Merrimack River.

Connecticut River Population

The Holyoke Dam divides the Connecticut River shortnose population; there is currently limited successful passage downstream of the Dam. No shortnose sturgeon have passed upstream of the dam since 1999 and passage between 1975-1999 was an average of four fish per year. The number of sturgeon passing downstream of the Dam is unknown. Despite this separation, the populations are not genetically distinct (Kynard 1997, Kynard *et al.* 2016, Wirgin *et al.* 2005). The most recent estimate of the number of shortnose sturgeon upstream of the dam, based on captures and tagging from 1990-2005 is approximately 328 adults (CI = 188–1,264 adults; B. Kynard, USGS, unpubl. data in SSSRT 2010); this compares to a previous Peterson mark-recapture estimate of 370–714 adults (Taubert 1980). Using four mark-recapture methodologies, the long-term population estimate (1989-2002) for the lower Connecticut River ranges from 1,042-1,580 (Savoy 2004). Comparing 1989-1994 to 1996-2002, the population exhibits growth on the order of 65-138 percent. The population in the Connecticut River is thought to be stable, but at a small size.

The Turners Falls Dam is thought to represent the natural upstream limit of the species. While limited spawning is thought to occur below the Holyoke Dam, successful spawning has only been documented upstream of the Holyoke Dam. Abundance of pre-spawning adults was estimated each spring between 1994–2001 at a mean of 142.5 spawning adults (CI = 14–360 spawning adults) (Kynard *et al.* 2012b). Overwintering and foraging occur in both the upper and lower portions of the river. Occasionally, sturgeon have been captured in tributaries to the Connecticut River including the Deerfield River and Westfield River. Additionally, a sturgeon tagged in the CT river was recaptured in the Housatonic River (T. Savoy, CT DEP, pers. comm.). Three individuals tagged in the Hudson were captured in the CT, with one remaining in the river for at least one year (Savoy 2004).

Hudson River Population

The Hudson River population of shortnose sturgeon is the largest in the United States. Studies indicate an extensive increase in abundance from the late 1970s (13,844 adults (Dovel *et al.* 1992), to the late 1990s (56,708 adults (95 percent CI 50,862 to 64,072; Bain *et al.* 1998). This increase is thought to be the result of high recruitment (31,000 – 52,000 yearlings) from 1986-

1992 (Woodland and Secor 2007). Woodland and Secor (2007) examined environmental conditions throughout this 20-year period and determined that years in which water temperatures drop quickly in the fall and flow increases rapidly in the fall (particularly October), are followed by high levels of recruitment in the spring. This suggests that these environmental factors may index a suite of environmental cues that initiate the final stages of gonadal development in spawning adults. The population in the Hudson River exhibits substantial recruitment and is considered to be stable at high levels.

Delaware River-Chesapeake Bay Metapopulation

Shortnose sturgeon range from Delaware Bay up to at least Scudders Falls (RKM 223); there are no dams within the species' range on this river. The population is considered stable (comparing 1981-1984 to 1999-2003) at around 12,000 adults (ERC 2006a, Hastings *et al.* 1987). Spawning occurs primarily between Scudders Falls and the Trenton rapids. Overwintering and foraging also occur in the river. Shortnose sturgeon have been documented to use the Chesapeake-Delaware Canal to move from the Chesapeake Bay to the Delaware River.

In Chesapeake Bay, shortnose sturgeon have most often been found in Maryland waters of the mainstem bay and tidal tributaries such as the Susquehanna, Potomac, and Rappahannock Rivers (Kynard *et al.* 2016, SSSRT (Shortnose Sturgeon Status Review Team) 2010). Spells (1998), Skjeveland *et al.* (2000), and Welsh *et al.* (2002) all reported one capture each of adult shortnose sturgeon in the Rappahannock River. Recent documented use of Virginia waters of Chesapeake Bay is currently limited to two individual shortnose sturgeon: one captured in 2016 (Balazik 2017) and a second sturgeon (a confirmed gravid female) caught in 2018 in the James River (Balazik, pers. comm. 2018).

Spawning has not been documented in any tributary to the Bay although suitable spawning habitat and two pre-spawning females with late stage eggs have been documented in the Potomac River. Current information indicates that shortnose sturgeon are present year round in the Potomac River with foraging and overwintering taking place there. Shortnose sturgeon captured in the Chesapeake Bay are not genetically distinct from the Delaware River population.

Southeast Metapopulation

There is no evidence of shortnose sturgeon between the mouth of Chesapeake Bay and the Carolinas. Shortnose sturgeon are only thought to occur in the Cape Fear River and Yadkin-Pee Dee River in North Carolina and are likely present in very small numbers.

The Altamaha River supports the largest known population in the Southeast with successful self-sustaining recruitment. The most recent population estimate for this river was 6,320 individuals (95 percent CI = 4,387-9,249; DeVries 2006). The population contains more juveniles than expected. Comparisons to previous population estimates suggest that the population is increasing; however, there is high mortality between the juvenile and adult stages in this river.

This mortality likely results from incidental capture in the shad fishery, which occurs at the same time as the spawning period (DeVries 2006).

The only available estimate for the Cooper River is of 300 spawning adults at the Pinopolis Dam spawning site (based on 1996-1998 sampling; Cooke *et al.* 2004). This is likely an underestimate of the total number of adults as it would not include non-spawning adults. Estimates for the Ogeechee River were 266 (95 percent CI=236-300) in 1993 (Weber 1996, Weber *et al.* 1998); a more recent estimate (sampling from 1999-2004; (Fleming *et al.* 2003)) indicates a population size of 147 (95 percent CI = 104-249). While the more recent estimate is lower, it is not significantly different from the previous estimate. Available information indicates the Ogeechee River population may be experiencing juvenile mortality rates greater than other southeastern rivers.

Spawning is also occurring in the Savannah River, the Congaree River, and the Yadkin-Pee Dee River. There are no population estimates available for these rivers. Occurrence in other southern rivers is limited, with capture in most other rivers limited to fewer than five individuals. Shortnose sturgeon are extremely rare or possibly extirpated from the St. Johns River in Florida as only a single specimen was found by the Florida Fish and Wildlife Conservation Commission during extensive sampling of the river in 2002/2003. In these river systems, shortnose sturgeon occur in nearshore marine, estuarine, and riverine habitat.

Threats

Because sturgeon are long-lived and slow growing, stock productivity is relatively low; this can make the species vulnerable to rapid decline and slow recovery (Musick 1999). In well studied rivers (e.g., Hudson, upper Connecticut), researchers have documented significant year to year recruitment variability (up to 10 fold over 20 years in the Hudson and years with no recruitment in the CT). However, this pattern is not unexpected given the life history characteristics of the species and natural variability in hydrogeologic cues relied on for spawning.

The small amount of effective movement between populations means recolonization of currently extirpated river populations is expected to be very slow and any future recolonization of any rivers that experience significant losses of individuals would be expected to be very slow. Despite the significant decline in population sizes over the last century, gene diversity in shortnose sturgeon is moderately high in both mtDNA (Quattro *et al.* 2002, Wirgin *et al.* 2005) and nDNA (King *et al.* 2001) genomes.

A population of sturgeon can go extinct as a consequence of demographic stochasticity (fluctuations in population size due to random demographic events); the smaller the metapopulation (or population); the more prone it is to extinction. Anthropogenic impacts acting on top of demographic stochasticity further increase the risk of extinction.

All shortnose sturgeon populations are highly sensitive to increases in juvenile mortality that would result in chronic reductions in the number of sub-adults as this leads to reductions in the number of adult spawners (Gross *et al.* 2002, Secor 2002). Populations of shortnose sturgeon that do not have reliable natural recruitment are at increased risk of experiencing population decline leading to extinction (Secor *et al.* 2002). Elasticity studies of shortnose sturgeon indicate that the highest potential for increased population size and stability comes from young of year and juveniles as compared to adults (Gross *et al.* 2002); that is, increasing the number of young of year and juveniles has a more significant long term impact to the population than does increasing the number of adults or the fecundity of adults.

The Shortnose Sturgeon Recovery Plan (NMFS (National Marine Fisheries Service) 1998) and the Shortnose Sturgeon Status Review Team's Biological Assessment of shortnose sturgeon (2010) identify habitat degradation or loss and direct mortality as principal threats to the species' survival. Natural and anthropogenic factors continue to threaten the recovery of shortnose sturgeon and include: poaching, bycatch in riverine fisheries, habitat alteration resulting from the presence of dams, in-water and shoreline construction, including dredging; degraded water quality which can impact habitat suitability and result in physiological effects to individuals including impacts on reproductive success; direct mortality resulting from dredging as well as impingement and entrainment at water intakes; and, loss of historical range due to the presence of dams. Shortnose sturgeon are also occasionally killed as a result of research activities. The total number of sturgeon affected by these various threats is not known.

Changing environmental conditions, particularly shifts in seasonal temperature regimes and impacts to spawning habitat, may impact shortnose sturgeon in the future. Hare *et al.* (2016b) provided a method for assessing the vulnerability of shortnose sturgeon to changing environmental conditions using the best available information from models and what we know of the life history, biology, and habitat use. Based on their comprehensive assessment, Hare *et al.* (2016a) determined that shortnose sturgeon are highly vulnerable to changing environmental conditions. Contributing factors include their low potential to alter their distribution in response to changes and their general exposure to the stressors throughout their range, including in estuarine and marine waters. Sea level rise, reduced DO, and increased temperatures have the potential to decrease productivity, but the magnitude and interaction of consequences is difficult to assess (Hare *et al.* 2016b).

Limited information on the thermal tolerances of shortnose sturgeon is available. Shortnose sturgeon are typically found in waters less than 28°C (82.4°F) and have been documented in the lab to experience mortality at temperatures of 33.7°C (92.66°F) or greater and are thought to experience stress at temperatures above 28°C (82.4°F) (Niklitschek 2001). Elevated temperatures also 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 changing environmental conditions) and river flow (which could be affected), it is not possible to predict how any change in water temperature alone will affect the seasonal movements of sturgeon through the action area.

The increased rainfall predicted by some models within given areas may increase runoff and scour spawning habitat. Additionally, 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. Shortnose sturgeon are tolerant to water temperatures up to approximately 28°C (82.4°F); these temperatures are experienced naturally in some rivers during the summer months. If river temperatures rise and temperatures above 28°C (82.4°F) are experienced over larger expanses, sturgeon may be excluded from some currently occupied habitats. Increasing hypoxia, in combination with increasing temperature, affects juvenile sturgeon metabolism and survival (Secor and Gunderson 1998), which could impact overall fitness of juvenile sturgeon in the action area in the future.

Survival and Recovery

The 1998 Recovery Plan outlines the steps necessary for recovery and indicates that each population may be a candidate for downlisting (i.e., to threatened) when it reaches a minimum population size that is large enough to prevent extinction and will make the loss of genetic diversity unlikely; the minimum population size for each population has not yet been determined. The Recovery Outline contains three major tasks: (1) establish delisting criteria; (2) protect shortnose sturgeon populations and habitats; and, (3) rehabilitate habitats and population segments. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. In many rivers, particularly in the Southeast, habitat is compromised and continues to impact the ability of sturgeon populations to recover. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting and migrations of all individuals. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. The loss of any population or metapopulation would result in the loss of biodiversity and would create (or widen) a gap in the species' range.

5 ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include 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 impacts to listed species or designated critical habitat from

federal agency activities or existing federal 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 for this Opinion 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 of this consultation generally include dredging operations, water quality, fisheries, scientific research, shipping and other vessel traffic, and recovery activities associated with reducing those impacts.

5.1 Environmental Setting

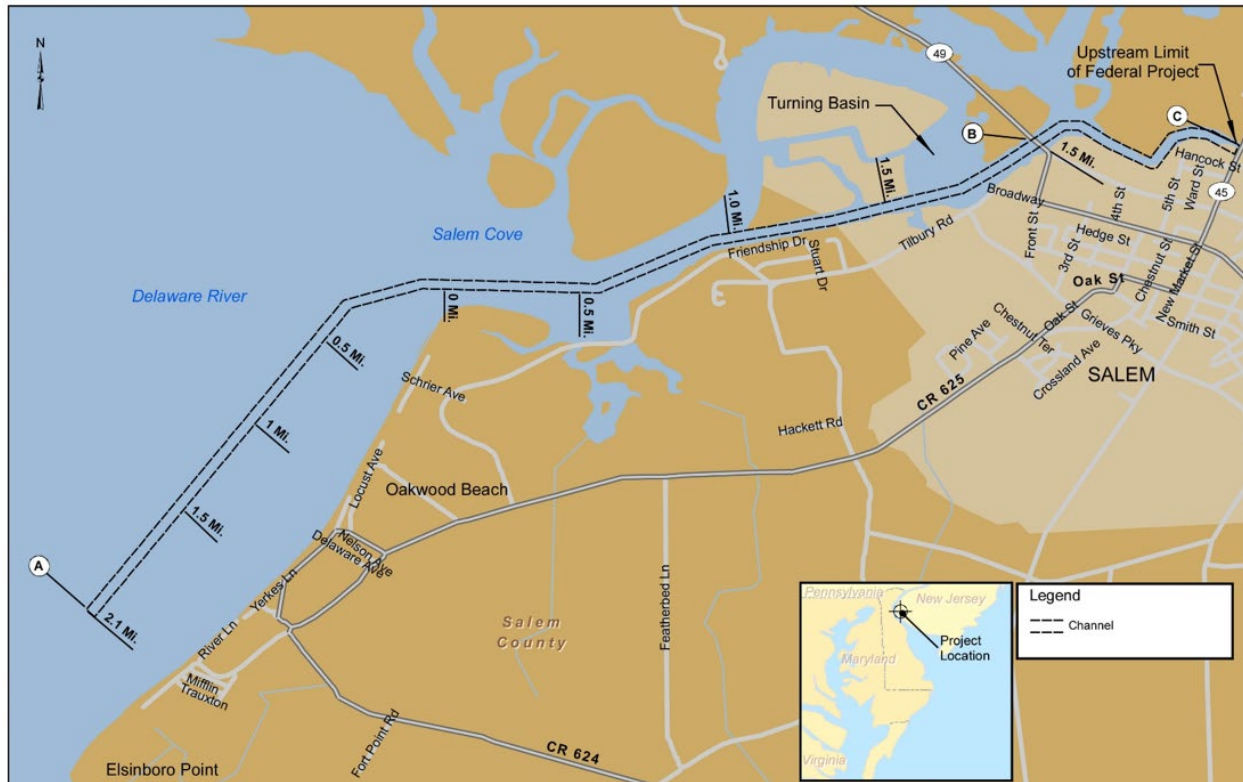
5.1.1 Salem River

Existing water depths at the Port range from approximately 0–5.5 m (0–18 ft) at MLW. Average tidal range is approximately 1.8 m (5.84 ft) and maximum tidal currents at the site are swift (roughly 1.5–2.0 knots; 0.77–1.03 m/sec)¹⁶. Sand is the predominant bottom substrate in the construction area as a result of strong tidal currents. Salinity within the tidal Salem River is similar to that in the adjacent Delaware River, ranging from approximately 2–10 parts per thousand (ppt), and varying with time of year, tidal stage, and local meteorological conditions. Submerged aquatic vegetation (SAV) is present within the portion of the action area where construction activities (dredging, pile driving, etc.) will occur (see Appendix A for the project plans).

The Salem River Federal Navigation Channel is located just outside of the Port construction area. The Federal Navigation Channel is approximately 4.9 m (16 ft) deep and approximately 46 to 76 m (150 to 250 ft) wide in the Delaware River across Salem Cove and approximately 4.9 m (16 ft) deep (MLLW) and approximately 30 m (100 ft) wide to the highway bridge (Route 49) in Salem, NJ (a distance of approximately 4.2 miles and a subtidal bottom acreage of approximately 91 acres). The Salem River Federal Navigation Channel transitions to approximately 3 m (9 ft) deep (MLLW) and approximately 30 m (100 ft) wide upstream of Route 49 and terminates at Route 45 (Market Street). The Salem River Federal Navigation Channel is subjected to regular maintenance dredging (Figure 18), therefore, SAV is unlikely to be present within this portion of the action area.

Figure 18. Salem River Federal Navigation Channel (USACE)

¹⁶ https://tidesandcurrents.noaa.gov/noaacurrents/predictions.html?id=DEB2114_12



5.1.2 Delaware River and Delaware Bay

The Philadelphia to the Sea Federal Navigation Channel in the Delaware River and Bay is maintained at a controlling depth of -13.7 m (-45 ft) MLLW. Substrate types within the channel vary widely from silty clay to gravel (Sommerfield and Madsen 2003). Salinity ranges from tidal freshwater / oligohaline in the upper reaches of the Federal Navigation Channel to that of seawater at the mouth of Delaware Bay (Polis *et al.* 1973). SAV is unlikely to occur where the action area overlaps with the Federal Navigation Channel in the Delaware River and Delaware Bay because the area is regularly subjected to maintenance dredging.

5.1.2.1 Delaware River Flow Management

The Delaware River basin had no major diversions until 1927 when NY City (NYC) built three reservoirs to divert water from the Delaware River Basin to meet the needs of the growing city. A 1954 court order required NYC to release water to maintain a flow rate at Montague, NJ, to compensate for the diverted water and provide water for downstream uses. In 1983, the Delaware River Basin Commission adopted a drought management program and established the Trenton Flow Objective. The intent of the Trenton Flow Objective is to assure that enough freshwater flows into the estuary to “repel” salinity. Today, releases from several basin reservoirs are used to manage freshwater inflows to the estuary.

5.1.2.2 Salinity

Salinity affects the fitness and distribution of sturgeon age classes within the Delaware Bay and the tidal Delaware River. Sturgeon early life stages such as eggs and larvae do not tolerate saline water and their presence is restricted to freshwater reaches upstream of the salt front.

The distribution of salinity in the Delaware estuary exhibits significant variability on both spatial and temporal scales. At any given time, the salinity levels reflect the opposing influences of freshwater inflow from upstream non-tidal portion of the Delaware River, tributaries, and precipitation events versus the saltwater tidal inflow from the Delaware Bay and the Atlantic Ocean, downstream. The estuary can be divided into four longitudinal salinity zones (PDE 2017). Starting at the downstream end, the mouth of the Bay to RKM 44 (RM 27) is considered polyhaline (18-30 ppt) with a transition zone between RKM 44-50 (RM 27-31), RKM 50-92 (RM 31-57) is mesohaline (5-18 ppt) with a transition zone between RKM 92-94 (RM 57-58), RKM 94-121 (RM 58-75) is oligohaline (0.5-5 ppt), and upstream of RKM 121 (RM 75) is considered fresh (0.0-0.5 ppt).

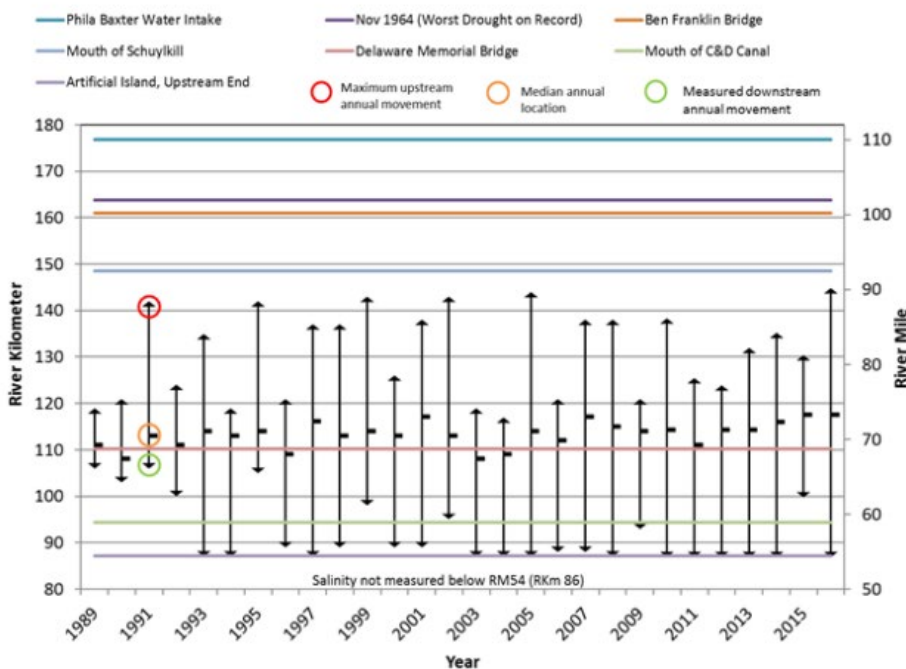
The salt front is considered the freshwater-saltwater interface in the estuary and the location is derived by calculating where the seven-day average chloride concentration equals 250 ppm (parts per million) in the river. Its location fluctuates in response to changing freshwater inflows and with each tidal cycle, but calculations show that current median salt front location range from RKM 107.8 and 122.3 (RM 67 and 76) (DRBC <https://www.nj.gov/drbc/programs/flow/salt-front.html>). The Delaware River Basin Commission calculated the 2021 median monthly salt front location between RKM 122 (RM 76) (September) and RKM 108 (RM 67) (April) just below the Delaware Memorial Bridge (2022). Seasonal and annual differences are much less pronounced today than they were before 1969 when the salt front was further downstream during spring and farther upstream during fall (DRBC 2019). Flow management releases water from upstream reservoirs to augment flows and meet a daily flow target of 84.9 cubic meters per second (3,000 cubic feet per second) in the Delaware River at the Trenton, NJ gage. Therefore, since 1970, low-flow values that once occurred 10% of the time now occur only 1 percent of the time.

The salt front shifts seasonally with its locations usually being further downstream during spring months and farther upstream during fall months (DRBC 2019) (Figure 19). Median locations during the months of April, May, and June (1969 to 2019) are at or below RKM 112.7 (RM 70) with the upper 50 percentiles a few miles below RKM 120.7 (RM 75) and the lower 50 percentiles being located at and upstream of RKM 104.6 (RM 65) (DRBC 2019). Median locations during the months of September, October, and November (1969 to 2019) are just upstream of RKM 112.7 (RM 70) with the upper 50 percentiles just below RKM 128.8 (RM 80) and the lower 50 percentiles just above RKM 112.7 (RM 70) (DRBC 2019).

Based on currently known salinity zones and the shifting location of the salt front, Atlantic sturgeon spawning would have to occur upstream of RKM 120.50/ RM 75 with the downstream limit of larvae rearing fluctuating between RKM 104/RM 65 and RKM 129/RM 80. It appears

likely that Atlantic sturgeon larvae in the Delaware River drift for only a short period of time, since long duration drift from the presumed spawning areas would transport the larvae into waters of higher salinity, where they would not survive. As with the larvae of other sturgeon species, Atlantic sturgeon have likely evolved river/population specific patterns of dispersal that result in their movement downriver from spawning areas to optimal rearing areas upriver of the salt front (Hilton *et al.*, 2016). The presumed Atlantic sturgeon spawning reach in the lower tidal Delaware River (RKM 125-137) overlaps with the area of greatest abundance of young of year Atlantic sturgeon (RKM 123-129), which suggests that post yolk-sac larvae dispersal is minimal; however, it is assumed that spawning may occur as far up as Trenton, NJ. Thus, the portion of the action area where temporary construction vessel will transit does contain the substrate needed to support sturgeon spawning, and larval rearing may occur within this portion of the action area, however, the portion of the action area where construction activities will occur and operational vessels will transit does not support spawning due to higher salinity levels (2 – 10 ppt). However, older life stages of Atlantic sturgeon are likely to be present throughout the action area. A study by Breece *et al.* (2013) demonstrates that adult Atlantic sturgeon are most likely to be within ± 30 km of the salt front. Shortnose sturgeon spawning occurs primarily between Scudders Falls and the Trenton rapids, upstream of the action area, therefore, spawning and early life stages are not expected within the action area.

Figure 19. Range of annual salt front locations from 1989-2016. The salt front river mile is estimated by DRBC using data provided by USGS and the Kimberly Clark Corporation (Figure 2.5.1 in PDE 2017)



5.1.2.3 Dissolved Oxygen

Dissolved oxygen (DO) refers to the concentration of oxygen gas incorporated in water. Oxygen

enters water both by direct absorption from the atmosphere, which is enhanced by turbulence, and as a by-product of photosynthesis from algae and aquatic plants. Sufficient DO is essential to growth and reproduction of aerobic aquatic life; however, low DO levels are connected to elevated nutrient levels (i.e., eutrophication) in the Delaware Estuary and are most likely to occur during summer months. The Delaware Estuary has historically been plagued by hypoxic conditions (severe depression of DO) that results from the discharge of raw and poorly treated wastewater. Although the Estuary has seen a remarkable recovery since the 1960s, with fish such as striped bass and sturgeon now able to spawn more regularly within the Estuary, DO remains a critical issue for the Estuary because of continued depression of oxygen levels below saturation.

The U.S. Geological Survey (USGS) continuously measures DO at the Chester, PA gage in the Delaware River (USGS 01477050) at RKM 133.7 (RM 83.1) about 10 to 11 km (6.4 to 7 mi) downstream from the Port. Dissolved oxygen levels at the gaging station near the proposed Berth vary greatly based on seasonality, with mean monthly average DO ranging between 12.23 to 10.87 mg/L in the winter months (i.e., December through January) to between 6.87 and 5.67 mg/L in the summer months (i.e., June through August) (Table 11). DRBC's water quality standard for DO in the location of the proposed Port is a 24-hour average concentration not less than between 4.5 mg/L and 6.0 mg/L in the lower Delaware Estuary. In the most recent Delaware River and Bay Water Quality Assessment (DRBC 2024 <https://www.nj.gov/drbc/public/publications/wq-assessment-rpts.html>), 96.9 percent of observations near the Chester, PA gage in the lower Delaware River met daily mean water quality standards criteria and 98.7 percent of observations in the lower Delaware River and Delaware Bay met the instantaneous minimum criteria.

Table 11. Mean monthly dissolved oxygen in the Delaware River at Chester, PA (USGS 01477050) from January 2009 to December 2019

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean monthly dissolved oxygen (mg/L)	12.23	-*	12.28	9.75	7.90	6.87	6.13	5.67	6.36	7.31	8.81	10.87

* No dissolved oxygen data was available at this location for the month of February

There are no available data on DO requirements for Atlantic sturgeon adults and little data for larvae, presenting a gap in the current scientific knowledge, but it is known that juvenile and larval life stage Atlantic sturgeon are sensitive to low DO at both the lethal and sub-lethal levels that occur in the Delaware Estuary. In the Atlantic sturgeon critical habitat designation, it was assumed that 6.0 mg/l DO or greater is needed for juvenile rearing habitat to support growth, development, and recruitment in the NY Bight DPS (82 FR 39160). There are no reported DO sensitivities for adult shortnose sturgeon, the life stage most likely to be present within the action area. In DO experiments conducted by Jenkins *et al.* (1993), shortnose sturgeon 22-77 days of age exposed to various DO levels in mostly freshwater at a mean temperature of 22.5°C

experienced a significant decrease in percent survival between 3.5 and 3.0 mg/l DO. In addition, using various temperature, DO, and salinity combinations (2.0 to 4.5 percent) in 24-hour exposures, Campbell and Goodman (2004) estimated the concentration that kills 50 percent (LC50) of 77 to 104 day old fish to be 2.7 mg/l (32 percent DO saturation, 22°C, 4 percent), 2.2 mg/l (28 percent DO saturation, 26°C, 4.5 percent), and 3.1 mg/l (42 percent DO saturation, 30°C, 2 percent).

5.1.2.4 *Changing Environmental Conditions*

Changing environmental conditions are occurring globally and are predicted to continue (IPCC 2023), which may impact water quality in the Delaware River. Into the future, 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. 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 is 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). 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.

5.1.3 Upper and Lower NY Bay and the East River

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 (the area between the Upper and Lower NY Bay at 40.6268° N and 74.0563° W) 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).

The East River is a tidal straight that is a length of about 25 km connecting Upper NY Bay to the east and Western Long Island Sound to the west. It ranges from 2.7 to 7.9 m (9 to 26 ft) in depth at MLLW¹⁷ and generally has substrate consisting of gravel, cobble, and rocks covered with a shallow layer of soft sediment. The lower East River at Pier J, Brooklyn, NY is approximately 450 m (1,475 ft) wide.

¹⁷ NOAA Nautical Chart (<https://nauticalcharts.noaa.gov/enconline/enconline.html>)

5.1.3.1 Salinity

The Upper and Lower NY Bays are tidally influenced and salinity is dependent on the amount of freshwater input and tidal conditions. During low flow conditions, surface and bottom salinities can be as high as 20 and 28 ppt, respectively. In the Upper NY Bay, the surface and bottom salinities can be between 5 and 20 ppt at periods of high freshwater input (Blumberg and Hellweger 2006). The East River is tidally dominated and salinity ranges from 28 ppt in the lower portion, where Pier J in Brooklyn is present, to one ppt in the upper river, depending on tidal direction and amount of freshwater inflow (Li et al. 2018).

5.1.3.2 Changing Environmental Conditions

Changing environmental conditions are well documented and are predicted to continue (IPCC 2023), increasing the likelihood for consequences to marine and anadromous protected species and their habitats within the marine environment. Ocean temperatures 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). Projections for these waters suggest that this region will warm two to three times faster than the global average (Saba *et al.* 2015). 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). Annual surface and bottom temperatures in the Gulf of Maine and Georges Bank have trended warmer since the early 1980s. The 2022 seasonal SST have trended warmer in the winter, spring, and fall and just slightly warmer than average in the summer throughout New England. Seasonal SST in 2022 were above average throughout the year, with some seasons rivaling or exceeding the record warm temperatures observed in 2012. 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 2023, 2024). Impacts from changing environmental conditions include changes in temperature and precipitation which can impact pH and ocean currents. Estuaries may also experience changes in habitat quality/quantity and productivity because of changes in freshwater flows, nutrient cycling, sediment delivery, sea level rise, and storm surge.

5.2 Listed Species in the Action Area

5.2.1 Sea Turtles in the Action Area

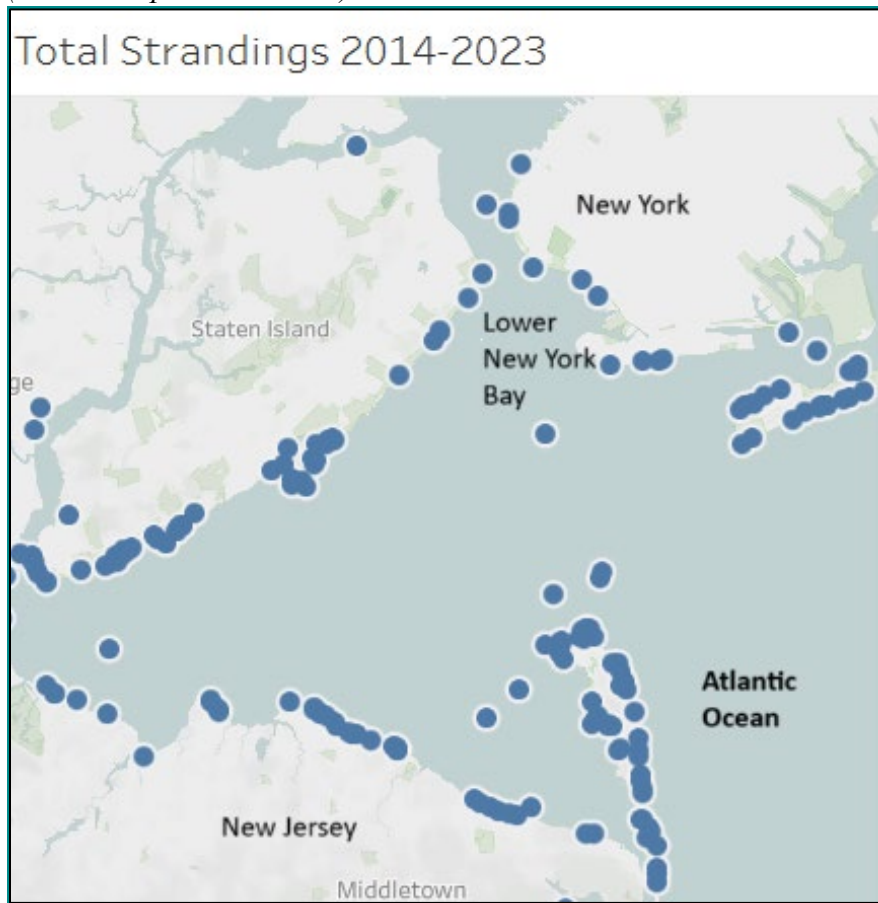
Four ESA-listed species of sea turtles (leatherback sea turtles, North Atlantic DPS of green sea turtles, Northwest Atlantic Ocean DPS of loggerhead sea turtles, Kemp's ridley sea turtles) make seasonal migrations into the NY Bight, including the East River, Upper and Lower NY Bay, Delaware Bay, and lower Delaware River. Based on STSSN unpublished data from 2014 to 2023, sea turtle strandings occurred throughout the lower Delaware River and Delaware Bay, and within Upper and Lower NY Harbor (Figures 20 and 21). One of the main factors influencing sea turtle presence in the north is seasonal temperature patterns (Ruben and Morreale 1999) as waters in these areas are not warm enough to support sea turtle presence year round. 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 (Braun-McNeill and Epperly 2002, Ceriani *et al.* 2012, Griffin *et al.* 2013, James *et al.* 2005c, Mansfield *et al.* 2009, Morreale and Standora 1998, Morreale and Standora 2005, NMFS NEFSC and SEFSC 2011, Shoop and Kenney 1992, TEWG 2009, Winton *et al.* 2018). 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 (George 1997, Milton and Lutz 2003, Morreale *et al.* 1992). That said, loggerhead sea turtles have been found in waters as low as 7.1-8 °C (Braun-McNeill *et al.* 2008, Smolowitz *et al.* 2015, Weeks *et al.* 2010). 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 2013). Sea turtles are most likely to occur in the action area when water temperatures are above this temperature, although depending on seasonal weather patterns and prey availability, they could be also present in months when water temperatures are cooler (as evidenced by fall and winter cold stunning records as well as year-round stranding records).

Figure 20. Reported Sea Turtle Strandings in the Delaware River and Bay from 2014 to 2023 (STSSN, unpublished data)



Figure 21. Reported Sea Turtle Strandings in the Upper and Lower NY Harbor from 2014-2023 (STSSN, unpublished data).



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 ft (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). A recent study by Stokes et al. (2024) of sea turtle swimming depths found that green and loggerhead sea turtles swim at depths of around three times the depth of their body diameter in order to maximize efficiency in the water - deep enough to not create waves at the surface, but close enough to the water surface to avoid travelling further than necessary up and down the water column for breath (Stokes et al. 2024).

Sea turtles have been documented throughout 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, 2006, NMFS 2019, Palka *et al.* 2021, Winton *et al.* 2018). AMAPPS aerial abundance surveys in summer 2021 indicate that loggerhead and leatherback turtles are relatively common in waters of the Mid-Atlantic Bight while Kemp's

ridley turtles and green turtles are less common (NEFSC and SEFSC 2022). Sea turtle nesting does not occur in Delaware, NJ, or NY, and there are no nesting beaches in the vicinity of the action area (STSSN, unpublished data). For this reason, sea turtles in the action area are adults or juveniles and no hatchlings will occur in the action area due to the distance from any nesting beaches. STSSN data (unpublished) also shows the documented strandings from 2014-2023 in the general area were mostly loggerhead sea turtles¹⁸.

One sea turtle stranding event occurred upstream of Artificial Island, NJ (Figure 20), but sea turtle presence above the saltwater line in the Delaware River is extremely rare. Therefore, sea turtle presence in the Salem River where the Port construction activities (pile driving, dredging, fill placement) will occur is not expected to occur, thus these effects will not be considered further. Individuals from all four species are seasonally present in the coastal waters that may be transited by operational vessels traveling to the Port, typically from late spring/early summer through the fall. Based on the best available information, we expect migratory and opportunistically foraging adult and juvenile sea turtles to be present throughout the action area in the East River, Upper and Lower NY Bay, Delaware Bay, the lower Delaware River (below Artificial Island), and within the coastal waters of NJ from May through November.

5.2.2 Atlantic Sturgeon in the Action Area

5.2.2.1 *Distribution of Atlantic Sturgeon within the Delaware River and Bay*

In the Delaware River and Estuary, Atlantic sturgeon occur from the mouth of the Delaware Bay to the fall line near Trenton, NJ, a distance of almost 220 km (136.7 mi) (Hilton *et al.* 2016, Simpson 2008). All historical Atlantic sturgeon habitats appear to be accessible in the Delaware (ASSRT 2007); however, given upstream shifts in the salt wedge over time, a reduction in riverine freshwater habitat is available to Atlantic sturgeon compared to pre-industrial times.

Spawning

Spawning may occur from April to July. Atlantic sturgeon early life stages do not tolerate saline waters. Therefore, spawning must occur in freshwater upstream of saltwater intrusion. Cobb (1899) and Borodin (1925) reported spawning between RKM 77 and 130 (RM 48 and 81) (Delaware City, DE to Chester City, PA). However, based on more recent tagging and tracking studies, current Atlantic sturgeon spawning may occur upstream of the salt front over hard bottom substrate between Claymont, DE/Marcus Hook, PA (Marcus Hook Bar), approximately RKM 125 (RM 78), and the fall line at Trenton, NJ, approximately RKM 212 (RM 132) (Breece *et al.* 2013, Simpson 2008). The upstream shift from historical spawning sites is thought to be at least partially a result of dredging and changing environmental conditions that shifted the location of the salt wedge over time and likely eliminated historic spawning habitats in the lower Delaware River (Breece *et al.* 2013). Though only one larva has been collected from the river, as noted below, the recent documented presence of young of year in the Delaware River provides

¹⁸ https://haproxy-traffic-splitter/views/SalemRiverActionAreaDashboard/SalemRiverActionArea?:language=en-US&:sid=&:redirect=auth&:display_count=n&:origin=viz_share_link

confirmation that regular spawning is still occurring in this river.

Based on previous studies, the likely spawning area in the lower tidal river closest to the Port is located between the Marcus Hook Bar (RKM 125/RM 78) and the downstream end of Little Tinicum Island (RKM 138/RM 86). A portion of this spawning area is within the action area where construction vessels will be temporarily transiting to White's Basin CDF (RM 82, RKM 132) during the construction phase of the project. This area contains hard bottom habitat appropriate for sturgeon spawning (gravel/coarse grain depositional material and cobble/boulder habitat) (Breece *et al.* 2013, Sommerfield and Madsen 2003). Tracking of adult male and female Atlantic sturgeon confirmed the use and affinity to this area by adults during April to July (Breece *et al.* 2013). The sturgeon selected areas that contained mixed gravel and mud substrate (Breece *et al.* 2013), DiJohnson *et al.* (2015). The entrainment of a yolk sac larva at the cooling intake of the Eddystone Generating Station in 2017 (NMFS 2020a) confirms that spawning occurs in this reach of the river.

Breece *et al.* (2013) argues that sea level rise, in conjunction with channel deepening efforts, may shift the average location of the salt front upstream, compressing the available habitat for spawning. They also state that movement of the salt front may increase sedimentation rates over current spawning habitat and concentrate Atlantic sturgeon in areas of the river with the highest volume of vessel traffic.

Early Life Stages

All early life stages are intolerant of high salinity and only occur in the freshwater reach of the river. Atlantic sturgeon eggs are adhesive and stick to the substrate. Therefore, eggs will remain at or near the site where the female releases them in appropriate spawning habitat. The closest possible spawning area is approximately 31 km (19 miles) upstream of the Port location. Based on studies in artificial streams, hatchlings (yolk-sac larvae) will seek cover in the interstitial spaces of larger material such as gravel and cobble and are assumed to inhabit the same riverine or estuarine areas where they were spawned (Bain *et al.* 2000, Kynard and Horgan 2002). Post yolk-sac larvae (stage when the larva has exhausted the yolk-sac and is free moving) initiated downstream movement in the simulated river drift that lasted for 6-12 days, which, in the Hudson River, would be sufficient to transport the larvae from spawning to rearing areas without entering salt water (Kynard and Horgan, 2002).

There is no information about post yolk-sac larvae distribution and presence in the Delaware River or the Salem River; however, post yolk-sac larvae are believed to drift with currents downstream to areas immediately above the salt front where they settle to feed and grow (Kynard and Horgan 2002), but they are also free-swimming and capable of accessing habitat upstream. Salinity within the tidal Salem River at the Port location is similar to that in the adjacent Delaware River, ranging from approximately 2–10 ppt, and varying with time of year, tidal stage, and local meteorological conditions. Based on this information, as well as what is

known about early life stages, eggs, yolk-sac and PYSL do not likely occur in the Delaware River at its confluence with the Salem River and within the Salem River at the Port due to the salinity levels. However, the action area where project vessels will transit from the Port to White's Basin CDF during the construction phase of the project may overlap with early life stages.

Juveniles

All juvenile (non-migratory) Atlantic sturgeon present in the Delaware River are part of the NY Bight DPS. Juvenile Atlantic sturgeon are present from the mouth of the Delaware River and upstream to Trenton, NJ and within the Salem River. Within the lower estuary, juveniles are present year-round but with higher concentrations during spring/early summer and late fall. Older juveniles may move into the Delaware Bay and eventually make their way to marine waters at two-years or older, becoming subadults.

Young of year Atlantic sturgeon nurse in the Delaware River below Little Tinicum Island to just upstream of the salt front. Sampling in 2009 targeted young of year and resulted in the capture of more than 60 young of year in the Marcus Hook anchorage (RKM 127/RM 79) area during late October through late November 2009 (Calvo *et al.* 2010, Fisher 2009). Two telemetry studies of young of year with acoustic tags showed that young of year use several areas from Deepwater (RKM 105/RM 65) to Roebbling (RKM 199/RM 124) during late fall to early spring. Some remained in the Marcus Hook area while others moved upstream, exhibiting migrations in and out of the area during winter months (Calvo *et al.* 2010, Fisher 2011). At least one young of year spent some time downstream of Marcus Hook (Calvo *et al.* 2010, Fisher 2011). Downstream detections from May to August between Philadelphia (RKM 150/RM 93) and New Castle (RKM 100/RM 62) suggest non-use of the upriver locations during the summer months (Fisher 2011). Based on this, it is likely that young of year occur within the action area.

Salinity intrusion and water temperatures seem to influence summer distribution of late stage juveniles in the river with concentrations in the Marcus Hook occurring during years with high salinity and water temperatures, and expanded distribution downstream to and below Artificial Island during years with below average salinity and water temperature (Fisher 2011). During the summer months, concentrations of Atlantic sturgeon have been located in the Marcus Hook (RKM 123-129/RM 76-80) and Cherry Island Flats (RKM 112-118/RM 70-73.3) regions of the river (Simpson, 2008; Calvo *et al.*, 2010) as well as near Artificial Island (Simpson 2008).

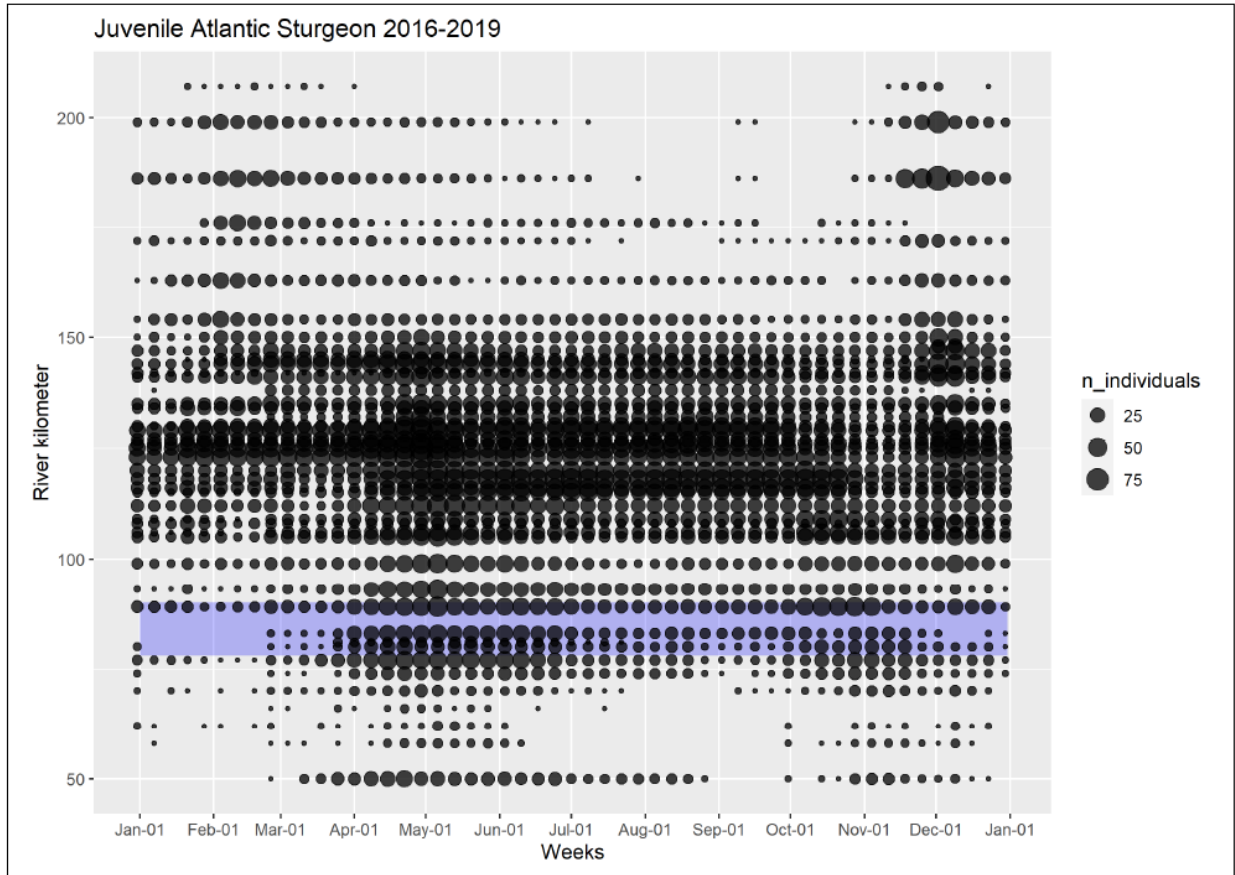
Brundage *et al.* (2014), found that the juveniles shifted their center of distribution progressively down-estuary as they aged, until they migrated to the higher salinity waters of Delaware Bay and eventually the nearshore Atlantic Ocean during the fall of their second or third years. Brundage and O'Herron (in Calvo *et al.* (2010)) tagged 26 juvenile Atlantic sturgeon, including six young of year. For one-year old juveniles and older, most detections occurred in the lower tidal Delaware River from the middle Liston Range (RKM 70/RM 43.5) to Tinicum Island (RKM

141/RM 87.6). For non-young of year fish, the researchers also detected a relationship between the size of individuals and the movement pattern of the fish in the fall. The fork length of fish that made defined movements to the lower bay and ocean averaged 815 mm (range 651-970 mm) while those that moved towards the bay but were not detected below Liston Range averaged 716 mm (range 505-947 mm), and those that appear to have remained in the tidal river into the winter averaged 524 mm (range 485-566 mm) (Calvo *et al.* 2010).

Juvenile Atlantic sturgeon (254 to 750 mm fork length) were acoustically tagged from 2015 to 2019 as part of a sturgeon protection and monitoring program associated with the USACE Delaware River deepening project. Telemetry data from 2016 to 2019 indicate that acoustic-tagged juvenile Atlantic sturgeon occur in the Berth area (where pile driving and dredging will occur) throughout the year, based on acoustic detections at receivers in the tidal portion of the Delaware River (Figure 22).

In general, within the Delaware River, the distribution of juvenile Atlantic sturgeon is centered on the Marcus Hook-Chester ranges (RKM 121-136/RM 75-84.5), consistent with earlier acoustic tracking studies (Brundage and O'Herron, 2009; Brundage et al., 2014; Hale et al., 2016). Marcus Hook range also supports high densities of young of year and young juveniles, particularly during winter. The reach also includes likely Atlantic sturgeon spawning sites along the edge of the navigation channel, close to Little Tinicum Island, which is outside of the action area, and near Chester, PA. Post yolk-sac larvae may occur throughout the reach above the salt front from late May to September depending on when spawning occurs. The Whites Basin CDF, where construction vessels will be transiting, is located in Logan Township at the downstream most portion of the Marcus Hook range. A total of 14 temporary, seasonal (July 1 through March 14) construction vessel routes will transit through this portion of the action area to Whites Basin CDF. No other project activities will overlap with this portion of the action area.

Figure 22. Distribution of Juvenile Atlantic Sturgeon in the tidal Delaware River, by week, all years combined



Adults and Subadults

Adult and subadult (non-natal late-stage juveniles) Atlantic sturgeon both move through the action area during up and downstream migrations as well as for foraging and spawning staging (NYB adults only). Adults and, especially, subadults occur and reside in lower estuary while both life stages occur in dense aggregations throughout Delaware Bay and at the mouth of the Delaware Bay. The majority of adults entering the river are of Delaware River origin while subadults may belong to any DPS. Adult and subadult Atlantic sturgeon in the Delaware Bay and at the mouth of the Bay consists of a mixture of several DPSs.

Spawning adults migrate upstream through the action area in the Delaware River during April and May. Spawning occurs through mid- to late-June (Simpson 2008). Females leave the spawning sites to move downstream soon after spawning but males may remain in the river until October. Some research indicates that there may be a fall spawning run of adult Atlantic sturgeon in the Delaware River, as seen further south in the James River (Balazik *et al.* 2012b, Fox *et al.* 2015); however, at this time, more research is needed to confirm whether or not an

independent run of fall spawning Atlantic sturgeon is occurring in the Delaware River.

The Delaware River estuary (the lower tidal river) and Bay are used by sturgeon from multiple DPSs. Early life stages and young juveniles will not be present in the lower tidal river due to unsuitable salinity levels in this reach, while older (age-1+) juvenile, subadult, and adult Atlantic sturgeon are present. Best available information indicates that the highest concentration of juveniles within the area occur from April to June and October to December. Genetic studies show that the majority of juvenile sturgeon are assigned to the Delaware River (NYB DPS) population, while subadult and adult fish are highly mixed from multiple DPSs; however, samples were only taken from river-resident juvenile fish, which could result in an overestimate of Delaware River fish (Kazyak *et al.* 2021). Kazyak (2021) notes that expanded genetic sampling that include additional populations that are not currently represented will improve inferences from mixed-stock analyses.

Generally, subadults immigrate into the estuary in spring, establish home range in the summer months in the river, and emigrate from the estuary in the fall (Fisher 2011). Subadults tagged and tracked by Simpson (2008) entered the lower Delaware Estuary as early as mid-March but, more typically, from mid-April through May. Tracked sturgeon remained in the Delaware Estuary through the late fall departing in November (Simpson 2008). Previous studies have found a similar movement pattern of upstream movement in the spring-summer and downstream movement to overwintering areas in the lower estuary or nearshore coastal areas in the fall-winter (Brundage and Meadows, 1982; Lazzari *et al.*, 1986; Shirey *et al.*, 1997; 1999; Brundage and O'Herron, 2009; Brundage and O'Herron in Calvo *et al.*, 2010).

From 2009 to 2014, Fox *et al.* (2015) tracked adult Atlantic sturgeon captured in marine waters off the Delaware Bay in the spring in an attempt to locate spawning areas in the Delaware River. Adults mostly used the area from New Castle, DE (RKM 100/RM 62) to Little Tinicum Island (RKM 138/RM 86) though adult Atlantic sturgeon were detected as far upstream as Roebling, NJ (RKM 201) (Fox *et al.* 2015). The earliest detection was in mid-April while the latest departure occurred in mid-June, which supports the assumption that adults are only present in the river during spawning. However, Fox *et al.* (2015) also observed several individuals of both sexes and unknowns that entered the river later in the spring and occupied suitable spawning habitats into the fall months. The sturgeon spent relatively little time in the river each year, generally about four weeks, though adult sturgeon of unknown sex remained in the area of likely spawning twice as long (67.1 days).

In general, Atlantic sturgeon from all rivers move south along the Atlantic coast during winter and north during summer (Erickson *et al.* 2011, Hilton *et al.* 2016, Smith 1985). Aggregations of sturgeon from Long Island to Virginia during winter months indicate the presence of important overwintering areas in coastal waters (Dunton *et al.* 2010). In coastal waters, Atlantic sturgeon generally use depths between 10 and 50 m (33 and 164 ft) and most captures occurs at depths of

20 m (65 ft) or less (Dunton *et al.* 2015, Dunton *et al.* 2010, Erickson *et al.* 2011), while Savoy and Pacileo (2003) found that Atlantic sturgeon can occur at depths as shallow as 2.5 m (8.2 ft).

The Delaware Bay mouth has been identified as an aggregation area (Dunton *et al.* 2010, Erickson *et al.* 2011, Fox *et al.* 2010, Stein *et al.* 2004a). A number of recent studies have provided us with an increasing understanding of Atlantic sturgeon utilization of the Delaware Bay and nearshore coastal areas near its mouth (Breece *et al.* 2016, Breece *et al.* 2017, Breece *et al.* 2018, Haulsee *et al.* 2020, Kuntz 2021). These studies have identified important aggregations of Atlantic sturgeon subadults in the lower Delaware Bay and in the Atlantic Ocean off the Delaware Bay. Most of these aggregations occur adjacent to or within established shipping lanes (Breece *et al.* 2018, Haulsee *et al.* 2020). While Atlantic sturgeon may be present year-round in these areas, both density and residency vary seasonally among sites. Depth distribution also shifts with season, as fish inhabit the deepest waters during winter and shallowest waters during summer and early fall. High occurrence rates at the mouth of the Delaware Bay occur in April and June and again in September and October corresponding with seasonal migration into and out of the Delaware Bay, respectively (Breece *et al.* 2017, Haulsee *et al.* 2020). The highest number of Atlantic sturgeon within the Delaware Bay occur during late spring through the fall while the highest number of Atlantic sturgeon in the deeper waters off the mouth occur during November and December (Fox *et al.* 2010). Fox *et al.* (2015) detected a large aggregation of telemetered adult and subadult Atlantic sturgeon near the mouth of the Delaware Bay during summer months. During winter, Atlantic sturgeon movement is high with small pockets of resident fish present in deeper water near the mouth of the Delaware Bay occurring in early spring (Breece *et al.* 2018). As temperature increases, pockets of resident Atlantic sturgeon expand in an isolated region near the mouth of the Delaware Bay. Kuntz (2021) also found a large number of Atlantic sturgeon concentrated from late spring through the fall in two locations in the lower Delaware Bay. Telemetry studies and modeling identified Atlantic sturgeon areas of residency on the eastern side of the Delaware Bay and possibly in the shallow waters on the southwest side of the Delaware Bay (Breece *et al.* 2018). These areas are where many individuals remain from May to October. Breece *et al.* (2018) postulated that upwelling brings in cooler, nutrient-rich, highly oxygenated offshore waters that provide near-optimal metabolic temperatures along the bottom. Environmental conditions have also led to ideal foraging opportunities for Atlantic sturgeon and examination of gut content has confirmed that Atlantic sturgeon are feeding on benthic invertebrates in these areas (Fox *et al.* 2020). Adult and subadult Atlantic sturgeon move through the Delaware Bay (RKM 78 to RKM 5 (RM 48.5 to RM 3.1)) in April and June to spawn and aggregate at the mouth of the Delaware Bay from April to November, but are present year-round. Operational vessel routes will transit through the Delaware Bay within the Federal Navigation Channel throughout the life of the project.

5.2.2.2 *Atlantic Sturgeon Coastal Presence*

Adult and subadult (less than 150 cm in total length, not sexually mature, but have left their natal rivers) Atlantic sturgeon from all five DPSs undertake seasonal, coastal marine migrations along

the United States eastern coastline inclusive of waters off of NY and NJ (Dunton *et al.* 2010, Erickson *et al.* 2011) , where the action area overlaps, and along the Atlantic coastal shelf (Erickson *et al.* 2011, Savoy *et al.* 2017). Atlantic sturgeon use the coastal nearshore zone (i.e., typically depths less than 50 m) to migrate between river systems (ASSRT 2007, Eyler *et al.* 2004) while demonstrating strong spawning habitat fidelity (Savoy *et al.* 2017) Erickson *et al.* (2011) found that adults remain in nearshore and shelf habitats ranging from 6 to 125 ft (2 to 38 m) in depth, preferring shallower waters in the summer and autumn and deeper waters in the winter and spring. In areas with gravel, sand and/or silt bottom habitats and relatively shallow depths (primarily <50 m), sturgeon may also be foraging during these trips on prey including mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Dadswell 2006), (Dunton *et al.* 2010), (Erickson *et al.* 2011).

Data from capture records, tagging studies, and other research efforts (Damon-Randall *et al.* 2013, Dunton *et al.* 2010, Stein *et al.* 2004a, b, Zollett 2009) indicate the potential for occurrence in the action area during all months of the year. Individuals from every Atlantic sturgeon DPS have been captured in the Virginian marine ecoregion (Cook and Auster 2007, Wirgin *et al.* 2015a, Wirgin *et al.* 2015b), which extends from Cape Cod, Massachusetts, to Cape Lookout, North Carolina. Additionally, Atlantic sturgeon aggregate in several distinct areas along the Mid-Atlantic coastline. These aggregation areas are located within the coastal waters off North Carolina; waters between the Chesapeake Bay and Delaware Bay; the southern NJ coast near the mouth of Delaware Bay; and the southwest shores of Long Island (Figure 23 and Figure 24) (Laney *et al.* 2007; Erickson *et al.* 2011; Dunton *et al.* 2010). The latter two aggregation areas are in the action area that will be transited by operational vessels moving between Brooklyn, NY and the Port. 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. These aggregation areas are believed to be where Atlantic sturgeon overwinter and/or forage (Dunton *et al.* 2010, Erickson *et al.* 2011, Laney *et al.* 2007). Areas between the aggregation sites are used by sturgeon migrating to and from these areas, as well as to spawning grounds found within natal rivers.

Based on the best available scientific data, adult and subadult Atlantic sturgeon originating from any of five DPSs could occur in coastal water of the vessel transit portion of the action area year-round. For the mixed stock analysis in this Opinion, we use the percentages from O'Leary *et al.* (2014) for the Upper and Lower NY Bay portion of the action area because the sampling area is more consistent with habitat and geography of the action area defined in this Opinion, where we expect take to occur. We do not use (Kazyak *et al.* 2021) for the mixed stock analysis because the percentages were based on genetic sampling of Atlantic sturgeon that were encountered across the U.S. Atlantic coast. Based on a mixed stock analysis done by O'Leary *et al.* (2014), we expect Atlantic sturgeon in the Upper and Lower NY Bay portion of the action area originate from the five DPSs at the following frequencies: New York Bight 87 percent; Chesapeake Bay 8 percent; South Atlantic 3 percent; and Gulf of Maine and Carolina (combined) 2 percent. 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 coastal waters portion of the action area.

Figure 23. Atlantic sturgeon captures during spring months (Dunton et al. 2010)

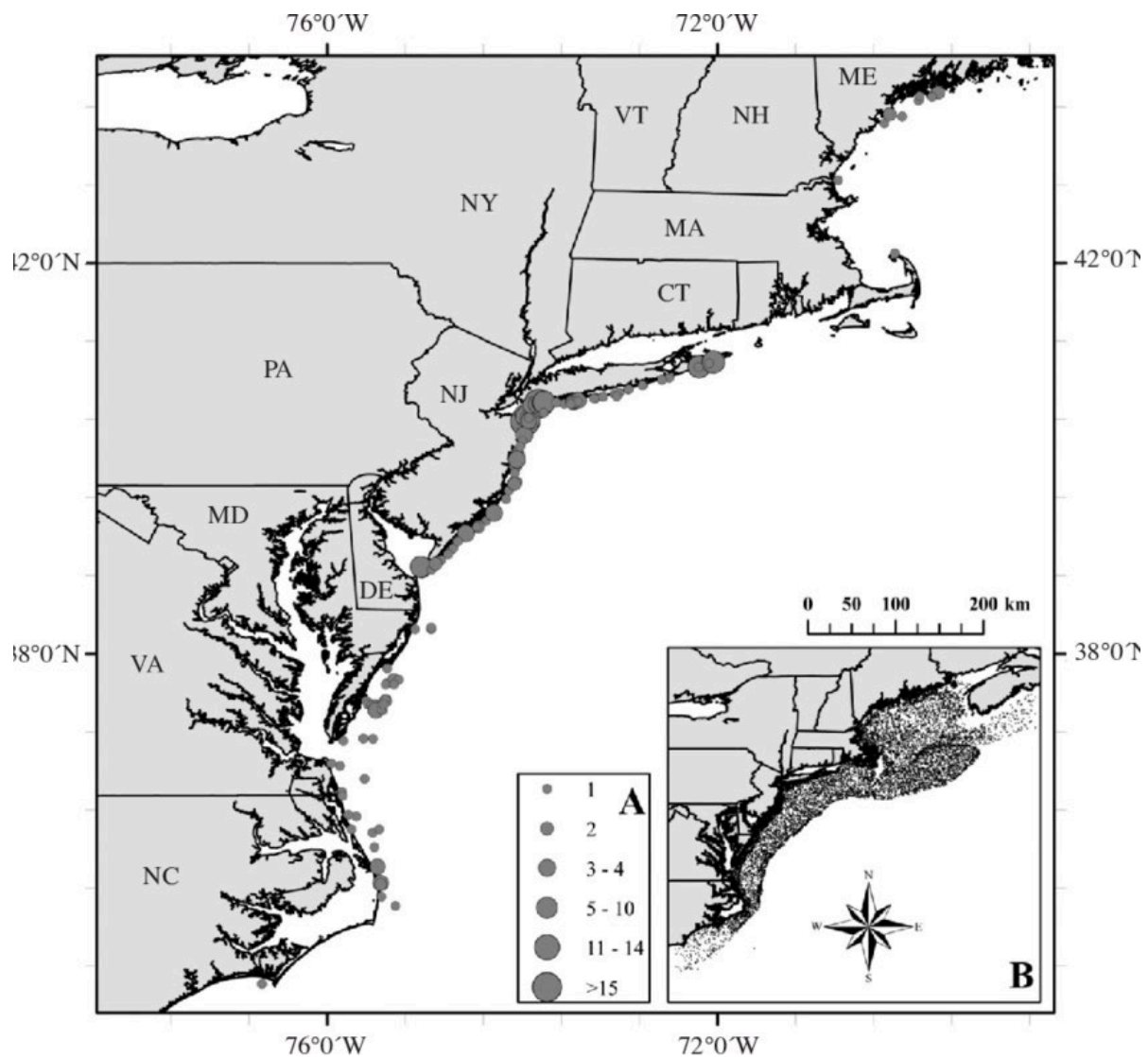
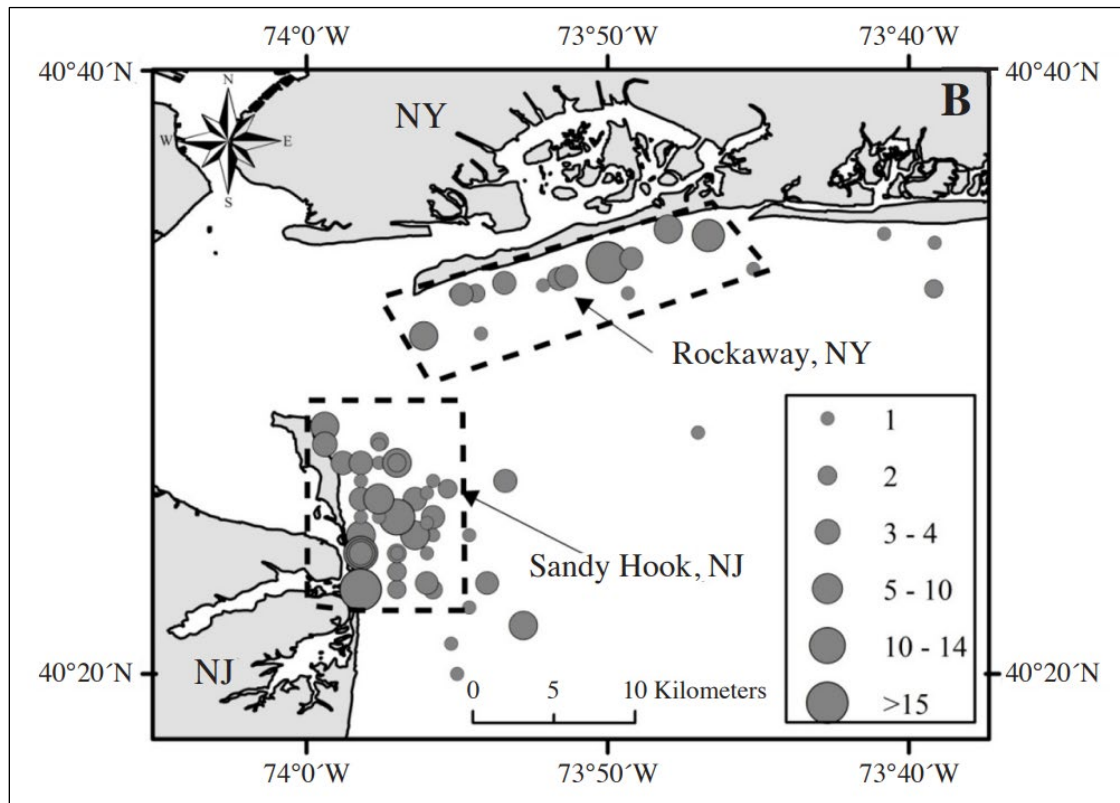


Figure 24. Number of captures of Atlantic sturgeon determined from Sandy Hook, NJ and Rockaway, NY, including all captures from the NMFS bottom trawl survey, NJ Department of Environmental Protection finfish survey, and NY bottom trawl survey (Dunton et al. 2010).



Atlantic sturgeon (*Acipenser oxyrinchus*) from all surveys during spring months. Circle size corresponds to total number of Atlantic sturgeon captured at a given location.

Evidence suggests that Atlantic sturgeon orient to specific coastal features that provide foraging opportunities linked to depth-specific concentrations of fauna. Multiple studies demonstrate that Atlantic sturgeon commonly aggregate in areas that presumably provide optimal foraging opportunities, such as the Bay of Fundy, Massachusetts Bay, Rhode Island, NJ, and Delaware Bay (Dovel and Berggren 1983; Johnson et al. 1997; Rochard et al. 1997; Kynard et al. 2000; Eyler et al. 2004; Stein et al. 2004a; Dadswell 2006, as cited in ASSRT 2007). Similarly, Stein et al. (2004a, 2004b) reviewed 21 years of sturgeon bycatch records in the Mid-Atlantic And found that Atlantic sturgeon were routinely captured in waters ranging from 10–50 m (33 to 164 ft) deep in areas associated with coarse gravel substrates, presumably associated with depth-specific concentrations of preferred prey fauna. The action area overlaps with Atlantic sturgeon in marine and coastal waters 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

year-round in the areas where the action area will occur.

5.2.2.3 *Summary of Atlantic Sturgeon Presence in the Action Area*

In summary, Atlantic sturgeon of all five DPS are present throughout most of the action area, with distribution influenced by seasonal water temperature, forage items, and salinity. The action area overlaps with subadult and adult Atlantic sturgeon throughout the action area from White's Basin to Brooklyn, NY. Adult and subadults may be present in the Salem River, Delaware River, Delaware Bay, along the coast of NJ, in Upper and Lower NY Bay, and the lower East River. We assume 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 year-round in the action area. The action area also overlaps with young of year and juvenile Atlantic sturgeon from the NY Bight DPS in the Delaware River. Early life stages of NY Bight DPS Atlantic sturgeon are expected to be present upstream of the Port to White's Basin where seasonal, temporary construction vessel will transit based on the fact that spawning occurs near Chester, PA.

5.2.3 Shortnose Sturgeon in the Action Area

5.2.3.1 *Overall Distribution in the Delaware River*

Shortnose sturgeon occur in the Delaware River from the lower bay upstream to at least Lambertville, NJ (RKM 238/RM 148). Based on documented habitat use by various life stages of shortnose sturgeon in the Delaware River, juveniles and adults of this species are expected to occur in the action area. Shortnose sturgeon early life stages are not likely to occur in the action area because spawning occurs at and upstream of Trenton, NJ, which is more than 70 km upstream of the Berth (NMFS 2014) and does not overlap with vessel routes to White's Basin, which is the most upstream extent of the action area.

Distribution of shortnose sturgeon in the action area is influenced by seasonal water temperature, the distribution of forage items, and salinity. Although they have been documented in waters with salinities as high as 31 parts per thousand (ppt), shortnose sturgeon are typically concentrated in areas with salinity levels of less than 3 ppt (Dadswell *et al.* 1984). Jenkins *et al.* (1993) demonstrated in lab studies that 76-day old shortnose sturgeon experienced 100 percent mortality in salinity greater than 14 ppt. One-year-old shortnose sturgeon were able to tolerate salinity levels as high as 20 ppt for up to 18 hours, but experienced 100 percent mortality at salinity levels of 30 ppt. A salinity of 9 ppt appeared to be a threshold at which significant mortalities began to occur, especially among the youngest fish (Jenkins *et al.* 1993). The Delaware River reach from approximately RKM 50 to 92 (RM 31 to 57.2) is considered mesohaline (5-18ppt). Thus, based on this information and the known salinity tolerances and preferences of shortnose sturgeon, this species is most likely to occur upstream of RKM 91/RM 57 where salinity is typically less than 5ppt. As tolerance to salinity increases with age and size, large juveniles and adults are likely to be present through the mesohaline area extending to RKM 50/RM 31. Due to the typical high salinities experienced in the polyhaline zone (below RKM

50/RM 31), shortnose sturgeon are likely to be rare in this reach of the river.

Historically, shortnose sturgeon were relatively rare below Philadelphia (RM 85–90) due to poor water quality. Since the 1990s, the water quality in the Philadelphia area has improved leading to an increased use of the lower river by shortnose sturgeon. Shirey *et al.* (1999) captured nine shortnose sturgeon at Cherry Island Flats and Artificial Island in 1998. During the June through September study period, shortnose sturgeon were found to use the area on the west side of the shipping channel between Deepwater Point, NJ and the Delaware-Pennsylvania line (RKM 126.8/RM 78.3). Shortnose sturgeon have also been documented at the trash racks of the Salem nuclear power plant in Salem, NJ at Artificial Island.

Juvenile Distribution

Young of year shortnose sturgeon are intolerant of high salinity and concentrate in freshwater upstream of the salt front. In the Delaware River, the salt front location varies throughout the year, with the median monthly salt front ranging from RKM 107.8 to RKM 122.3 (RM 67 to 76) (DRBC 2017). The maximum recorded upstream occurred during the drought of 1960 with the salt front extending as far north as to Philadelphia, Pennsylvania (RKM 164/RM 102) and may retract as far south as Artificial Island at RKM 87 (RM 54).

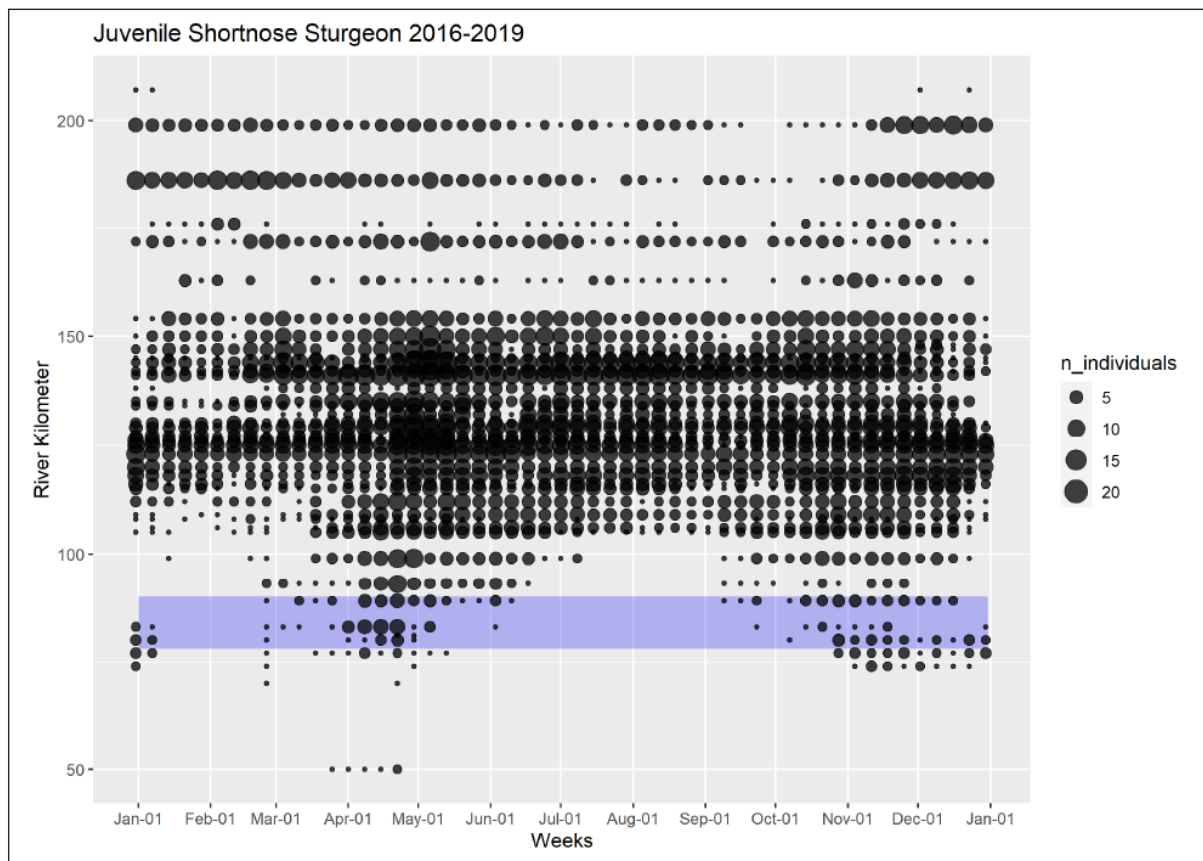
Over five winters (2015 to 2020), the USACE conducted blasting of rock outcrops in an effort to deepen the Federal Navigation Channel (between Marcus Hook and Tinicum Ranges) and collected several young of year (based on length) at the Marcus Hook Range from December and early January (ERC 2016, 2017, 2018, 2019, 2020b) in relocation trawls. Finding young of year in December may indicate that downstream migration from spawning sites occur either as drifting post yolk sac larvae or in fall after they are fully developed into juveniles.

A total of 1,356 shortnose sturgeon were captured during the five seasons of relocation trawling. Juveniles (<500 mm (<20 in) Fork Length) represented from 9% of 539 total (2017-2018 relocation) to 92.3 percent of 259 (2019-2020 relocation). The results from the relocation trawls carried out each winter from 2015-2016 to 2019-2020, indicate that juvenile shortnose sturgeon are present in the Marcus Hook area during the winter in larger numbers than previously predicted.

Early telemetry studies found that large juvenile shortnose sturgeon (length ranged from 454-566 mm TL) use the lower estuary during early late fall with the largest sturgeon spending most of its time in the Baker Range during late fall to January (ERC 2007). Further, the BA for another consultation in this region (ERC 2020a) provided the results of tracking studies conducted in the vicinity of the Hope Creek Marine Terminal that indicate that during the winter months juvenile shortnose sturgeon are more widely distributed in the Delaware River and were found closer to the confluence with the Salem River than previously thought. Juvenile (225 to 490 mm FL) and adult (502 to 905 mm FL) shortnose sturgeon were acoustically tagged as part of the sturgeon

protection and monitoring program associated with USACE's Delaware River deepening project (ERC 2020b). Based on telemetry data collected on acoustic receivers in the tidal Delaware River (Figure 25), juvenile shortnose sturgeon were detected throughout the year with fewer detections in August through September and January.

Figure 25. Distribution of Juvenile Shortnose Sturgeon in the tidal Delaware River, by week, all years combined



Adults

After spawning, which occurs during spring months and ceases by the time water temperatures reach 15°C (although sturgeon have been reported on the spawning grounds with water temperatures as high as 18°C), shortnose sturgeon move rapidly downstream to the Philadelphia area (~RKM 161/RM 100). After adult sturgeon migrate to the area around Philadelphia, many adults return upriver to between RKM 204 and 216 (RM 127 and 134) within a few weeks, while others gradually move to the same area over the course of the summer (O'Herron *et al.* 1993). However, the capture of multiple shortnose sturgeon at the Cherry Island Flats at RKM 119 (RM 74) during the summer months (Shirey *et al.* 1999) indicates that this area may serve as a summer aggregation site.

By the time water temperatures have reached 10°C, typically by mid-November¹⁹, most adult sturgeon have returned to the overwintering grounds around Duck Island and Newbold Island. These patterns are generally supported by the movement of radio-tagged fish in the region between RKM 201 and RKM 238 (RM 125 and RM 148) as presented by Brundage (1986), although, changing environmental conditions may have changed the water temperature and shifted how shortnose sturgeon move within the river. Based on water temperature data collected at the USGS gage at Philadelphia, in general, shortnose sturgeon are expected to be at the upstream overwintering grounds between RKM 190 and 211 (RM 118 and 131) between early November and mid-April.

Early studies of shortnose sturgeon adult movements found that some of the tagged adults moved rapidly between the upper tidal river (RKM 212/RM132) and the lower tidal river, moving as far downstream as RKM 93 (RM 58). These movements occurred in spring and early to mid-winter and were likely associated with sturgeon moving downstream to summer foraging and upstream to overwintering areas, respectively (ERC 2006a). However, three fish overwintered below Wilmington DE, but Aberdeen (1994) concluded that the majority of individuals overwinter in upstream areas below Trenton, NJ (RKM 212/RM 132).

Newer data indicates that adult shortnose sturgeon are present in the Marcus Hook area during the winter in larger numbers than previously predicted. The relocation trawls during deepening blasting within the Marcus Hook, Chester, Eddystone, and Tinicum ranges of the channel during the winters from 2015-2016 to 2019-2020 collected a large number of adult shortnose sturgeon. These data further demonstrate the use of the lower tidal river (below Little Tinicum Island) during the winter months; however, we do not expect them to occur in dense, sedentary aggregations as is seen in the upriver overwintering sites.

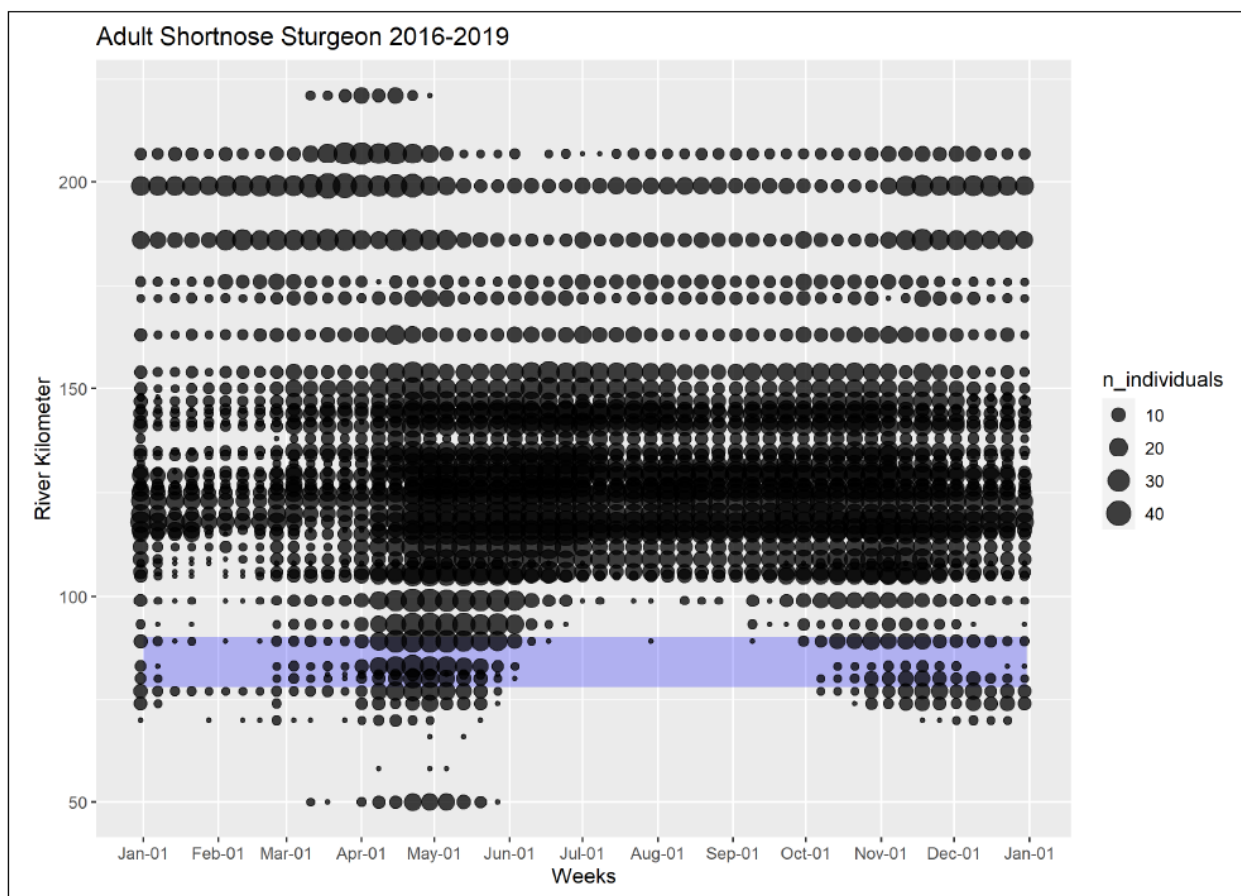
The results of tracking studies indicate that during the winter months, juvenile and adult shortnose sturgeon are more widely distributed in the Delaware River than previously thought. ERC (2007) tracked four shortnose sturgeon; three of the shortnose sturgeon were tracked through the winter (one shortnose was only tracked from May – August 2006). Shortnose sturgeon 171 was located in the Baker Range in early January (RKM 83/RM 51.6), and moved upriver to the Deepwater Point Range (RKM 105/RM 65) in mid-January where it remained until it moved rapidly to Marcus Hook (RKM 130/RM 81) on March 12. Shortnose sturgeon 2950 was tracked through February 2, 2007. In December the fish was located in the Bellevue Range (RKM 120/RM 74.6). Between January 29 and February 2, the fish moved between Marcus Hook (RKM 125) and Cherry Island (RKM 116/RM 72). Shortnose sturgeon 2953 also exhibited significant movement during the winter months, moving between RKM 123 and 163 (RM 76.4 and 101) from mid-December through mid-March. Tracking of adult and juvenile

¹⁹ Based on information from the USGS gage at Philadelphia (01467200) during the 2003-2008 time period, mean water temperatures reached 10°C between October 29 (2005 and 2006) and November 14 (2003). In the spring, mean water temperature reached 10°C between April 2 (2006) and April 21 (2009).

shortnose sturgeon captured near Marcus Hook (RKM 127-139/RM 79-86) and relocated to one of three areas (RKM 147, 176 and 193/RM 91, 109 and 120) demonstrated extensive movements during the winter period.

Telemetry data for adult shortnose sturgeon indicate that adults display similar seasonality as juveniles (ERC 2020a). Adults are detected in the vicinity of the Salem River confluence with the Delaware River year-round with a lower abundance December through February (Figure 26).

Figure 26. Distribution of Adult Shortnose Sturgeon in the tidal Delaware River, by week, all years combined



5.2.3.2 Summary of Shortnose Sturgeon Presence in the Delaware River/Bay Action Area

In summary, the action area overlaps with adult shortnose sturgeon from the mouth of the Delaware Bay to White's Basin, including the Salem River, suggesting that if suitable forage and/or habitat features are present, adults may be foraging or migrating in the action area. The action area in the Delaware River and Salem River also overlaps with young of year and juvenile shortnose sturgeon. Temporary construction vessel routes to Whites Basin CDF will transit

through freshwater reaches of the river where juvenile and young of year shortnose sturgeon may be present. Based on the best available information on spawning locations, early life stages are not likely to be present within these reaches.

5.3 Federal Actions that have Undergone Formal Section 7 Consultation

5.3.1 Delaware River

The Delaware River Federal Navigation Projects

The USACE have conducted annual maintenance dredging of the Delaware River for over 70 years. A batched consultation was completed in 1996 between us and the USACE on the effects on listed species and their habitat of the USACE's maintenance of the Philadelphia to Trenton Federal Navigation Channel, maintenance of the Philadelphia to the Sea Federal Navigation Channel, and dredging projects conducted by private applicants and authorized by the USACE. Since 2008, the USACE have been working with us to consider effects of the deepening of the Philadelphia to the Sea Federal Navigation Channel from -12 to -13.7 m (-40 to -45 ft) (with 0.6 m (2 ft) over-dredge) MLLW. A formal consultation was completed with issuance of a biological opinion dated July 17, 2009. The biological opinion concluded that dredging and rock blasting to deepen the channel from -12 to -13.7 m (-40 ft to -45 ft) may adversely affect, but is not likely to jeopardize the continued existence of shortnose sturgeon. In 2012, we listed the Atlantic sturgeon, and, consequently we reinitiated the consultation, and issued a biological opinion dated July 11, 2012. This consultation was again reinitiated in January 2014 and again in November 2015. The 2015 consultation included the use of a trawl to capture and relocate sturgeon from the blast site in the weeks before and during blasting. Both biological opinions concluded that the proposed project may adversely affect, but is not likely to jeopardize the continued existence of shortnose sturgeon and Atlantic sturgeon.

We published two proposed rules (81 FR 35701; 81 FR 36078) to designate critical habitat for the five distinct population segments of federally listed Atlantic sturgeon on June 3, 2016. Consequently, the USACE requested a conference to consider the effects of the remaining deepening project, Philadelphia to the Sea maintenance, and Philadelphia to Trenton maintenance. To streamline and consolidate these consultation processes, we (NMFS and the USACE) agreed to complete a new consolidated biological opinion to include the effects of the Delaware River channel deepening project, Philadelphia to the Sea maintenance dredging and Philadelphia to Trenton maintenance dredging. The USACE also requested that we include a new project, the Delaware River Dredged Material Utilization (DMU) study. On November 17, 2017, we issued a new, consolidated biological opinion that replaced the previous opinions covering these activities:

- 2015 Opinion: Deepening of the Delaware River Federal Navigation Channel
- 2013 Opinion: Maintenance of the 40-foot Philadelphia to the Sea navigation channel
- 1996 Opinion: Maintenance Dredging Operations within USACE's Philadelphia District

The 2017 Opinion included an analysis of the projects' effects on designated Atlantic sturgeon

critical habitat, as we published the final rule in the Federal Register on August 17, 2017 (82 FR 39160; effective date: September 18, 2017). We reinitiated this consultation in 2018 and issued a new biological opinion on December 10, 2018. In 2019, USACE informed us that they needed a fifth season using explosives to remove additional rock pinnacles in the navigation channel that could not be removed with dredging equipment. We again reinitiated the consultation based on the USACE proposal to conduct additional blasting that was not considered in the 2018 biological opinion. On November 22, 2019, we issued the last biological opinion on the deepening and maintenance of the Philadelphia to the Sea Federal Navigation Project (FNP), the Philadelphia to Trenton FNP, and the DMU study. The biological opinion considered the deepening blasting, the associated sturgeon relocation trawling proposed to be conducted during the winter of 2019 and 2020, and 50 years of maintenance dredging (2020 to 2070) of the two FNPs.

The 2019 biological opinion concluded that the proposed action may adversely affect, but is not likely to jeopardize the continued existence of the shortnose sturgeon, the GOM, NYB, CB, and SA DPSs of Atlantic sturgeon, Kemp's ridley sea turtles, and loggerhead sea turtles. The biological opinion concluded that the proposed project was not likely to adversely affect Atlantic sturgeon from the Carolina DPS, green sea turtles, or leatherback sea turtles. We also determined that the proposed action is not likely to adversely affect critical habitat designated for the NYB DPS of Atlantic sturgeon.

Although listed whales occur seasonally off the Atlantic coast of Delaware and right whales occasionally transit near the mouth of the Delaware Bay, we determined that no listed whales are known to occur within the maintenance dredging action area. Therefore, the biological opinion did not discuss impacts to listed whale species.

Delaware River Philadelphia to Trenton Maintenance Dredging Program

The Philadelphia to Trenton Federal Navigation Project (FNP) is upstream of the site of the proposed Port. The USACE maintains to -12 m (-40 ft) depth the Delaware River Navigation Channel from Allegheny Avenue in Philadelphia (RKM 176.9/RM 110) to Newbold Island in Bucks County (RKM 191.3/RM 119), north of Philadelphia. From there, the USACE maintains navigation channels of varying authorized depths to the upstream limit of the FNP (RKM 214.5/RM 133.3) just below the Penn-Central R.R. Bridge crossing over the Delaware River at Trenton, NJ. Dredging is completed by hydraulic dredging, bucket dredging, or hopper dredge and dredged material is transported to either Fort Mifflin or Palmyra Cove for containment.

Dredging of the Philadelphia to Trenton project has resulted in shortnose sturgeon mortality. In mid-March 1996, three fresh shortnose sturgeon were found in a dredge discharge pool on Money Island, near Newbold Island, Burlington County, NJ. The dead sturgeon were found on the side of the spill area into which the hydraulic pipeline dredge was pumping. In January 1998, three shortnose sturgeon were discovered in the hydraulic maintenance dredge spoil in the

Florence to Trenton section of the upper Delaware River. These fish also appeared to have been alive and in good condition prior to entrainment (NMFS 2015). The entrainment of shortnose sturgeon in the cutterhead dredge occurred during dredging in or near aggregation areas during winter. Since 1998, the USACE has been avoiding dredging in the overwintering area during the time of year when shortnose sturgeon are present. The biological opinions for the Philadelphia to Trenton FNP as well as the subsequent consolidated biological opinions have required observation of the dredge spoils during hydraulic cutterhead dredging, and the USACE has not reported additional take of sturgeon from this project.

Since the 2015 biological opinion, maintenance dredging of the -12 m (-40 ft) Philadelphia to Trenton channel has resulted in three Atlantic sturgeon (dead) and one shortnose sturgeon (dead). All of the sturgeon takes occurred during hopper dredging.

Philadelphia to the Sea FNP Deepening and Maintenance

As reported in the 2015 Biological Opinion, the Delaware River Stem and Main Channel Deepening Project began in March 2010. The USACE completed the deepening of the channel from -12 m to -13.7 m (-40 ft to -45 ft) in 2020. Maintenance dredging of the -12 m (-40 ft) channel has occurred since the 1970s until completion of the deepening in 2020. The 2019 biological opinion for the Delaware River FNPs covers 50 years of maintenance dredging of the -13.7 m (-45 ft) channel. River reaches from AA to E divide the Philadelphia to the Sea FNP. Reach E is the downstream end of the channel in the Delaware Bay that starts at RKM 5 (RM 3) and the uppermost reach, Reach AA, ends at Allegheny Avenue in Philadelphia (RKM 176.9/RM 110) (Figure 27).



Figure 27. Delaware River main channel deepening project

The Philadelphia to the Sea Deepening

Prior to completion of the deepening project, the USACE maintained the channel at a depth of 12m (40 ft) at mean low low water (MLLW). Only portions of the channel that were between 12 m and 13.7 m (40 ft and 45 ft) MLW were dredged for the deepening project. Explosives were used to deepen the channel in Reach B (Marcus Hook and Chester Ranges) where rock and hard substrate precluded dredging. Blasting occurred over five consecutive winters from 2015 to 2020. Relocation trawling for sturgeon occurred three weeks prior to blasting and during blasting. Relocation trawling consisted of trawling the blasting area and transport all sturgeon caught upriver near Trenton, NJ, where they were released.

The surface area of the Delaware estuary from the Ben Franklin Bridge to the capes (excluding tidal tributaries) is approximately 1,813 square kilometers (700 square miles). The Philadelphia to the Sea Federal Navigation Channel has a surface area of 39.6 square kilometers (15.3 square miles), or approximately 2.2 percent of the total estuary surface area, of which 22 square kilometers (8.5 square miles) has been dredged to 13.7 m (45 ft).

The Philadelphia to the Sea Maintenance Dredging

The USACE has maintained the Philadelphia to the Sea Channel at 13.7 m (45 ft) since the completion of the deepening in 2020. Maintenance dredging in the river typically occurs between August and December using a hydraulic cutterhead dredge. A federally owned hopper dredge, other large hopper dredges, and hydraulic cutterhead dredges are also used. Material excavated from the river is placed in existing upland CDFs located along the Delaware River or in the open water disposal site Buoy 10 in the Delaware Bay (NMFS 2019). Table 12 and 13 show the frequency of maintenance dredging, expected volume dredged, and the periods when dredging can occur for each reach of the Philadelphia to the Sea FNP.

Table 12. Philadelphia to the Sea proposed maintenance activities, methods, and dates (NMFS 2019).

Activity	Channel Reach/ Location	River miles & (RKM)	Duration (mo.)	Dredge Frequency	Dredge Depth/ Width	Vol. (CY)	Type of Dredge/ Equipment	Disposal location (if applic- able)	Scheduled Dates
Maintenance dredging	A-B (Allegheny Ave., Philly to Burlington Island)	109.93-118.87 (176.9-191.3)	1-3	Annual	40' deep; 400' wide	100,000-200,000	Hopper, Cutter-head, or Mechanical	Palmyra Cove, Burlington Island, Money Island, Biles Island, Ft. Mifflin	June 1 – March 15
Maintenance dredging	A-B (Burlington Island to Newbold Island, Bucks)	118.87-126.88 (191.3-204.2)	1-3	2-3 year cycle	40' deep; 400' wide	700,000	Cutterhead or Mechanical	Money Island, Biles Island	July 1 – March 15 (Mechanical); July 1 – December 31 (Cutterhead)

Activity	Channel Reach/ Location	River miles & (RKM)	Duration (mo.)	Dredge Frequency	Dredge Depth/ Width	Vol. (CY)	Type of Dredge/ Equipment	Disposal location (if applicable)	Scheduled Dates
	County)								
Maintenance dredging	B-C (Newbold Island to Trenton Marine Terminal)	128.66-132.06 (207.1-212.5)	10-20 days	3-5 years	25' deep; 300' wide	150,000	Cutterhead or Mechanical	Money Island, Biles Island	July 1 – March 15 (Mechanical); July 1 – December 31 (Cutterhead)
Maintenance dredging	C-D	132.07-133.29 (212.5-214.5)	1-3	Not routinely maintained	12' deep; 20' wide	<100,000	Cutterhead or Mechanical	Money Island, Biles Island	Oct. 1 – March 15
Maintenance dredging	Fairless Turning Basin	126.88 (204.2)	1	2 year cycle	40'	200,000	Cutterhead	Money Island	July 1 – March 15

Table 13. Philadelphia to the Sea proposed maintenance activities, methods, and dates (NMFS 2019). Shaded row indicates the reach where the Project Area of this consultation is located.

Activity	Channel Reach/ Location	River miles & (RKM)	Duration (mo.)	Dredge Frequency	Dredge Depth/ Width	Vol. (CY)	Type of Dredge/ Equipment	Disposal location (if applicable)	Scheduled Dates
Maintenance dredging	E	5-41 (8-66)	2-3	Annual	45'	400,000	Hopper	Buoy 10	All Year
Maintenance dredging	D	41.1-55 (66.1-88.5)	2-3	3-Year Cycle	45'	1,000,000	Hopper & Cutterhead	Artificial Island CDF	All Year
Maintenance dredging	C	55.1-67 (88.7-107.8)	2-3	Annual	45'	2,000,000	Cutterhead & Hopper	Killcohook and Pedrick-town CDFs	All Year
Maintenance dredging	B	67.1-85 (108-136.8)	2-3	Annual	45'	2,700,000	Hopper & Cutterhead Suction & Mechanical	Oldmans and Pedrick-town CDFs	July 1 – March 15
Maintenance dredging	A	85.1-97 (137-156.1)	2-3	5-Year Cycle	45'	200,000	Mechanical & Hopper & Cutterhead	National Park & Fort Mifflin CDFs	July 1 - March 15
Maintenance dredging	AA	97.1-102 (156.3-164.2)	2-3	5-Year Cycle	45'	450,000	Mechanical & Hopper	National Park & Fort Mifflin CDFs	July 1 – March 15

Summary of 2019 Biological Opinion ITS

The 2019 biological opinion concluded that the proposed action has the potential to result in the mortality of shortnose sturgeon and individuals from the NY Bight, Gulf of Maine, Chesapeake Bay and South Atlantic DPSs of Atlantic sturgeon due to entrainment in hopper or cutterhead dredges, entrapment in mechanical dredges, relocation trawling, and blasting activities. In the

biological opinion, we concluded that the proposed project may affect but is not likely to adversely affect critical habitat designated for Atlantic sturgeon. We estimated that, on average, one sturgeon of either species will interact with a hopper dredge for every 2,496,000 cy of material dredged. In the 2019 biological opinion, we determined that the anticipated take is not likely to jeopardize the continued existence of listed species. The biological opinion exempts take incidental to the implementation of the proposed project as follows:

- The lethal take of eight adult or juvenile sturgeon during blasting and relocation trawling in 2019 and 2020. Of the eight, an undetermined fraction will be shortnose sturgeon and an undetermined fraction will be Atlantic sturgeon NYB DPS.
- The lethal take of up to 13 sturgeon takes as a consequence of handling stress and relocation of sturgeon, any combination of adult and/or juvenile shortnose and juvenile Atlantic sturgeon (NYB DPS).
- The lethal take by dredging entrainment/entrapment of up to 116 juvenile and/or adult sturgeon of which all or a fraction will be shortnose sturgeon or Atlantic sturgeon (i.e., an undetermined fraction will be shortnose sturgeon and an undetermined fraction will be Atlantic sturgeon). This take will occur during maintenance dredging from Trenton to the Sea over the next 50 years or until 2070.
- Of the 116 sturgeon killed, incidental take of up to 67 Atlantic sturgeon NY Bight DPS.
- Of the 116 sturgeon killed, incidental take of up to 21 Atlantic sturgeon Chesapeake Bay DPS.
- Of the 116 sturgeon killed, incidental take of up to 20 Atlantic sturgeon South Atlantic DPS.
- Of the 116 sturgeon killed, incidental take of up to 8 Atlantic sturgeon Gulf of Maine DPS.
- Lethal take of an unquantified number of post yolk-sac Atlantic sturgeon NY Bight DPS larvae.

The incidental take statement (ITS) also exempts the capture/collection of up to 1,663 sturgeon (any combination of NYB DPS Atlantic sturgeon and shortnose sturgeon) during relocation trawling project carried out over the blasting season (December 1, 2019-March 15, 2020). Of the 1,663, 100 sturgeon may be injured from surgery to install acoustic tags (any combination of NYB DPS Atlantic sturgeon and shortnose sturgeon).

Salem and Hope Creek Generating Stations (CENAP-OP-2006-6232)

PSEG Nuclear operates two nuclear power plants pursuant to licenses issued by the U.S. Nuclear Regulatory Commission (NRC). These facilities are the Salem and Hope Creek Generating Stations (Salem and HCGS), which are located on adjacent sites within a 740-acre parcel of property at the southern end of Artificial Island in Lower Alloways Creek Township, Salem County, NJ. Salem Unit 1 is authorized to operate until 2036 and Salem Unit 2 until 2040. Hope Creek is authorized to operate until 2046 (NMFS 2015).

Consultation pursuant to Section 7 of the ESA between NRC and NMFS on the effects of the operation of these facilities has been ongoing since 1979. NMFS completed consultation with NRC in 2014 and issued a biological opinion considering the effects of operations under the renewed operating licenses (issued in 2011). In that biological opinion (NMFS 2014), we concluded that the continued operation of the Salem 1, Salem 2 and Hope Creek Nuclear Generating Stations through the duration of extended operating licenses may adversely affect, but is not likely to jeopardize, the continued existence of any listed species. In 2020, we reinitiated consultation between NRC and NMFS on the effects of the operation of these facilities, and the consultation is ongoing. Therefore, we rely on the ITS of the 2014 biological opinion.

As described in Table 14 through Table 17 below, the ITS of the Salem and Hope Creek Generation Stations 2014 biological opinion exempts take (injured, killed, capture or collected) of 26 shortnose sturgeon, 500 Atlantic sturgeon, and 5 loggerhead, 1 green, and 2 Kemp’s ridley sea turtles resulting from the operation of the cooling water system. The ITS also exempts the capture of one live shortnose sturgeon and one live Atlantic sturgeon (originating from any of the five DPSs) during gillnet sampling associated with the Radiological Environmental Monitoring Program for either Salem 1, Salem 2, or Hope Creek. We did not identify any ESA-listed whale species within the Salem and HCGS action area (NMFS 2014).

As explained in the 2014 biological opinion, we estimated that the continuation of the bottom trawl survey will result in the non-lethal capture of 9 shortnose sturgeon, 11 Atlantic sturgeon (6 New York Bight, 2 Chesapeake Bay, and 3 South Atlantic, Gulf of Maine or Carolina DPS) and 5 sea turtles (4 loggerheads and 1 Kemp’s ridley or green). We also expected the beach seine survey to result in the non-lethal capture of one Atlantic sturgeon (likely NYB DPS origin) and one shortnose sturgeon. The ITS exempts this amount of take (“capture” or “collect”) of live shortnose sturgeon, Atlantic sturgeon and sea turtles incidentally captured during these surveys.

Table 14. Salem and HCGS - Impingement or Collection of Shortnose Sturgeon at the Trash Bars.

Salem Unit 1	Salem Unit 2	Total Unit 1 and 2
12 (10 dead, 5 due to impingement)	14 (12 dead, 6 due to impingement)	26 (22 dead, 11 due to impingement)

Table 15. Salem and HCGS - Impingement or Collection of Atlantic Sturgeon at the Trash Bars.

Age Class and DPS	Salem Unit 1	Salem Unit 2	Total Unit 1 and 2
All age classes and DPSs combined	92 (28 dead, 8 due to impingement)	108 (33 dead, 10 due to impingement)	200 (61 dead, 18 due to impingement)
Juveniles (NYB DPS)	88 (27 dead, 7 due to impingement)	104 (32 dead, 9 due to impingement)	192 (59 dead, 16 due to impingement)
Subadult or adult TOTAL:	4 (1 dead due to impingement)	4 (1 dead due to impingement)	8 (2 dead due to impingement)
Sub adult or adult NYB DPS	3 (1 dead due to impingement)	3 (1 due to impingement)	6 (2 dead due to impingement)
Sub adult or adult CB DPS Subadult or adult SA DPS Subadult or adult GOM DPS Subadult or adult Carolina DPS	1 dead or alive from either the CB, SA, GOM or Carolina DPS	1 dead or alive from either the CB, SA, GOM and/or Carolina DPS	Total of 2 from the CB, SA, GOM and/or Carolina DPS

Table 16. Salem and HCGS - Impingement/Collection of Atlantic Sturgeon at the Traveling Screens.

DPS	Salem Unit 1	Salem Unit 2	Total Units 1 and 2
NYB DPS	138 (12 injury or mortality)	162 (14 injury or mortality)	300 (26 injury or mortality)

Table 17. Salem and HCGS - Impingement/Collection of Sea Turtles at the Trash Bars.

Sea Turtle Species	Salem Unit 1	Salem Unit 2
Loggerhead	4 (1 dead)	5 (1 dead)
Green	One at Unit 1 or Unit 2 (alive or dead)	
Kemp's Ridley	2 (1 dead)	2 (dead)

Delaware River Partners (DRP) Marine Terminal

On December 8, 2017, we issued a biological opinion to the USACE for the development by the Delaware River Partners, LLC (DRP) of a multiuse deep-water seaport and international logistics center (DRP Port) on a portion of the former Dupont Repauno Property in Gibbstown, NJ at RKM 139/RM86.5 (NMFS 2017a). The biological opinion considered the consequences of vessel traffic that would travel between the Pilot Area at the mouth of the Delaware River and the DRP Port. Thus, the action area for the DRP Port overlaps with the action area for this consultation even though the DRP Port is outside the action area for this consultation.

The proposed multiuse terminal will support automobile import and processing, perishables and bulk cargo handling, and bulk energy liquid products storage and handling. The development included dredging of an approach channel for vessels up to 265 m (870 ft) and 9 to 12 m (30 to 40 ft) deep draft, two berths with mooring dolphins, an auto terminal, a cargo area, facilities for

bulk liquid energy storage, and warehouses. Estimated vessel traffic is 133 one-way vessel trips per year. Of these, the USACE considered 91 vessel calls as new vessels to the Delaware River and the remaining 41 Roll On/Roll Off (RoRo) vessel calls to be vessels diverted and redistributed from existing terminals. Since vessel strikes are a stressor associated with vessel traffic, we determined that vessel traffic between the Pilot Boarding area at the mouth of the Delaware Bay and the proposed terminal was effect of the proposed action. Thus, the action area for this consultation overlaps with the action area for the DRP port from RKM 86/RM 53.5 to the end of the Federal Navigation Channel, the precautionary area, the connecting channel, and the pilot area.

In the biological opinion for the DRP Port, we concluded that construction activities were not likely to adversely affect listed species or result in the destruction or adverse modification of critical habitat. However, based on the best science available at the time, we did determine that the transit of RoRo vessels interrelated to operation of the terminal will entrain and kill up to six adult sturgeon during the 30 years of terminal operation (until 2047)²⁰. Four of these are likely to belong to the NYB DPS, one to CB DPS, and one from either SA DPS or GOM DPS²¹. We also determined that it is likely that RoRo vessels transiting the Delaware River during 30 years of terminal operation would result in the vessel strike mortality of one adult shortnose sturgeon. However, we concluded that these effects would not jeopardize the continued existence of these species. We concurred that the effects of the construction and operations of the facility were not likely to adversely affect listed sea turtles and whales.

On September 26, 2019, USACE sent us a request for reinitiation of consultation and a biological assessment for the development of a second dock (Dock 2) that can handle two vessels simultaneously. The applicant proposed to change operations of Dock 1 from RoRo cargo to on/off loading of liquid energy products and to construct an additional dock specifically to be used to trans-load liquid energy products to two vessels simultaneously (allowing three vessels to be in port at any given time). Based on these changes, USACE informed us that they had determined that the proposed modifications would not change the number of vessels using the terminal (the existing dock and proposed dock combined) because handling of liquefied energy

²⁰ In May 2022, we received guidance from the Northeast Fisheries Science Center that, although our general analytical approach for the vessel traffic analysis applied in prior consultations was sound, certain improvements should be made, including incorporating the findings of a recent study by Fox et al. (2020) into the vessel strike rate analysis used to inform the amount of anticipated take of Atlantic sturgeon. Fox et al. (2020) estimated Atlantic sturgeon carcass reporting rates for the Delaware River and Estuary. This study was specifically designed to estimate Atlantic sturgeon carcass reporting rates in the Delaware River while accounting for temporal and spatial differences. Applying the reporting rates from Fox et al. (2020) results in 43 takes of Atlantic sturgeon over 30 years or 1.4 per year. To ensure that this Opinion fully complies with the analytical requirements of the ESA, including the requirement to use the best available scientific information, we will apply the updated take estimates for Atlantic sturgeon derived from the study by Fox et al. (2020) to the Environmental Baseline.

²¹ The Northeast Fisheries Science Center also provided updated guidance on the mixed stock analysis rates. The updated rates are as follows: NYB 42%; CB 24%; SA 20%; and GOM 13%. Based on this new guidance, the updated rates for DRP are as follows: NYB 18; CB 10 (rounded down from 10.3); SA 9 (rounded up from 8.6); and GOM 6 (rounded up from 5.6).

products requires a substantially longer docking time per vessel. However, because the construction of the additional dock included dredging of 45 acres of river bottom and the placement of numerous steel piles in the river, the USACE determined that the modifications would result in effects that were not considered in the previous biological opinion.

Combined, the dredging and use of the former and proposed access channels and berths will affect approximately 72 acres of benthic habitat and fauna. The proposed construction of the new wharf included pile driving of 280 24-inch to 48-inch steel piles and added another season of driving of piles. The proposed new dock will have an over-water footprint of 3.2 acres that added to the footprint of the wharf considered in the previous consultation. However, since the number of new vessel calls would not change, the USACE determined that the proposed modification to the project would not result in additional adverse effects to what were considered previously and that the proposed project was not likely to adversely affect (NLAA) listed species. On November 19, 2019, we issued a letter where we concurred with the USACD NLAA determination.

NJ Wind Port

On February 28, 2022, we issued a biological opinion to the USACE for the development by the Public Service Enterprise Group (PSEG) of a marshalling facility in support of offshore wind projects in NJ and other U.S. East Coast states. The Port will serve as a location where major offshore wind components are delivered (from manufacturing centers), partially assembled prior to loading onto an installation vessel/barge, and shipped (vertically) to an offshore wind site. The proposed Port is located on the east bank of the Delaware River within the greater estuary at approximately RKM 84 (RM 52), 24 km (15 mi) south of the Delaware Memorial Bridge. The Port will be constructed at the northwestern edge of the existing 734-acre PSEG property, which is the site of two power generation facilities, Salem Generating Station and Hope Creek Generating Station.²² The proposed Port will occupy approximately 30 acres of the PSEG property, immediately to the south of USACE CDF Cell No. 3. The project site lies between the NJ shoreline and the Philadelphia to the Sea Federal Navigation Channel (Figure 28), located approximately 2,000 m (6,600 ft) west of the shoreline and maintained at approximately 13.7 m (45 ft) depth. The Artificial Island anchorage, General Anchorage No. 2, is located off the northern edge of Artificial Island, approximately 6 km (3.7 mi) upriver from the proposed Port.

²² PSEG's Salem and Hope Creek Nuclear Generating Stations operate pursuant to licenses issued by the Nuclear Regulatory Commission. Incidental take of ESA-listed species as a result of these operations is exempted from Section 9 of the Endangered Species Act by an Incidental Take Statement (NER-2010-6581) issued by NMFS following the conclusion of formal ESA consultation on July 17, 2014. The Incidental Take Statement exempts take resulting from impingement or collection of sturgeon and sea turtles at the cooling water intake structure and from collection during routine biological monitoring. As a result of exceedances of the exempted take, formal consultation was reinitiated by the Nuclear Regulatory Commission on July 2, 2020 with the submission of a new BA for continued operation of Salem Generating Station (NRC 2020). Consultation is currently ongoing.

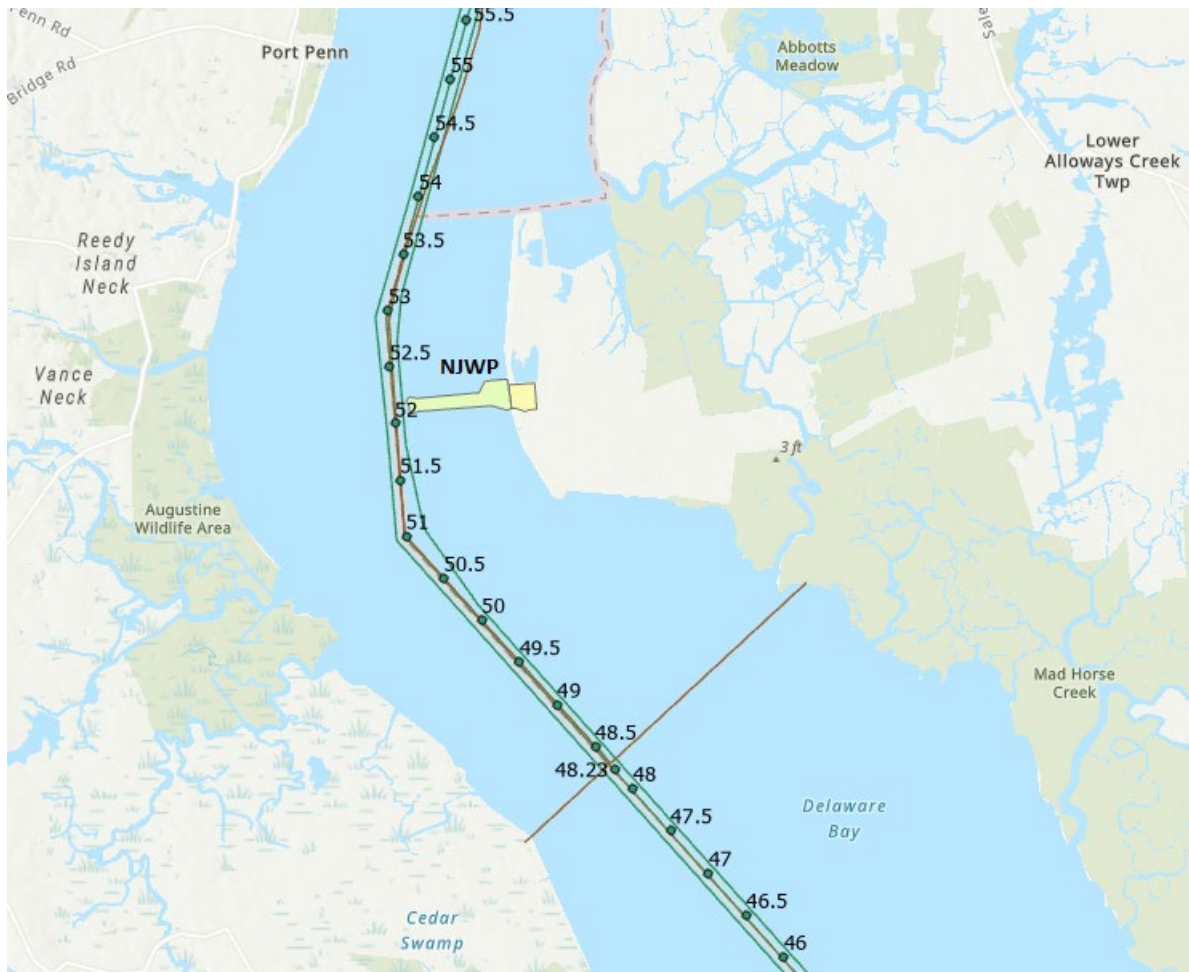


Figure 28. NJ Wind Port Development Boundary. The line across the channel is the location of the Delaware River mouth.

In the biological opinion, we concluded that the proposed action may adversely affect, but is not likely to jeopardize the continued existence of the shortnose sturgeon, the GOM, NYB, CB, and SA DPSs of Atlantic sturgeon. We concurred that the effects of the construction and operations of the facility were not likely to adversely affect listed sea turtles and whales. In addition, we concluded that the proposed action may adversely affect, but is not likely to adversely modify or destroy critical habitat designated for the NY Bight DPS of Atlantic sturgeon. We determined that the proposed action has the potential to result in the mortality of shortnose sturgeon and NYB Atlantic sturgeon from entrainment in a cutterhead dredge and by vessel strike from construction vessels. We also anticipate that the long-term operation of the NJWP will cause vessel strikes of Atlantic sturgeon NYB, GOM, CB, and SA DPSs as well as shortnose sturgeon. We expect cutterhead dredging to kill up to two (2) sturgeon. These may be two juvenile shortnose sturgeon, two juvenile NYB DPS Atlantic sturgeon, or one of each. In addition, we

expect that sturgeon interacting with construction vessels during construction of the NJWP will result in the mortality of one (1) shortnose sturgeon and one (1) Atlantic sturgeon. The shortnose sturgeon may be a juvenile or an adult. The Atlantic sturgeon will be either a juvenile or an adult of the NYB DPS. Finally, we expect up to 39 lethal vessel strikes over the operational life of the NJ Wind Port Development ²³. Of these:

- Up to 4 shortnose sturgeon juveniles, adults, or mix of the two
- Up to 7 juvenile Atlantic sturgeon from NYB DPS
- Up to 16 adult Atlantic sturgeon from NYB DPS
- Up to 5 adult Atlantic sturgeon from CB DPS
- Up to 5 adult Atlantic sturgeon from SA DPS
- Up to 2 adult Atlantic sturgeon from GOM DPS²⁴

Edgemoor Container Port

On March 30, 2022, we issued a biological opinion to the USACE for the development by the Diamond State Port Corporation (DSPC) of a new shipping container port facility on a site formerly occupied by the Chemours (DuPont) Edge Moor Plant along the Delaware River in Edgemoor, New Castle County, Delaware. The re-development would convert the property into a multi-user containerized cargo port capable of accepting New Panamax cargo ships. The proposed Port will be located at 4600 Hay Road in the Edgemoor section of unincorporated New Castle County, Delaware, along the eastern shore of the Delaware River. Latitude/Longitude: 39.74825° N/75.496028° W (NAD 83) and approximately from RKM 117 to RKM 118 (RM 72.5 to RM 73.3).

In the biological opinion, we concluded that the proposed action may adversely affect, but is not likely to jeopardize the continued existence of the shortnose sturgeon, the GOM, NYB, CB, and SA DPSs of Atlantic sturgeon. We concurred that the effects of the construction and operation of the facility were not likely to adversely affect listed sea turtles and whales. In addition, we concluded that the proposed action may adversely affect, but is not likely to adversely modify or

²³ In May 2022, we received guidance from the Northeast Fisheries Science Center that, although our general analytical approach for the vessel traffic analysis applied in prior consultations was sound, certain improvements should be made, including incorporating the findings of a recent study by Fox et al. (2020) into the vessel strike rate analysis used to inform the amount of anticipated take of Atlantic sturgeon. Fox et al. (2020) estimated Atlantic sturgeon carcass reporting rates for the Delaware River and Estuary. This study was specifically designed to estimate Atlantic sturgeon carcass reporting rates in the Delaware River while accounting for temporal and spatial differences. Applying the reporting rates from Fox et al. (2020) results in 250 takes of Atlantic sturgeon over 25 years or 10 takes per year. To ensure that this Opinion fully complies with the analytical requirements of the ESA, including the requirement to use the best available scientific information, we will apply the updated take estimates for Atlantic sturgeon derived from the study by Fox et al. (2020) to the Environmental Baseline.

²⁴ The Northeast Fisheries Science Center also provided updated guidance on the mixed stock analysis rates. The updated rates are as follows: NYB 42%; CB 24%; SA 20%; and GOM 13%. Based on this new guidance, the updated rates for NJWP are as follows: NYB 15 (rounded up from 14.7); CB 8 (rounded down from 8.4); SA 7; and GOM 5 (rounded up from 4.5).

destroy critical habitat designated for the NY Bight DPS of Atlantic sturgeon. We determined that the proposed action has the potential to result in the mortality of shortnose sturgeon and NYB Atlantic sturgeon from entrainment in a cutterhead dredge and by vessel strike from construction vessels. We also anticipate that the long-term operation of the Port will cause vessel strikes of Atlantic sturgeon NYB, GOM, CB, and SA DPSs as well as shortnose sturgeon. We expect cutterhead dredging to kill up to three (3) sturgeon (no more than one per dredge cycle). These may be juvenile shortnose sturgeon or juvenile NYB DPS Atlantic sturgeon. In addition, we expect that sturgeon interacting with construction vessels during construction of the Port will result in the mortality of one (1) shortnose sturgeon and two (2) Atlantic sturgeon. The shortnose sturgeon may be a juvenile or an adult. The Atlantic sturgeon will be either juveniles or adults or one of each of the NYB DPS. Finally, we expect up to 54 lethal vessel strikes during operation of the Port²⁵. Of these:

- Up to 4 shortnose sturgeon juveniles, adults, or mix of the two
- Up to 10 juvenile Atlantic sturgeon from NYB DPS
- Up to 23 adult Atlantic sturgeon from NYB DPS
- Up to 7 adult Atlantic sturgeon from CB DPS
- Up to 7 adult Atlantic sturgeon from SA DPS
- Up to 3 adult Atlantic sturgeon from GOM DPS²⁶

Table 18. Comparison of Atlantic Sturgeon Takes from Hope Creek, Edgemoor, and DRP

Project	Life	Trips	Project Life Takes (Fox)	Project Life Takes (Balazik)	Annual Takes (Fox)	Annual Takes (Balazik)
Hope Creek	25	32,000	249.60	38.4 *	9.98	1.54
Edgemoor	50	35,400	276.12	42.48 *	5.52	0.85
DRP	30	5,460	42.59	6.55 *	1.42	0.22

Paulsboro Roll-on/Roll-off Berth

On July 19, 2022, we issued a biological opinion to the USACE for the development by the South Jersey Port Corporation (SJPC) of a Roll-on/Roll-off (RoRo) Berth in support of offshore

²⁵ In May 2022, we received guidance from the Northeast Fisheries Science Center that, although our general analytical approach for the vessel traffic analysis applied in prior consultations was sound, certain improvements should be made, including incorporating the findings of a recent study by Fox et al. (2020) and salvage data into the vessel strike rate analysis used to inform the amount of anticipated take of Atlantic sturgeon. Fox et al. (2020) estimated Atlantic sturgeon carcass reporting rates for the Delaware River and Estuary. This study was specifically designed to estimate Atlantic sturgeon carcass reporting rates in the Delaware River while accounting for temporal and spatial differences. Applying the reporting rates from Fox et al. (2020) results in 276 takes of Atlantic sturgeon over 50 years or 5.5 takes per year. To ensure that this Opinion fully complies with the analytical requirements of the ESA, including the requirement to use the best available scientific information, we will apply the updated take estimates for Atlantic sturgeon derived from the study by Fox et al. (2020) to the Environmental Baseline.

²⁶ The Northeast Fisheries Science Center also provided updated guidance on the mixed stock analysis rates. The updated rates are as follows: NYB 42%; CB 24%; SA 20%; and GOM 13%. Based on this new guidance, the updated rates for Edgemoor are as follows: NYB 21; CB 12; SA 10; and GOM 7 (rounded up from 6.5).

wind projects in New Jersey and other U.S. East Coast states at the existing and under-development Paulsboro deep-water import-export marine terminal. The Paulsboro Marine Terminal is adjacent to the Delaware River and Mantua Creek in the Borough of Paulsboro, Gloucester County, New Jersey, along the east bank of the Delaware River at approximately RKM 145 (RM 90).

We reinitiated consultation in 2023 and on November 7, 2023, we issued the biological opinion incorporating the Fox (2020) study into our analyses. We concluded that the proposed action may adversely affect, but is not likely to jeopardize the continued existence of the shortnose sturgeon, the Gulf of Maine, New York Bight, Chesapeake Bay, and South Atlantic DPSs of Atlantic sturgeon. We concurred that the consequences of the construction and operations of the facility were not likely to adversely affect listed sea turtles and whales. In addition, we concluded that the proposed action may affect, but is not likely to adversely affect critical habitat designated for the New York Bight DPS of Atlantic sturgeon. We determined that the long-term operation of the Berth will cause vessel strikes of Atlantic sturgeon New York Bight, Gulf of Maine, Chesapeake Bay, and South Atlantic DPSs as well as shortnose sturgeon. We expect up to 9 lethal vessel strikes over the operational life of the Berth²⁵. Of these:

- Up to 1 shortnose sturgeon juvenile or adult
- Up to 2 juvenile Atlantic sturgeon from NYB DPS
- Up to 2 adult and/or subadult Atlantic sturgeon from NYB DPS
- Up to 2 adult and/or subadult Atlantic sturgeon from CB DPS
- Up to 1 adult and/or subadult Atlantic sturgeon from SA DPS
- Up to 1 adult or subadult Atlantic sturgeon from GOM DPS

5.3.2 Upper and Lower NY Bay

NY and NJ Harbor Deepening Channel Improvements (HDCI) Navigation Study

On January 26, 2022, NMFS issued an Opinion that considered the consequences of the USACE's proposed channel deepening to the already completed 50 ft NY/NJ Harbor Deepening Project (HDP) under the newly authorized HDCI study. The project involves the initial deepening of several waterways including Kill Van Kull. The initial dredging and blasting events are expected to occur from 2025 through 2039. NMFS concluded that the proposed action may adversely affect, but was not likely to jeopardize the continued existence of listed species of the Northwest Atlantic DPS of loggerhead and Kemp's Ridley sea turtles and the five DPSs of Atlantic sturgeon. NMFS also concluded that the proposed action was not likely to adversely affect leatherback and the North Atlantic DPS green sea turtles; North Atlantic right or fin whales; and shortnose sturgeon. The 2022 Opinion included an ITS which exempted the lethal takes of either six loggerhead or five loggerhead and one Kemp's Ridley sea turtle and up to three lethal takes of Atlantic sturgeon (three from the NYB DPS or two from the NYB DPS and one from any of the other DPSs) during dredging. This project has not started yet.

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, NJ (NMFS 2002). The permit authorized sand mining activities every year for a period of 10 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 10 year duration of the permit. On July 23, 2012, the USACE started coordination to reinstate 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. In 2016, the USACE then issued a new 10 year permit for this project to the new applicant Weeks Marine/North American Aggregates without completing an ESA consultation with us. We notified the USACE on October 24, 2023, that this project is currently not covered under an ESA consultation. To date, no takes of listed species have been recorded.

Arthur Kill Terminal

On October 21, 2024, NMFS issued an Opinion that considered the consequences of the MARAD's proposed funding for construction of port infrastructure on the Arthur Kill. The USACE participated in the consultation as a co-agency and issued a permit for construction of port infrastructure under their permitting process. The applicant, Arthur Kill Terminal LLC, proposed to construct a new port facility along the Arthur Kill waterfront in the Charleston area of southwestern Staten Island, NY to support offshore wind projects in the NY Bight and off the East Coast of the United States. NMFS concluded that the proposed action may adversely affect, but was not likely to jeopardize the continued existence of listed species of the Northwest Atlantic DPS of loggerhead, Kemp's ridley sea turtles, leatherback sea turtles, North Atlantic DPS green sea turtle, and the five DPSs of Atlantic sturgeon. NMFS also concluded that the proposed action was not likely to adversely affect North Atlantic right or fin whales and shortnose sturgeon. Over the two year construction and 20 year life of the Terminal, the 2024 Opinion exempted the lethal take due to vessel strikes during construction, mitigation (sea turtles only), and operation of the Terminal of two NY Bight DPS Atlantic sturgeon, 61 Northwest Atlantic DPS loggerhead sea turtles, one North Atlantic DPS green sea turtle, six leatherback sea turtles, and six Kemp's ridley sea turtles. To date, no takes of listed species have been recorded.

Empire Wind Offshore Energy

On September 8, 2023, NMFS issued an Opinion that considered the consequences of BOEM's proposed construction, operation, maintenance, and decommissioning of the Empire Wind Offshore Energy project (Lease OCS-A 0512) and the connected action at South Brooklyn Marine Terminal (SBMT). The project involves the construction of a commercial-scale offshore wind energy facility within Lease Area OCS-A 0512 that would generate up to approximately 2,076 megawatts (MW) and consist of 147 wind turbine generators, two offshore substations,

and associated inter-array cabling as well as export cabling to bring electricity to land. This project would be located in the NY Wind Energy Area offshore of the action area, but there would be vessels transiting from SBMT and the Hudson River through the action area in NY Harbor to deliver the parts for the construction of the facility. Construction and installation of the wind projects and cables is anticipated to occur between 2023 and 2027. The entire project will include the construction, operation, maintenance, and decommissioning of the wind facility which is expected to last for 39 years. Due to the "Temporary Withdrawal of All Areas on the Outer Continental Shelf from Offshore Wind Leasing and Review of the Federal Government's Leasing and Permitting Practices for Wind Projects" Executive Order, work on this project has been halted.

NMFS concluded that the proposed action may adversely affect, but was not likely to jeopardize the continued existence of listed species of fin, sei, sperm, or North Atlantic right whales or the Northwest Atlantic DPS of loggerhead sea turtles, North Atlantic DPS of green sea turtles, leatherback sea turtles, or Kemp's ridley sea turtles, or any of the five DPSs of Atlantic sturgeon. NMFS also concluded that the proposed action was not likely to adversely affect blue whales, shortnose sturgeon, giant manta rays, hawksbill sea turtles, or oceanic whitetip sharks. The 2023 Opinion included an ITS which exempted the serious injury or mortality take from vessel strikes over the 39 years for one green, three Kemp's ridley, four leatherback, and 22 loggerhead sea turtles. For the eight-year duration of the planned trawl survey, the Opinions also exempts the capture/minor injury take of one Atlantic sturgeon from the Gulf of Maine DPS, 15 from the NY Bight DPS, six from the Chesapeake Bay DPS, four from the South Atlantic DPS, two from the Carolina DPS, one green sea turtle, two Kemp's ridley sea turtles, and three loggerhead sea turtles. Lastly from pile driving, the Opinion exempts injury (PTS) take due to exposure to impact pile driving noise for six fin whales, and harassment (TTS behavior) take for 22 North Atlantic right whales, 190 fin whales, five sei whales, six sperm whales, one green sea turtle, nine Kemp's ridley sea turtles, two leatherback sea turtles, and 96 loggerhead sea turtles. To date, no takes of listed species have been recorded.

U.S. FWS Funded State Fisheries Surveys

The U.S. FWS Region 5 provides an annual apportionment of funds to 13 Northeast states and the District of Columbia under the Dingell-Johnson Sport Fish Restoration Grant program and State Wildlife Grant programs. 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, NY, NJ, Pennsylvania, Delaware, Maryland, Virginia) and the District of Columbia carry out numerous 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 last completed an opinion on this grant program in September 2023 (NMFS 2023c). 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 2023 to 2027 will result in the capture of:

- Up to 37 sea turtles (all in bottom trawl studies)
- Up to 25 loggerhead sea turtles,
- Up to eight Kemp's ridley sea turtles,
- Up to three green sea turtles, and
- Up to one leatherback sea turtle;
- Up to 577 Atlantic sturgeon (including two in beach/haul seine studies, 407 in bottom trawl studies, one interaction during electrofishing activities, five in pound net surveys, and 162 in gillnet studies); and
- Up to 54 shortnose sturgeon (including eight in beach/haul seine studies, one in the Westfield River fish passage facility, nine in bottom trawl studies, two in gillnet studies, and 34 interactions during electrofishing activities).

We anticipate two shortnose sturgeon and 12 Atlantic sturgeon mortalities during gillnet surveys carried out by NY, Maryland, and Virginia. Of those mortalities, ten are anticipated to be from the CB DPS with the other two from the NYB DPS. In 2023, no ESA-listed species mortalities were reported by U.S. FWS or their state grantees.

NEFSC Fisheries and Ecosystem Research

In June 2023, we completed a programmatic Opinion (NMFS 2023d) on all fisheries and ecosystem research activities to be conducted and funded by the NEFSC from 2021-2026, inclusive of handling and sampling activities on ESA-listed species by the NEFSC's observer programs. 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 (up to ten lethal);
- up to 95 Kemp's ridley sea turtles (up to 15 lethal);
- up to 10 North Atlantic DPS of green sea turtles (up to one lethal);
- up to 10 leatherback sea turtles (up to five lethal);
- up to 10 shortnose sturgeon (up to one lethal);
- up to 595 Atlantic sturgeon (up to 30 lethal)
 - up to 425 from the NYB DPS (up to 21 lethal),
 - up to 64 from the CB DPS (up to three lethal),

- up to 52 from the GOM DPS (up to three lethal),
- up to 33 from the SA DPS (up to two lethal),
- up to 15 from the Carolina DPS (up to one lethal), and
- up to six Canadian origin (non-listed).

In addition, we estimated the number of animals to be handled and sampled by the NEFSC's observer programs from 2023 through 2026 to be as follows:

- up to 124 NWA DPS loggerhead sea turtles (none lethal);
- up to 40 Kemp's ridley sea turtles (none lethal);
- up to eight North Atlantic DPS green sea turtles (none lethal);
- up to eight leatherback sea turtles (none lethal);
- up to one shortnose sturgeon (none lethal);
- up to 1,240 Atlantic sturgeon (none lethal);
- up to 885 from the NY Bight DPS,
- up to 133 from the Chesapeake Bay DPS,
- up to 108 from the Gulf of Maine DPS,
- up to 70 from the South Atlantic DPS,
- up to 32 from the Carolina DPS,
- up to 12 Canadian origin (non-listed).

USGS Fisheries Telemetry in East Coast Rivers

On March 6, 2024, NMFS issued an Opinion that considered the consequences of USGS's proposed telemetry and scientific collection project using gillnets, electrofishing, and angling to collect shad in the Delaware Bay, Delaware River, and Connecticut River from March 2024 to May 2034. We anticipate the minor and recoverable injury of no more than one sturgeon, either one shortnose sturgeon or one Atlantic sturgeon (NY Bight DPS) per year due to exposure to the electric current. We did not anticipate any mortality; therefore, no lethal take was exempted.

5.4 Federal Actions that have Undergone Informal Consultations

Several federally authorized private projects in the Delaware River and in NY and NJ waters have undergone informal consultation. These projects include dredging, construction (including pile driving), and vessel traffic associated with construction and operations of the new or modified port facilities discussed below. No interactions with ESA-listed sea turtles or sturgeon have been reported in association with any of these projects, nor has any take been authorized.

5.4.1 Consultations on Port and Terminal Constructions

Liberty Terminal (NAP-2016-00978-24)

In 2021, the USACE proposed to issue a Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) and Section 404 of the Clean Water Act (33 U.S.C. 1344) to Liberty Terminal at

Pennsauken Urban Renewal, LLC. The permit would allow the repair/rehabilitation of an existing dock facility to its intended purpose (i.e., loading of petroleum related product to land-based storage tanks) and bring the facility to modern working standards. In a letter dated September 2, 2021, we concurred with the USACE's determination that the proposed project may affect, but is not likely to adversely affect listed species under our jurisdiction or designated critical habitat.

The terminal is located in Pennsauken Township, Camden County, NJ at RKM 167 (RM 104). The proposed project included pile driving for construction of a new loading platform, mooring dolphins, and catwalks. The applicant did not propose dredging of the berth as the channel already is deep enough for vessels to dock at the landing platform. The proposed project also included increasing the pipe diameter of two outfalls and placing protective riprap to protect the shoreline from scouring.

The applicant anticipated up to 120 tug-supported barges annually calling at the terminal during operation of the terminal. No more than one barge would be moored at any one time. According to the USACE, the applicant's marketing plan is based on attracting customers from other terminals in the area as the Liberty terminal will be a state of the art facility meeting or exceeding all terminal services provided by the existing old facilities and having the most up to date safety and emissions standards. The USACE concluded that the Liberty Terminal will be serving a portion of the refinery market that already uses the existing river traffic, and their operation would only replace a small fraction of this supply and demand. Therefore, the proposed project would not add vessels to the existing baseline as the need for transporting refinery products would occur irrespective of the proposed terminal.

Sunoco Marcus Hook Mariner East project (CENAP-OP-R-2013-0067-46)

The Sunoco Marcus Hook site is located in Marcus Hook, Delaware County, Pennsylvania at RKM 127 (RM 79), approximately 10 kilometers (6.3 mi) upstream of the proposed Port. The USACE issued a Public Notice on August 3, 2015 for the modification of the existing Dock IA to allow for the on-loading of ethane, butane, and propane to marine vessels in association with the Sunoco Partners Marketing & Terminals, L.P. - Marcus Hook Mariner East 1 project. The permit was issued on December 5, 2015, with work including the demolition of existing marine structures and construction of a new approach way, roadway and pipeline, pile-supported concrete deck platform, gangway/crane tower, six mooring dolphins, three breasting/mooring dolphins with fenders and concrete-filled pilings, and walkway, a concrete containment sump with associated sump pipes, re-ringing of existing breasting cells with new steel sheet piling, and installation of new piping systems on top of the pier, and the installation of structural and fender piles. No dredging would be required for this activity.

As stated in the Public Notice, a preliminary review of this application by USACE found that the proposed work may affect shortnose sturgeon and Atlantic sturgeon. No other ESA species were

identified in the Mariner East action area. In communication to us (August 12 through September 3, 2015), USACE determined that the project may affect, but is not likely to adversely affect, the shortnose or Atlantic sturgeon.

By letter dated October 1, 2015, we agreed with USACE's determination that the project was not likely to adversely affect and listed species in NMFS jurisdiction. In this letter, NMFS did not identify any ESA-listed sea turtles or whales within the Mariner East action area. In this letter, NMFS discussed the potential effects to listed species associated with habitat modification, piling driving, and vessel traffic.

The potential increased risk of vessel strike to sturgeon was considered as it relates vessel traffic associated with construction. We found that, because the use of the dock would be the same as its previous use, there would not be an increase in vessel traffic (NMFS 2015a). Because no increase in vessel traffic was expected, NMFS concluded that there would be no increased risk of vessel strike in the future.

Southport Marine Terminal (CENAP-OP-R-2009-0933)

The Southport Marine Terminal project is located at the eastern end of the Philadelphia Naval Business Center, formerly known as the Philadelphia Naval Shipyard, in the city and county of Philadelphia, Pennsylvania. The applicant, Philadelphia Regional Port Authority, proposed to construct a new marine terminal on approximately 116 acres of currently vacant land. In a letter dated March 21, 2013, we concurred with the USACE's determination that the proposed action was not likely to adversely affect any ESA listed species under our jurisdiction and that all effects to protected species were insignificant and discountable. The consultation considered the effects from the dredging of approximately 35 acres within the Delaware River, construction of a pile supported wharf, installation of 731.5 m (2,400 ft) of riprap along the Delaware River shoreline, filling of approximately 11 acres of aquatic habitat within the Delaware River, and the maintenance dredging of the berths with the removal of approximately 20,000 cy of material every two years. In addition, the consultation also considered the effects of vessels traveling between the port and the mouth of the Delaware Bay during operation of the port. The USACE and applicant anticipated that the port would receive 260 cargo vessel calls per year. The Section 10/404 Permit was issued by the USACE on April 16, 2013. However, in November 2016, the Philadelphia Regional Port Authority suspended the bid process for the vacant 195-acre Southport Marine Terminal Complex (Lloyd 2017). Instead of developing a new terminal facility, the Commonwealth of Pennsylvania invested \$93 million into landside development of an auto terminal at the site, including development of 155 paved acres and conversion of a former seaplane hangar into an automobile processing and detailing facility (Lloyd 2017). The development was completed in 2019. In late 2019, the USACE informed us that the applicant had requested an extension of the permit to allow for completion of the work as proposed in the original 2013 consultation. The USACE requested a reinitiation of the consultation to address effects to critical habitat designated for Atlantic sturgeon in 2017. Consequently, in a letter

dated January 22, 2020, we concurred with the USACE's determination that the proposed project may affect but is not likely to adversely affect critical habitat designated for Atlantic sturgeon.

On August 5, 2024, MARAD submitted a letter requesting NMFS concurrence with MARAD adopting the USACE consultation for the Southport Marine Terminal development project. After coordination with both MARAD and the USACE, USACE determined they would be the lead action agency for consultation with NMFS. The reinitiated consultation will consider the updated information on effects of vessels strike risk to sturgeon from vessels related to the Southport Marine Terminal operation. We have not received a request for reinitiation of consultation at this time.

Paulsboro Marine Terminal (CENAP-OP-R-2007-1125)

The Paulsboro Marine Terminal (PMT) is located in Paulsboro, Gloucester County, NJ at RKM 144 (RM 89.5). USACE issued a permit for the construction of the project in January 2011. The NJ Department of Environmental Protection issued their permit, including water quality certification and coastal zone management approval, on October 15, 2010. The PMT wharf will accommodate four berths and is expected to handle a variety of general cargo. Berths 1, 2 and 3 are designed to accommodate Handymax²⁷ class cargo vessels, which are typically 198 m (650 ft) long and 29 m (95 ft) wide. The fourth berth will be designated as a barge berth and is designed to accommodate a typical 122 m (400 ft) long by 30.5 m (100 ft) wide barge. A ship traffic modeling study was completed in September 2010 for the project. The model was used to assess the impact of the work load brought by PMT on the marine traffic in the Delaware River Main Channel. The results of the model show the expected increase in the daily number of vessels at seven locations within the Delaware River, once the Paulsboro terminal was operational. The predicted increase in daily counts at any location was consistently less than one and the 95% confidence interval was between 0.7 and 1. Using this model, USACE predicted that the construction and operation of the PMT would, on average, result in an increase of one additional ship in the Delaware River per day. In the 2010 consultation, the USACE determined that given the high volume of traffic on the river and the variability in traffic in any given day, the increase in traffic of one cargo vessel per day is negligible and that it is unlikely there would be any detectable increase in the risk of vessel strike to shortnose sturgeon, Atlantic sturgeon or sea turtles. Listed whales were not identified to be present within the PMT action area (which included the Philadelphia to the Sea Navigation Channel from the port to the mouth of the Delaware River) and therefore impacts to ESA-listed whale species were not discussed. In a letter dated July 25, 2011, we concurred with the USACE's determination that all effects to these species would be insignificant and discountable. Phase 1 of the project was completed. However, the permit expired and in 2018 the USACE requested reinitiation of the consultation to consider the effects of completing Phase 2 of the project on the listed Atlantic sturgeon and the designated critical habitat for Atlantic sturgeon. All dredging had been completed during Phase

²⁷ Handymax is a commonly occurring, general purpose bulk, oceangoing cargo ship at southern New Jersey ports. Typical Handymax ships are 650 feet long and 95 feet wide.

1 and the consultation only considered the effects of pile driving for the construction of wharf structures. On August 31, 2021, we issued a letter concurring with the determination by the USACE that the proposed project may affect but is not likely to adversely affect Atlantic sturgeon or Atlantic sturgeon critical habitat.

Salem River Federal Navigation Channel Maintenance Dredging and Beneficial Use
The USACE consulted in 2021 for 10-year maintenance dredging of the Salem River Federal Navigation Channel and reinitiated consultation in 2023. Maintenance dredging will occur within 4.2 miles of the Salem River Federal Navigation Channel from the Delaware River entrance channel to the Rt. 49 Bridge in Salem, NJ, which encompasses approximately 91 acres of soft subtidal bottom within the Delaware River and Salem River. The original project proposed dredging for a total of 7.2 acres (5,000 cy up to 30,000 cy per year). In 2023, the USACE proposed to modify the action to include a one-time increase to dredge 30 acres (up to 209,000 cy) at the mouth of the Salem River and beneficial placement at Goose Pond (209,000 cy) that occurred from July 2023 to March 2024. In subsequent years (2025 to 2032), maintenance dredging within the Salem River will occur on an as needed basis for annual small quantity dredging with a split hull hopper where placement of sand will occur at Oakwood Beach, and periodic large quantity dredging with a hydraulic cutterhead dredge where placement of sand and fine-grained sediments will occur at Goose Pond and/or Killchook CDF. The annual maintenance dredging from 2025 to 2032 is anticipated to impact up to 7.2 acres of bottom habitat per year, in quantities of 5,000 cy up to 30,000 cy dredged per year, and will include beneficial placement within the nearshore at Oakwood Beach. Periodic maintenance dredging of 20,000 to 300,000 cy of both sand and fine-grained materials within the channel would occur every 1 to 3 years and utilize Goose Pond, and/or disposal at the Killchook CDF disposal site. On March 10, 2023, we concurred with the determination by the USACE that the proposed project may affect but is not likely to adversely affect Atlantic sturgeon, shortnose sturgeon, or Atlantic sturgeon critical habitat.

5.4.2 Vessel Operations

Potential sources of adverse effects from federal vessel operations in the action area of this biological opinion include operations of the U.S. Navy (USN) and the U.S. Coast Guard (USCG) (which maintain the largest federal vessel fleets), the EPA, the National Oceanic and Atmospheric Administration (NOAA), and USACE. We have conducted formal consultations with the USCG, the USN, EPA and NOAA on their vessel operations. In addition to operation of USACE vessels, we have consulted with the USACE to provide recommended permit restrictions for operations of contract or private vessels around whales. Through the Section 7 process, where applicable, we have and will continue to establish conservation measures for all these agency vessel operations to avoid adverse effects to listed species. Refer to the biological opinions for the USCG (September 15, 1995; July 22, 1996; and June 8, 1998) and the USN (May 15, 1997) for detail on the scope of vessel operations for these agencies and conservation measures being implemented as standard operating procedures. No interactions with sturgeon or

sea turtles have been reported with any of the vessels considered in these biological opinions. The effects of vessels (private and commercial) in the action area are further considered in section 6.

5.4.3 Other Projects

We have completed several other informal consultations on effects of in-water construction activities in the action area permitted by the USACE. This includes several pier reconfiguration and maintenance dredging projects. No interactions with ESA-listed species have been reported in association with any of these projects.

We have also completed several informal consultations on effects of private dredging projects permitted by the USACE. All of the dredging was with a mechanical or cutterhead dredge. No interactions with ESA-listed species have been reported in association with any of these projects. On April 12, 2017, we completed an informal, programmatic consultation pursuant to Section 7 of the ESA, for six categories of projects regularly permitted, funded, or otherwise carried out by the USACE (the NLAA program). Proposed projects within these activity categories will be covered by the programmatic consultation provided they meet the project design criteria (PDC) that are outlined in this programmatic consultation. For any project USACE considered covered under the program, they will provide us with a form verifying that each PDC is met or a justification for why they believe that the project fits under the program even if some PDC are not met. If we agree with their determination that a project fits under the program, we sign the form, as our concurrence.

We have included several in-water construction activities in the action area permitted by the USACE under the NLAA program. These include dock and pier repairs, bank stabilization projects, aquaculture projects, and routine maintenance dredging activities. No interactions with ESA-listed species have been reported in association with any of these projects, nor has any take been authorized.

5.5 Scientific Studies

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. The following Section 10(a)(1)(A) permits are currently in effect for Atlantic sturgeon and shortnose sturgeon.

We searched for research permits on the NOAA Fisheries' online application system for Authorization and Permits for Protected Species (APPS) interactive website²⁸. The search criteria used confined our search to active permits that include take of sturgeon and sea turtles

²⁸ APPS website URL: <https://apps.nmfs.noaa.gov/index.cfm>

within the Delaware River and Bay as well as research in coastal waters off of NJ and NY.

There are currently five research permits pursuant to Section 10(a)(1)(A) of the ESA that authorize research of shortnose sturgeon in the Delaware River/Bay (Table 19), seven for Atlantic sturgeon in the Delaware River/Bay (Table 20), six for sea turtles in NY and NJ waters (Table 21), and for Atlantic sturgeon in NY and NJ waters (Table 22). 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 here only includes take authorized under section 10(a)(1)(A) of the ESA. Research projects may also include take authorized under other authority, 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 19. Shortnose sturgeon Section 10(a)(1)(A) permits within the Delaware River and Bay

Permittee	File #	Project	Area	Shortnose Sturgeon Takes	Research Timeframe
School of Marine and Atmospheric Sciences, Stony Brook University	20351	Atlantic and Shortnose Sturgeon Population Dynamics and Life History in NY and Coastal Marine and Riverine Waters	Marine aggregation areas located in NY, NJ, Delaware, and Connecticut waters. Riverine and estuarine areas of the Hudson and Delaware Rivers.	<u>Lethal</u> Incidental mortality - 1 Adult/Sub-adult ²⁹ - 1 Juvenile Direct mortality - 80 early life stages annually with no more than a total of 160 <u>Non-lethal</u> Gill net - 285 adults, 195 sub-adults, 195 juveniles, capture/handle/release, annually Trawl 285 adults, 195 sub-adults, 195 juveniles, capture/handle/release, annually	10 years, 02/27/2016 to 03/31/2027
Dewayne Fox, Assistant Professor, Delaware State University, Dept. of Agriculture and Natural Resources	20548	Reproduction, habitat use, and interbasin exchange of Atlantic and Shortnose Sturgeons in the mid-Atlantic	- Marine waters between Virginia and NY. - Delaware Bay and Delaware River and estuary. - Hudson River and estuary	<u>Lethal (annually)</u> Incidental mortality - 1 adult/sub-adult ³⁰ <u>Non-lethal (annually)</u> - 150 adult, capture/handle/release, in each of Delaware and Hudson Rivers	10 years, 03/31/2017 to 03/31/2027

²⁹ Although GARFO does not include the term “sub-adult” as a lifestage for shortnose sturgeon, the term is often used by researchers and managers to indicate larger and older shortnose sturgeon individuals that have not yet reached maturity (i.e. adult phase). The application for permit 20351 states the sub-adult lifestage to range from 1000–1300 mm FL, while GARFO considers shortnose sturgeon ranging from 140 to 450 mm (in the northern part of their range) to be juveniles and sturgeon greater than 450 mm are considered to be adults.

³⁰ For permit 20548, the applicant describes the shortnose sturgeon sub-adult phase as ranging from 450– 600 mm FL.

Permittee	File #	Project	Area	Shortnose Sturgeon Takes	Research Timeframe
				(Spawning Site Identification) - 100 adult, sub-adult from each of Delaware and Hudson Rivers (Hydroacoustic Assessment)	
Delaware Department of Natural Resources and Environmental Control	24020	Characterizing juvenile life stages of endangered Atlantic and Shortnose Sturgeon in the Delaware River and Estuary.		<u>Lethal</u> Incidental mortality - 1 adult (no more than 2 for 10 yr permit period) - 1 juvenile (no more than 2 for 10 yr permit period) <u>Non-lethal</u> - 10 adult - 65 juvenile	10 Years, 01/28/2021 to 01/31/2031
Normandeau Associates Inc.	28294	Investigating Atlantic and Shortnose Sturgeon at the egg, larval and juvenile lifestage in the Delaware River Estuary	Sampling sites would be located above the head of tide at 250RKM to the mouth of the Delaware Estuary with a majority of the sampling being in the tidal area of the Delaware River.	<u>Lethal:</u> 300 egg/larvae shortnose sturgeon 1 subadult/adult shortnose sturgeon 1 juvenile shortnose sturgeon <u>Non-lethal:</u> 265 juvenile shortnose sturgeon 25 subadult adult shortnose sturgeon	10 years, 12/11/2024 to 01/31/2035
Environmental Research and Consulting, Inc	25870	Application for a permit under the Endangered Species Act of 1973 to conduct scientific research on shortnose sturgeon (<i>Acipenser brevirostrum</i>) and Atlantic sturgeon (<i>Acipenser oxyrinchus oxyrinchus</i>) in the Delaware River and Estuary	Delaware River and Estuary / Delaware River and Estuary; mouth of Delaware Bay (river kilometer (rkm) 0) to rkm 245. Further tracking of sturgeon on spawning runs could occur in the Delaware River further upstream of rkm 245 should evidence indicate.	<u>Lethal:</u> 1 shortnose sturgeon annually <u>Non-lethal:</u> Annual research activities would include capturing a total of 330 adult (>600mm FL), subadult (450mm-600mm FL), and juvenile (< 450mm FL) shortnose sturgeon. Sub-sets of 30 adults/subadults and 30 juveniles annually, would be anesthetized and surgically implanted with acoustic transmitters. An additional sub-set of 20 shortnose sturgeon adults/subadults would be tethered in a nylon sock for hydroacoustic testing.	10 years, 02/08/2022 to 01/31/2032

Table 20. Atlantic sturgeon Section 10(a)(1)(A) permits within the Delaware River and Bay

Permittee	File #	Project	Area	Atlantic Sturgeon Takes	Research Timeframe
Northeast Fisheries Science Center	24387	Conservation engineering to reduce sea turtle and Atlantic sturgeon bycatch in fisheries in the Northeast Region	Fisheries Dependent Studies Locations: U.S. waters south of New Hampshire to the Virginia/North Carolina border	<u>Lethal:</u> Incidental mortality - 6 adult/subadult <u>Non-lethal:</u> - 173 adult/subadult	5 years, 06/23/2022 to 06/30/2027
NMFS Headquarters	24016	Chesapeake Bay Atlantic and shortnose sturgeon population dynamics, metapopulation analysis, and phenological assessment of	All freshwater and estuaries to the Chesapeake Bay and other coast-wide river systems, as well as along the off-shore Atlantic continental shelf (Atlantic Ocean)	<u>Non-lethal take within the action area:</u> -50 subadult/ adult -50 juvenile	10 years, 01/28/2021 to 01/31/2031

		reproductive ecology			
School of Marine and Atmospheric Sciences, Stony Brook University	20351	Atlantic and Shortnose Sturgeon Population Dynamics and Life History in NY Coastal, Marine, and Riverine Waters	Marine aggregation areas located in NY, NJ, Delaware, and Connecticut waters. Riverine and estuarine areas of the Hudson and Delaware Rivers.	<u>Lethal</u> Incidental mortality - 1 Adult/Sub-adult - 2 Juvenile Direct mortality - 80 early life stages annually with no more than a total of 160 Non-lethal Gill net - 71 adults, 352 sub-adults, 437 juveniles, 130 small juveniles, capture/handle/release, annually Trawl 71 adults, 352 sub-adults, 437 juveniles, 130 small juveniles, capture/handle/release, annually	10 years, 02/27/2016 to 03/31/2027
Dewayne Fox, Assistant Professor, Delaware State University, Dept. of Agriculture and Natural Resources	20548	Reproduction, habitat use, and interbasin exchange of Atlantic and Shortnose Sturgeons in the mid-Atlantic	- Marine waters between Virginia and NY. - Delaware Bay and Delaware River and estuary. - Hudson River and estuary	Lethal (annually) Direct mortality: - 150 early life stage from each of Delaware River and Hudson River Incidental mortality - 1 adult Non-lethal (annually) - 150 adult, capture/handle/release, in each of Delaware and Hudson Rivers (Spawning Site Identification) - 100 adult, sub-adult, and juvenile from each of Delaware and Hudson Rivers (Hydroacoustic Assessment) - 150 adults/sub-adults and/or juveniles, capture/handle/release, from Delaware River estuary, Bay, NJ near shore (Estuarine and Marine Foraging) - 300 adult and sub-adult and 150 juveniles, capture/handle/release (Coastal Sampling) - 300 early life stages from each of Delaware River and Hudson River, capture/handle/release (Spawning Site Identification)	10 years, 03/31/2017 to 03/31/2027
Delaware Department of Natural Resources and Environmental Control	24020	Characterizing juvenile life stages of endangered Atlantic and Shortnose Sturgeon in the Delaware River and Estuary.	Tidal portion of the Delaware River, with a majority of the sampling being completed in the Marcus Hook area (may be adjusted using telemetry data)	Lethal Incidental mortality - 1 adult/subadult (no more than 2 for 10 yr permit period) - 1 juvenile (no more than 2 for 10 yr permit period) Non-lethal - 10 adult/subadult - 340 juvenile	10 years, 01/28/2021 to 01/31/2031
Environmental Research and Consulting, Inc	25870	Application for a permit under the Endangered Species Act of 1973 to conduct scientific research on shortnose sturgeon (Acipenser	Delaware River and Estuary / Delaware River and Estuary; mouth of Delaware Bay (river kilometer (rkm) 0) to rkm 245. Further tracking of sturgeon on	Lethal: 1 Atlantic sturgeon annually Non-lethal: Annual research activities would include capturing a total of 330 subadult (1,000mm-1300mm FL) and juvenile (<1,000mm FL)	10 years, 02/08/2022 to 01/31/2032

		brevirostrum) and Atlantic sturgeon (<i>Acipenser oxyrinchus oxyrinchus</i>) in the Delaware River and Estuary	spawning runs could occur in the Delaware River further upstream of rkm 245 should evidence indicate.	Atlantic sturgeon annually, via gill net or trawl net. For Atlantic sturgeon, sub-sets of 30 juveniles and 30 subadults annually would be anesthetized and surgically implanted with acoustic transmitters. An additional sub-set of 20 subadult Atlantic sturgeon would be tethered in a nylon sock for remote hydroacoustic testing.	
Normandeau Associates Inc.	28294	Investigating Atlantic and Shortnose Sturgeon at the egg, larval and juvenile life stage in the Delaware River Estuary	Sampling sites would be located above the head of tide at 250RKM to the mouth of the Delaware Estuary with a majority of the sampling being in the tidal area of the Delaware River.	<u>Non-lethal:</u> 50 juvenile Atlantic sturgeon <u>Lethal:</u> 1 juvenile Atlantic sturgeon	10 years, 12/11/2024 to 01/31/2035

Table 21. Sea turtle section 10(a)(1)(A) permits within NJ and NY waters

Permittee	File #	Project	Area	Sea Turtle Takes	Research Timeframe
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 90 turtles annually (30 green, 30 Kemp's ridley, 30 loggerhead) would be captured, sampled, and tagged. Up to one leatherback sea turtle may be opportunistically captured, sampled, and tagged.	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	Atlantic Ocean (including bays, sounds and estuaries) / Atlantic Ocean (including bays, sounds and estuaries), from Maine through Florida, Puerto Rico, and US Virgin Islands.	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
NMFS Northeast Fisheries Science Center (NEFSC)	22218	Northeast Fisheries Science Center Sea Turtle Ecology Program	Northwest Atlantic Ocean and its estuarine and coastal environments /	Capture, sample, and tag 74 green, 90 Kemp's, 72 leatherback, and 115 loggerhead sea turtles, to harass 100 of each species (green, Kemp's,	10 years, 07/30/2019 to 09/30/2028

Permittee	File #	Project	Area	Sea Turtle Takes	Research Timeframe
			Northwest Atlantic Ocean and its estuarine and coastal environments. Area of interest includes the western portions of the Northwest Atlantic Ocean northward from the GA/FL state line.	leatherback, loggerhead, plus unidentified), and to import or receive samples from 500 animals.	
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>i.e.</i> , through failed capture attempts) 60 loggerheads, 60 leatherbacks, 45 Kemp's ridley, 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>i.e.</i> , videography and aerial survey).	10 years, 09/25/2020 to 09/30/2030
Northeast Fisheries Science Center	24387	Conservation engineering to reduce sea turtle and Atlantic sturgeon bycatch in fisheries in the Northeast Region	Fisheries Dependent Studies Locations: U.S. waters south of New Hampshire to the Virginia/North Carolina border	Sampling up to 51 loggerhead and 18 non-loggerhead sea turtles. Directly capture and sample up to 236 sea turtles during the course of studies.	5 years, 06/23/2022 to 06/30/2027
Northeast Fisheries Science Center	20197	Biological sampling of incidentally caught sea turtles, during commercial fishing operations, by Northeast Fisheries Science Center (NEFSC) certified observers	Fisheries Dependent Studies Locations: State waters and the Exclusive Economic Zone in the U.S. Northwest Atlantic Ocean	Capture under other authority of up to 50 loggerheads, 10 Kemp ridleys, 10 greens, 20 leatherback, and 20 unidentified sea turtles.	5 years, 09/23/2021 to 09/30/2026

Table 22. Atlantic sturgeon section 10(a)(1)(A) permits within NJ and NY waters

Permittee	File #	Project	Area	Atlantic Sturgeon Takes	Research Timeframe
School of Marine and Atmospheric Sciences, Stony Brook University	20351	Atlantic and Shortnose Sturgeon Population Dynamics and Life History in NY and Coastal Marine and Riverine Waters	Atlantic Ocean, Long Island Sound, Raritan Bay, Sandy Hook Bay, Delaware Bay / State and Federal marine and estuarine waters covering the continental shelf, Hudson River, Delaware River	Capture 1035 Atlantic sturgeon and 470 shortnose sturgeon	10 years, 02/27/2016 to 03/31/2027
Delaware State University	20548	Reproduction, habitat use, and inter-basin exchange of Atlantic and Shortnose Sturgeons in the mid-Atlantic	Nearshore marine waters extending out to the 50 fathom line between Cape Charles, VA and Montauk, NY including coastal waters of VA, Hudson River, Delaware River	A mix of sampling techniques including gillnets, D-ring nets, egg pad collectors, biotelemetry, and hydroacoustic tools targeting both Atlantic (n=1701) and Shortnose (n=501) sturgeons.	10 years, 03/31/2017 to 03/31/2027
Northeast Fisheries Science Center	24387	Conservation engineering to reduce sea turtle and Atlantic sturgeon bycatch in fisheries in the Northeast Region	Fisheries Dependent Studies Locations: U.S. waters south of New Hampshire to the Virginia/North Carolina border	Sampling up to 223 sturgeon incidentally taken in gillnet and trawl fisheries. Directly capture and sample up to 204 sturgeon during the course of studies.	5 years, 06/23/2022 to 06/30/2027

5.6 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 below in Table 23 and 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 Delaware, Pennsylvania, or NJ states fisheries. We have issued a permit to the Exelon Generating Company, LLC., for the withdrawal of water through the cooling intake. We issued a biological opinion for the permit on June 19, 2020 (NMFS 2020a).

Table 23. Atlantic sturgeon and shortnose sturgeon Section 10(a)(1)(B) permit within the action area.

Permittee	Permit #	Project	Area	Atlantic Sturgeon Takes	Timeframe
Exelon Generating Company, LLC	23148	Operation of Eddystone Generating Station	Delaware River from 64 meters upriver from Eddystone (on the western shore of the Delaware River) downriver to the mouth, its tributary Crum Creek, and marine waters from the mouth of the Delaware River to NY Harbor.	NY Bight DPS Atlantic sturgeon <u>Vessel Strike</u> : 1 over 10 years (sub-adults/adults) <u>Entrainment</u> : 27,000 larvae (2 age-1 equivalents) per year <u>Impingement</u> : 5 per year (YOY/sub-adults) <u>Total</u> : 1 sub-adult/adult, 270,000 larvae, and 50 YOY/sub-adults over 10 years Shortnose sturgeon <u>Impingement</u> : 5 per year (YOY/sub-adults) <u>Total</u> : 50 YOY/sub-adults over 10 years.	10 Years, 07/06/2020 to 7/31/2030

5.7 State or Private Actions in the Action Area

5.7.1 State Authorized Fisheries

The action area includes portions of Pennsylvania, Delaware, NY, and NJ state waters. Several fisheries for species not managed by a federal FMP occur in 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 2021). 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, Atlantic sturgeon, and shortnose 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 Murray 2008, 2009a, b, 2013, 2015a, b, 2018, 2020, 2021, 2023, Murray and Orphanides 2013, 2001, Warden 2011a, b) and Atlantic sturgeon (ASMFC 2017b, ASSRT 2007) 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. Atlantic sturgeon, as well as shortnose sturgeon, are vulnerable to capture in state-water fisheries occurring in rivers, such as shad fisheries. Gear types used in these fisheries include hook-and-line, gillnet, trawl, pound net and weir, pot/trap, seines, and channel nets among others. 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 2017a). 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. 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 by the Commission and the coastal states to assess the impacts of state authorized fisheries on sturgeon. Several states (including Delaware and NJ) are working on applications for ESA Section 10(a)(1)(B) incidental take permits to cover their fisheries; however, to date, no permit applications have been submitted to NMFS by states that authorize fisheries within the Delaware River/Bay³¹. Below, we discuss the different fisheries authorized by the states and any available information on interactions between these fisheries and sturgeon. Fisheries that use types of gear unlikely take sturgeon (i.e., "to harass, harm...wound, kill, trap, capture, or collect" (ESA Section 3 (19))), or where there is no documented interactions of the fishery with sturgeon (e.g., American eel, American lobster, whelk) are not included.

Atlantic croaker fishery

Atlantic croaker (*Micropogonias undulates*) occur in coastal waters from the Gulf of Maine to Argentina, and are one of the most abundant inshore bottom-dwelling fish along the U.S. Atlantic coast. Recreational fisheries for Atlantic croaker are likely to use hook and line; commercial fisheries targeting croaker primarily use otter trawls. An Atlantic croaker fishery using trawl and gillnet gear also occurs within the action area and is managed under an ASMFC Interstate Fisheries Management Plan (ISFMP) (including Amendment 1 in 2005 and Addendum 1 in 2010), but no specific management measures are required. Atlantic croaker are seasonally present in Delaware Bay; fishing occurs for this species in the Bay, but not in the river.

Atlantic sturgeon interactions have been observed in the Atlantic croaker fishery, but a quantitative assessment of the number of Atlantic sturgeon captured in the croaker fishery is not available. A mortality rate of Atlantic sturgeon in commercial trawls has been estimated at 5 percent. A review of the Northeast Fisheries Observer Program (NEFOP) database indicates that from 2006-2010, 60 Atlantic sturgeon (out of a total of 726 observed interactions) were captured during observed trips where the trip target was identified as croaker. This represents a minimum number of Atlantic sturgeon captured in the croaker fishery during this time period as it only considers trips that included a NEFOP observer onboard. Because the fishery occurs in the Bay,

³¹ A Section 10 (a)(1)(b) permit was issued to the State of Georgia (Permit No. 16645) on January 8, 2013, exempting the incidental take of shortnose sturgeon and Atlantic sturgeon (SA, Carolina and CB DPS) in the State shad fishery. A Section 10 (a)(1)(b) permit was issued to the State of North Carolina on July 9, 2014, to exempt incidental take of Atlantic sturgeon from all 5 DPSs in the North Carolina inshore gillnet fishery.

we do not anticipate any interactions with shortnose sturgeon.

Weakfish fishery

Weakfish are found from Nova Scotia to southeastern Florida, but are more common from NY 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), NY (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 NJ. 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 NY 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 2009b). These estimates encompassed both state and federal waters.

In our 2021 biological opinion for the authorization of multiple fisheries, we determined that it is extremely unlikely that the fisheries, including the weakfish fishery, considered in the biological opinion will interact with shortnose sturgeon. A quantitative assessment of the number of Atlantic sturgeon captured in the weakfish fishery is not available; however, 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).

Whelk/conch fishery

A whelk/conch fishery occurs in waters off Maine, Massachusetts, Connecticut, NY, NJ, 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, NY, NJ 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, NY, 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 America, Maryland, Virginia, and North Carolina harvesters execute 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 carried out 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 NY, 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 NJ 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 (Bjorndal 1997, Burke *et al.* 1993, Dodd 1988, 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.

Horseshoe crab fisheries occur in saline and marine waters and are unlikely to interact with shortnose sturgeon. Atlantic sturgeon are known to be caught in state water horseshoe crab fisheries using trawl gear (Stein *et al.* 2004b). With the exception of NJ 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 Atlantic States

Marine Fisheries Commission) 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. NJ 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, NY, 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 2012.³² 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).

American shad fishery

An American shad fishery occurs in state waters of New England and the Mid-Atlantic and is managed under the Commission’s ISFMP. Amendment 3 to the ISFMP requires states and jurisdictions to develop sustainable FMPs, which are reviewed and approved by the Commission’s Technical Committee, in order to maintain recreational and commercial shad fisheries (ASMFC 2010). In 2005, the directed at-sea fishery was closed and subsequent landings from the ocean are only from the bycatch fishery. In 2012, only one commercial fishing license was granted for shad in NJ. The fishery occurs in rivers and coastal ocean waters and uses five-inch mesh gillnets left overnight to soak. Based on the available information, there is little bycatch mortality.

Recreational shad fishing is currently allowed within the Delaware River with hook and line only; commercial fishing for shad occurs with gill nets, but only in Delaware Bay. Recreational hook and line shad fisheries are known to capture shortnose sturgeon and Atlantic sturgeon. Data from the Atlantic Coast Sturgeon Tagging Database (2000-2004) shows that the shad fishery accounted for 8% of Atlantic sturgeon recaptures. In the past, it was estimated that over 100 shortnose sturgeon were captured annually in shad fisheries in the Delaware River, with an unknown mortality rate (O’Herron and Able 1985). Nearly all captures occurred in the upper Delaware River, upstream of the action area. No recent estimates of captures or mortality of shortnose or Atlantic sturgeon are available. Shortnose and Atlantic sturgeon continue be exposed to the risk of interactions with this fishery; however, because increased controls have been placed on the shad fishery, impacts to shortnose and Atlantic sturgeon are likely less than

³² The program was terminated in February 2012, with the listing of Atlantic sturgeon under the ESA.

they were in the past. This fishery is not expected to interact with sea turtles (NMFS 2011b).

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, NJ (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 2011b). 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.

Several states have reported incidental catch of shortnose sturgeon and Atlantic sturgeon during striped bass fishing activities (NMFS (National Marine Fisheries Service) 2011). There are numerous reports of Atlantic sturgeon bycatch in recreational striped bass fishery along the south shore of Long Island, NY. Shortnose sturgeon and Atlantic sturgeon bycatch is occurring in the Delaware Bay and River, but little bycatch mortality has been reported. Unreported mortality may occur. 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).

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 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 and shortnose 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.

State gillnet fisheries

State gillnet fisheries might occur in 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. Based on gear type (i.e., gillnets), it is likely that shortnose sturgeon and Atlantic sturgeon would be vulnerable to capture in these fisheries. Bycatch of a few shortnose sturgeon in the commercial gillnet fishery for shad (fixed and drift gillnets) in the Delaware River has been reported (SSSRT 2010). The majority of reports of Atlantic sturgeon captures during the Atlantic sturgeon reward program have been in drift gillnets and pound nets.

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 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 (National Marine Fisheries Service) 2011). A majority (84 percent) of Atlantic sturgeon bycatch in otter trawls occurs at depths <20 m (<65.6 ft), with 90 percent occurring at depths of <30 m (<98.4 ft) (ASMFC (Atlantic States Marine Fisheries Commission) 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 m (>210 ft) (ASMFC (Atlantic States Marine Fisheries Commission) 2011), which is well below the depths at which most Atlantic sturgeon bycatch occurs. Since these fisheries occur in saline waters, it is highly unlikely that they will capture shortnose sturgeon. 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 and shortnose sturgeon have 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. In addition, almost every year in spring during the American shad fishing season in the Delaware River, the NJ Department of Fish and Wildlife receives reports from hook and line anglers of foul hooked and released shortnose sturgeon in the vicinity of spawning grounds (SSSRT 2010). NMFS also engages in educational outreach efforts on disentanglement, release, and handling and resuscitation of sturgeon.

5.8 Other Activities in the Action Area

5.8.1 Pollution

Anthropogenic sources of marine pollution, while difficult to attribute to a specific federal, state, local, or private action, may affect sea turtles, Atlantic sturgeon, and shortnose sturgeon 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, as well as impact prey items for sea turtles.

Non-point sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from urban and residential development, groundwater discharges, and industrial activities. Vessel traffic also contributes pollutants to the ecosystem. The Delaware Bay and River and NY Harbor hosts multiple commercial terminals and docks for recreational vessels. Consequently, the navigation channel supports a large number of commercial and private vessels. Routine discharges and fuel leaks from commercial and recreational vessels release hydrocarbon-based pollutants into the waters of the NY Bight.

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

identified surrogates for anadromous fish and sea turtles (NMFS 2017d).

Although difficult to evaluate the effects, it is possible that the presence of contaminants in the action area have adversely affected sturgeon abundance, reproductive success and survival. Several characteristics of sturgeon life history including long life span, extended residence in estuarine habitats, and being a benthic omnivore, predispose this species to experience bioaccumulation of toxins after long term, repeated exposure to environmental contaminants. (Dadswell 1979). Toxins introduced to the water column become associated with the benthos and can be particularly harmful to fish, such as sturgeon, that feed on benthic organisms (Varanasi 1992). Heavy metals and organochlorine compounds are known to accumulate in fat tissues of sturgeon, but their long-term effects are not yet known (Ruelle and Henry 1992, Ruelle and Keenlyne 1993). Available data suggest that early life stages of fish are more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976). Although data on the impacts of contaminants on sturgeon are limited, elevated levels of environmental contaminants, including chlorinated hydrocarbons, in several other fish species have been associated with reproductive impairment (Cameron *et al.* 1992, Longwell *et al.* 1992), reduced egg viability (Hansen and Pethon 1985, Mac and Edsall 1991, Von Westernhagen *et al.* 1981), and reduced survival of larval fish (Berlin *et al.* 1981, Giesy *et al.* 1986). Some researchers have speculated that PCBs may reduce the shortnose sturgeon's resistance to fin rot (Dovel *et al.* 1992).

Although there is scant information available on levels of contaminants in Atlantic sturgeon and shortnose sturgeon tissues, some research on other, related species indicates that concern about effects of contaminants on the health of sturgeon populations is warranted. Detectable levels of chlordane, DDE, DDT, and dieldrin, and elevated levels of PCBs, cadmium, mercury, and selenium were found in pallid sturgeon tissue from the Missouri River (US Fish and Wildlife Service 1993). These compounds may affect physiological processes and impede a fish's ability to withstand stress. PCBs are believed to adversely affect reproduction in pallid sturgeon (Ruelle and Keenlyne 1993). Ruelle and Henry (1992) found a strong correlation between fish weight $r = 0.91$, $p < 0.01$, fish fork length $r = 0.91$, $p < 0.01$, and DDE concentration in pallid sturgeon livers, indicating that DDE concentration increases proportionally with fish size. While no directed studies of chemical contamination in sturgeon in the Delaware River have been undertaken, it is evident that the heavy industrialization of the Delaware River is likely detrimentally impacting the Atlantic sturgeon and shortnose sturgeon populations and may also impact sea turtle populations downstream.

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

Mrosovsky *et al.* 2009, Nelms *et al.* 2015, 1990, Schuyler *et al.* 2014). 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.

5.8.2 Private and Commercial Vessel Operations

The action area is used by a variety of vessels ranging from small recreational fishing vessels to large commercial cargo ships. Commercial vessel traffic in the action area includes research, tug/barge, liquid tankers, cargo, military and search-and-rescue vessels, and commercial fishing vessels. These activities have the potential to result in lethal (through 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.

We have reports of vessel interactions with listed species from several rivers, estuaries, and bays. Published studies in scientific journals, state reporting programs, the NMFS salvage program and reports, personal communications, and news articles all provide information and data on sturgeon and sea turtle vessel interactions. Vessels may impact listed species through generalized disturbance of essential life behaviors, injury/mortality due to collisions, and through the degradation of habitat (PIANC 2008, Stoschek *et al.* 2014).

5.8.2.1 Vessel Activity within the Delaware River and Bay

The Delaware River is geographically and operationally one of the most significant waterways on the East Coast of the U.S. for port operations. Collectively, the Ports of Philadelphia, South Jersey, and Wilmington, DE represent one of the largest general cargo port complexes in the nation (Altiok *et al.* 2012). We have identified 11 major ports with over 39 terminals within the Delaware River. Cargo and tanker vessels calling at these ports travel within the action area in the Federal Navigation Channel. In addition, substantial vessel activity by tugs supporting vessels during docking and departure, as well as other port activities (e.g., maintenance dredging of berths and constructions), occur in the river. This vessel traffic overlaps with Atlantic sturgeon, shortnose sturgeon, and sea turtle distribution within the action area. A high volume of commercial traffic greatly increases the risk of vessel strikes (Fisher 2011, Simpson 2008). Further, high volume of vessel traffic increases the risk of oil spills and leakage (Delaware River and Bay Oil Spill Advisory Committee 2010), which may detrimentally impact Atlantic sturgeon critical habitat as well as individual sturgeon of both species, and sea turtles.

Given the high volume of vessels that occur in the Delaware River and Delaware Bay, shortnose sturgeon and Atlantic sturgeon are likely at highest risk of vessel strike in these portions of the action area. Similarly, sea turtles are at highest risk of vessel strike in the Delaware Bay. The following section describes vessel activity in the Delaware River, Delaware Bay, and the Federal Navigation Channel and summarizes the best available information on the risk of vessel strike to shortnose sturgeon, Atlantic sturgeon, and sea turtles.

The USACE publishes data on waterborne traffic movements involving the transport of goods on navigable waters of the U.S. (<https://www.iwr.usace.army.mil/About/Technical-Centers/WCSC-Waterborne-Commerce-Statistics-Center-2/WCSC-Waterborne-Commerce/>). The data includes both self-propelled and non-self-propelled vessels but does not include non-commercial vessels such as recreational vessels. Vessel movements are reported as “trips.” A trip is the movement of a vessel from a starting point to an end point. A vessel trip may be the loading of cargo on a vessel to the offloading site of the cargo or it may be the transport of the working crew to (or from) a work site (e.g., dredging site). Thus, one vessel may have multiple trips during a day as it loads and unloads cargo or transports crew back and forth to a work site. The data includes ferry movements, but movements of vessels exclusively engaged in construction (e.g., supporting a dredge) are not included. That said, the movements of supplies and materials to and from a construction site must be reported. Movements of tugs assisting large ships in channels and harbors traveling less than one mile are not reported. Movements of towboats engaged in fleeting activities less than one mile are also not reported. In the USACE Waterborne Commerce Data, trips are reported as the annual number of trips by vessels of a given draft within a waterway or section of waterway. For this Opinion, the waterway of interest is the Philadelphia to the Sea Federal Navigation Channel in the Delaware River, which includes the Philadelphia to the mouth of the Delaware Bay (Table 24 and 25).

Table 24. Annual self-propelled and non-self-propelled vessel trips from Philadelphia to the Sea. (USACE Waterborne Commerce data 2021).

Year	2013	2014	2015	2016	2017	2018	2019	Total
Vessel Trips	34,993	42,399	51,574	48,040	45,826	46,738	30,418	299,988

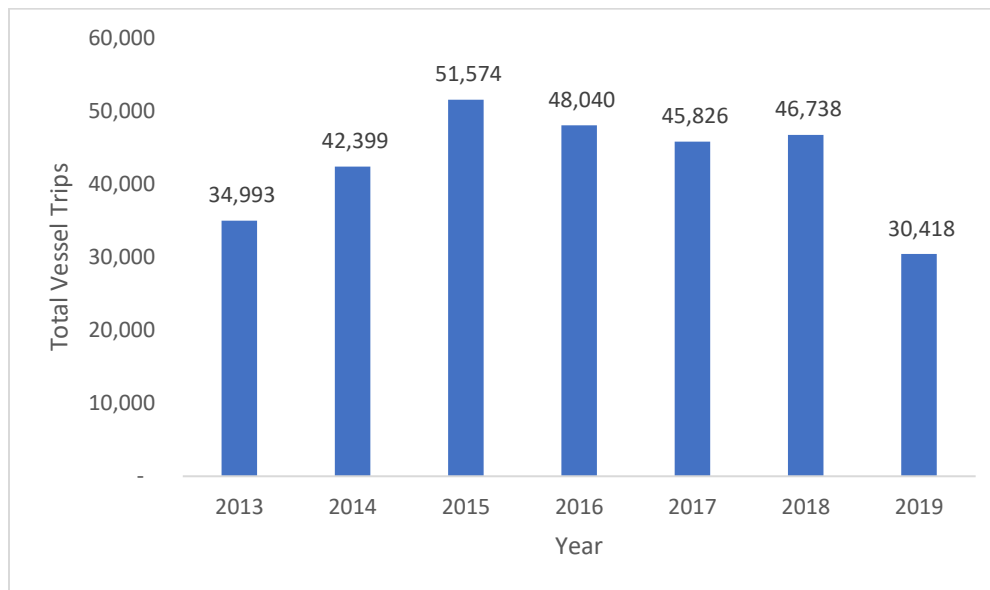
Table 25. Annual self-propelled vessel trips from Philadelphia to the Sea (USACE Waterborne Commerce Data).

Year	2013	2014	2015	2016	2017	2018	2019	Total
Vessel Trips	27,302	34,876	43,352	39,856	38,910	40,796	24,589	249,681

Our analysis includes data from Waterborne Commerce, spanning the years of 2013 to 2019. We used this data to characterize baseline vessel trips in the Philadelphia to the Sea Federal Navigation Channel. Vessel activity during this period in the Philadelphia to the Sea Federal Navigation Channel has varied with significant economic trends (Figure 29). The annual number of trips for all vessels (self-propelled and non-self-propelled, all drafts) in the Federal Navigation Channel from Philadelphia to the Sea ranged from 30,418 to 51,574 with a total of 299,988 vessel trips during the period from 2013 through 2019. Self-propelled vessels, such as tugboats, transport non-self-propelled vessels (e.g. barges, etc.). We consider the self-propelled vessel and the barge they transport as one vessel trip, not two. Therefore, only self-propelled vessels are

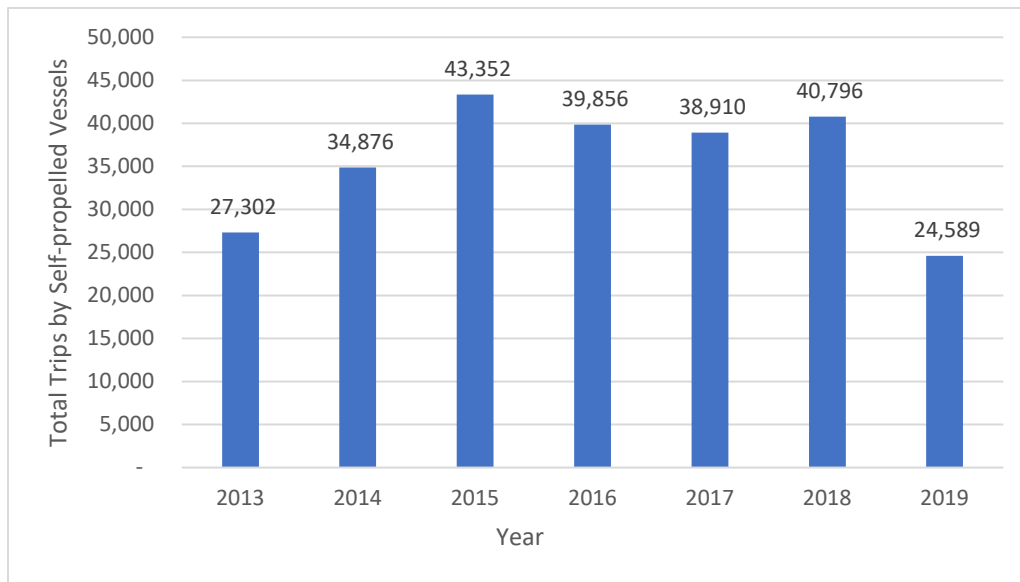
considered for the potential risk of vessel strike in this Opinion.

Figure 29. Annual number of vessel trips in the Philadelphia to the Sea Federal Navigation Channel (USACE Waterborne Commerce Data 2021).



The annual number of only self-propelled vessel trips ranged from 24,589 to 43,352 with a total of 249,681 trips over the period from 2013 to 2019 (Figure 30). Some research has suggested that large vessels with deep drafts providing little bottom clearance are likely to pose a greater risk of vessel strike than vessels with a draft that gives more bottom clearance because sturgeon tend to remain near the benthos for most of their time (Balazik *et al.* 2012d, Brown and Murphy 2010), however, given that sturgeon may migrate higher in the water column, we assume that the chance of vessel strike from a deep draft vessel is the same as a shallower draft vessel in our analysis. Given that the navigation channel is -45 ft MLLW, that a propeller may draw water from five to six meters below the hull (Maynord 2000), and that a sturgeon may swim a couple of meters above the bottom while moving between foraging spots; we expect that a vessel traveling in the navigation channel would need less than 25 ft of draft (i.e., 6 m or 20 ft clearance) to avoid interacting with a foraging sturgeon. However, during migration, sturgeon may occur in the water column at the same depth as the draft of a standard tugboat and, thereby, be exposed to the propeller of shallower draft vessels (Balazik *et al.* 2012d, Reine *et al.* 2014).

Figure 30. Annual number of Philadelphia to Sea vessel trips by self-propelled vessels (USACE Waterborne Commerce Data 2021).



These numbers represent the best available estimate of vessel traffic within the part of the action area that vessels will transit during operation of the Port. The estimate excludes recreational vessels, vessels not engaged in movement of cargo, and Department of Defense (DoD) vessels (i.e., USN, USCG, etc.). Therefore, this number likely underestimates the total annual vessel traffic within the action area. There is significant uncertainty in estimating the total amount of non-commercial vessel traffic in the action area. In general, recreational vessel traffic is expected to be seasonal with peak traffic occurring between the Memorial Day and Labor Day holidays (USCG 2012 as cited in NMFS 2017e).

5.8.2.1.1 Information on Sea Turtle Mortality Resulting from Vessel Strike in Delaware Bay and Lower Delaware River

Sea turtles are vulnerable to vessel strike, although the risk factors and areas of concern are different than sturgeon. As described above, self-propelled vessels, such as tugboats, transport non-self-propelled vessels (e.g. barges). Therefore, the self-propelled vessel and the barges they transport are considered one vessel trip and not two when calculating vessel strike risk to sea turtles in this Opinion.

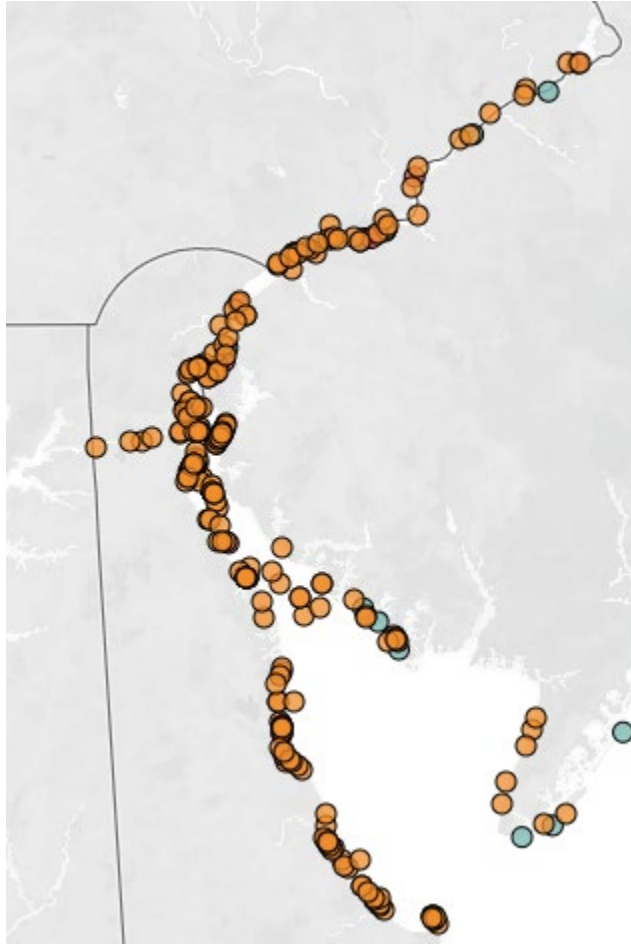
NMFS' STSSN database provides information on records of stranded sea turtles in the region. The STSSN database was queried for records of stranded sea turtles with evidence of vessel strike throughout the waters of Delaware Bay and lower Delaware River to overlap with the area where the majority of project vessel traffic will occur. Within Delaware Bay and the Lower Delaware River waters from 2013 to 2019, there were 77 records of sea turtles recovered with

either definitive evidence from vessel strikes or blunt force trauma, which indicates probable vessel collision. The majority of strikes and blunt force traumas were of loggerheads (n = 58) with a smaller number of leatherbacks (n = 1), Kemp's ridleys (n = 9), green (n = 4) turtles and five unknown species. A similar rate of strike is expected to continue in the action area over the life of the project and vessel strike will continue to be a source of mortality for sea turtles in the action area.

5.8.2.1.2 Information on Sturgeon Mortality Resulting from Vessel Strike in Delaware River and Bay

Published studies in scientific journals, state sturgeon reporting programs, the NMFS salvage program and reports, personal communications, and news articles provide information and data on sturgeon and vessel interactions. Sturgeon carcasses have been reported in all portions of the river from Trenton to the mouth of the river, as well as in all of the Delaware Bay (Figure 31). The following section summarizes the best available information on the risk of vessel strike to shortnose and Atlantic sturgeon.

Figure 31. Approximate locations of sturgeon carcasses reported from the Delaware River and Bay from 2005 to 2023.



Sturgeon vessel strike mortalities have been documented in the Delaware River and Bay and given that commercial traffic associated with ports in the Delaware River is high, incidence of strike may increase in the future. Brown and Murphy (2010) reported on 28 Atlantic sturgeon carcasses found in the Delaware River and Bay between 2005 and 2008 of which 14 mortalities were identified as the result of a vessel strike. The remaining fish were too decomposed to determine cause of death but the authors believed that the majority most likely died after interaction with vessels. Brown and Murphy (2010) reported that a majority of mortalities in the river were adult Atlantic sturgeon greater than 150 cm (5 ft) total length with 39 percent of the mortalities reported being juveniles. The majority (71 percent) of sturgeon carcasses showed signs of interaction with large commercial vessels with large propellers and deep draft (Brown and Murphy 2010). This corresponds to conclusions drawn from other rivers about the types of vessels interacting with sturgeon (Balazik *et al.* 2012d). Brown and Murphy (2010) found that vessel strikes predominantly occur between May through July and likely affect adults migrating through the river to spawning grounds (Brown and Murphy 2010).

We expect both deep draft and shallow draft vessels to potentially cause a strike based on the

behavior of the sturgeon. Sturgeon are present throughout the water column, close to the bottom when foraging and higher in the water column when migrating, thus, sturgeon may occur in the water column at the same depth as the draft of a standard tugboat and, thereby, be exposed to their propellers (Balazik *et al.* 2012d, Reine *et al.* 2014) or may be struck by a deep draft vessel while foraging at the bottom of the river.

Delaware Department of Natural Resources and Environmental Control (DNREC)

The DNREC Division of Fish and Wildlife initiated a reporting program in 2005, allowing the public to report sturgeon carcasses they find in the Delaware River and Bay (<https://dnrec.alpha.delaware.gov/fish-wildlife/fishing/sturgeon/>). When possible, a biologist from the state or a sturgeon researcher will visit the site to retrieve the carcass, make a species identification, and collect data. DNREC enters, and maintains the sturgeon carcass data in a MS Excel spreadsheet. We have included data from 2005 to 2023 in our analysis (data provided by Ian Park, DNREC, 2024).

The data does not represent a scientific or dedicated survey. All of the sturgeon mortalities are reported by interested citizens or directly by agency biologists who encountered the carcasses while conducting surveys on other species (personal communication, Ian Park, DNREC, 2017). Thus, while it represents the best available data, we cannot use the data to compare mortality rates between years. A lack of a population index for the Delaware River further makes it impossible to evaluate the number of reported carcasses relative to, for instance, yearly differences in vessel activity. Over the period from 2005 through 2023³³, the public and state employees reported 297 sturgeon carcasses (excluding Atlantic sturgeon carcasses from an experimental study). Of these, two were believed to be a duplicate of another entry in the DNREC, and 35 were reported from outside the Delaware River and Bay, leaving 260 carcasses observed within the Delaware River and Bay.

Of the 260 sturgeon carcasses reported within the Delaware River and Bay, 19 were identified as having died by other causes (some of these, e.g., entrapment in dredge, are included in discussions of mortalities caused by stressors other than vessel strike) and were excluded from the vessel traffic analysis. For the remaining 241 reported carcasses, DNREC staff had determined or indicated that vessel strike was the cause of death for 139 of the sturgeon. The cause of death was not determined or indicated for 102 of the carcasses, either because they were too decomposed when examined by state biologists or proper pictures were not provided (for carcasses not physically examined by a state biologist) to identify injuries. However, many of the decomposed carcasses had missing heads, tails, or consisted of a partial body, suggesting interaction with a large propeller. Of the 241 sturgeon reported from the Delaware River and Bay that had either been determined to be killed via vessel strike or whose cause of death was

³³ The data provided are the same as used by Brown and Murphy (2010) for the years 2005 through 2008. However, the data provided to us by DENRC includes an additional six reports of Atlantic sturgeon carcasses not included in Brown and Murphy (2010).

not determined, 220 were Atlantic sturgeon, 13 were shortnose sturgeon, and eight (8) were not identified to species (Table 26).

NJ Fish and Wildlife (NJFW)

The NJFW also has a public reporting program for sturgeon carcasses (https://www.nj.gov/dep/fgw/news/2013/sturgeon_reporting.htm). As with the DNREC data, the NJFW is not representative of a scientific or dedicated survey. A review in 2022 by the Northeast Fisheries Science Center (NEFSC) staff indicates that the NJFW data constitutes the best available information in addition to the DNREC data, and that the carcasses reported to NJFW should be added to the total carcasses reported to DNREC when evaluating the risk of vessel strike in our analysis. The NJFW has provided us with a spreadsheet that includes data for all carcasses reported along the shores and in waters within the boundaries of the state of New Jersey (i.e., they do not track carcasses found outside of state boundaries) from 2013 to 2023.

The NJFW spreadsheet contains 155 reported observations of sturgeon mortalities from New Jersey waters. In our review of the data, we determined that four of the reported carcasses from NJFW were either duplicates or included in the DNREC data and, therefore, excluded. Furthermore, several carcasses described as having been found along the shoreline of the Atlantic Ocean shoreline was likely misreported, as our review determined that the reported site of the carcasses was within the Delaware Bay. Thus, these were corrected to the Delaware Bay. After the correction, the NJFW spreadsheet includes data for 53 sturgeon mortalities reported from the Delaware River and Delaware Bay from 2013 to 2023.

NJFW staff did not determine the likely cause of death for the sturgeon reported to them. However, the spreadsheet includes comments for 39 of the 53 sturgeon carcasses reported from the Delaware River and Bay. Of these 39, two sturgeon were reported as being entrained in a hopper dredge operated by the USACE, ten were impinged on the trash rack at the cooling water intakes of the Salem Power Plants, and one was found fresh but with no visible sign of injury. These 13 are excluded from this vessel strike mortality analysis. Of the remaining 26, four comments mention interaction with a propeller as the likely cause of injury; 12 had descriptions of severed bodies and/or cuts consistent with an interaction with propellers; and the remaining ten comments did not include a description of injury. In all, excluding fish with known causes of death other than vessel strike, the NJFW spreadsheet contains data on 40 sturgeon carcasses from within the Delaware River and Bay. Of these 40, 27 were identified as Atlantic sturgeon, four (4) as shortnose sturgeon, and nine (9) were not identified to species (Table 26).

Table 26. Sturgeon carcass reports by data source. DNREC 2005 to 2019 records and NJFW 2013 to 2022 records.

The table shows the number of all sturgeon carcasses reported, number of all sturgeon carcasses reported within the Delaware River and Bay, and the number of carcasses reported within the

Delaware River and Bay by species. ALL = all mortalities, VESSEL AND UNKNOWN = cause of mortality either unknown or likely vessel strike.

SOURCE	REPORTED - TOTAL	DELAWARE RIVER & BAY (R & B): ALL	DELAWARE R&B: VESSEL & UNKNOWN	ATLANTIC: R & B VESSEL & UNKNOWN	SHORTNOSE: R & B VESSEL & UNKNOWN	UNKNOWN: R & B VESSEL & UNKNOWN
DNREC	297	260	241	220	13	8
NJFW	155	67	40	27	4	9
BOTH	452	327	281	247	17	17

When excluding known or likely causes of death other than vessel strike, the DNREC and NJFW spreadsheets include a total of 282 records of sturgeon carcasses in the Delaware River and Bay, of which 250 were identified as Atlantic sturgeon and 17 were identified as shortnose sturgeon (Table 26).

Adjusting the Number of Vessel Mortalities

Since it is unlikely that the public and other observers report all mortalities that occur in the Delaware River and Bay, we expect the actual number of sturgeon mortalities to be greater than the 233 reported and included in the overall dataset. In a study of sturgeon carcass observations on the James River (Virginia), Balazik *et al.* (2012d) found that monitoring in the James River documented about one-third of all vessel strike mortalities. However, the purpose of the study was to determine the likelihood of researchers finding carcasses during carcass surveys rather than opportunistic reporting rates. More recently, the Delaware State University, in partnership with the USFWS and DNREC, conducted a study to estimate opportunistic reporting rates of carcasses in the Delaware River and Bay (Fox *et al.* 2020). The estimated reporting rates varied from 2.0 (spring 2018) to 12.5 (summer and fall 2018) percent, with a reporting rate of 4.76 percent when they combined the data for all seasons over the two years (2018 and 2019) of the study. A 2022 review of these two studies by the NEFSC concluded that the Fox *et al.* (2020) study is the most appropriate to use for Delaware River biological opinions as it was specifically designed to estimate Atlantic sturgeon carcass reporting rates in the Delaware River. Therefore, in this Opinion, we will use the baseline vessel strike risk that the NEFSC calculated by using Fox *et al.* (2020) to adjust observed mortality. A more detailed discussion about the differences between these two studies and our reasoning for using Fox *et al.* (2020) was presented in the 2023 biological opinion issued for the reinitiated consultation for the proposed development of a port at Edgemoor, Pennsylvania (<https://doi.org/10.25923/b7zk-aa69>).

Considering that (Fox *et al.* 2020) represents the best available information for carcass reporting rates on the Delaware River and Bay, we used the combined reporting rate of 4.76 percent and the number of observed (i.e., reported) carcasses to estimate the actual (reported and non-reported) number of mortalities. However, the COVID pandemic in 2020 and 2021 likely

reduced reporting rates as restrictions on movements and public mingling were imposed. On the other hand, since the study by Fox *et al.* (2020), DNREC has updated its reporting website, simplified carcass reporting from mobile devices, and increased public outreach activities (Fox, per comm.). Therefore, it is likely that the reporting rate found by Fox *et al.* (2020) is not representative of the years since 2019 and should be used with caution when estimating vessel strikes during the last few years (Fox, pers comm.).

Table 27. Number of reported and adjusted Atlantic sturgeon carcasses within the Delaware River and Bay.

The shaded area shows years when data from DNREC and NJFW reports overlap. Adjusted numbers are calculated by dividing observed (reported) numbers by the reporting rate of 0.0476.

Year	DNREC	NJFW	Both	Adjusted
2005	7		7	147
2006	11		11	231
2007	6		6	126
2008	10		10	210
2009	5		5	126
2010	13		13	273
2011	19		19	462
2012	16		16	378
2013	22	0	22	525
2014	12	0	12	252
2015	9	1	10	294
2016	19	1	20	504
2017	9	2	11	315
2018	10	8	18	420
2019	13	6	19	462
2020	9	2	11	231
2021	8	2	10	231
2022	7	1	8	252
2023	15	4	19	462
All Years	220	27	247	5,903
2013-2023	133	27	160	3,950

Table 28. Number of reported and adjusted Atlantic sturgeon carcasses within the Delaware River and Bay.

The shaded area shows years when data from DNREC and NJFW reports overlap. Adjusted numbers are calculated by dividing observed (reported) numbers by the reporting rate of 0.0476.

Years	DNREC	NJFW	Both	Adjusted
2005	0	0	0	-
2006	0	0	0	-
2007	0	0	0	-
2008	0	0	0	-
2009	0	0	0	-
2010	0	0	0	-
2011	3	0	3	63
2012	2	0	2	42
2013	1	1	2	42
2014	0	0	0	0
2015	3	0	3	63
2016	2	2	4	84
2017	0	1	1	21
2018	0	0	0	-
2019	2	0	2	42
2020	0	0	0	-
2021	0	0	0	-
2022	0	0	0	-
2023	0	0	0	-
All Years	13	4	17	357
2013-2023	8	4	12	252

Atlantic Sturgeon Vessel Mortalities

For purposes of this Opinion, we assume that unknown mortalities were due to vessel strikes. This is reasonable since most reported sturgeon carcasses are adult, subadult, or larger juvenile Atlantic sturgeon, which have few natural predators, and most anthropogenic mortalities from other causes are reported as such (e.g., capture in a dredge). However, some anthropogenic mortalities may not be reported (e.g., sturgeon caught in fishing nets). With the exception of one sturgeon noted as caught in a gillnet and one as predated, none of the comments on individual records in the data indicate that something other than a vessel strike was the cause of death (e.g., presence of gillnet scars or entangled in fishing gear from state fisheries).

For the years from 2013 to 2019 (when we have data from both agencies and before the pandemic), the two datasets include 115 reports of Atlantic sturgeon carcasses within the Delaware River and Bay for which the cause of death was unknown or identified as a vessel strike. Using the 4.76 percent reporting rate from Fox *et al.* (2020), we estimate that the number of observed mortalities represents 2,416 actual Atlantic sturgeon mortalities within the river and bay. Assuming Atlantic sturgeon with unknown cause of death were vessel strike mortalities, the adjusted number of Atlantic sturgeon carcasses reported each year ranged from 210 (2015) to 462 (2013), with a median of 399 and an average of 345 mortalities per year.

Seasonal and Life Stage Distribution of Mortalities

The majority of Atlantic sturgeon mortalities in the Delaware River and Delaware Bay were reported during spring and early summer (Table 31). Fifty-two (52) percent of the Atlantic sturgeon vessel strike and unknown mortalities were reported during May and June. Eighty-nine percent (89%) were reported during the months from May through October. We expect more people to be on the river and bay during the warmer months, so the low number of reports during winter may be reflective of reduced public activity.

The NEFSC and GARFO reviewed sturgeon length data in the DNREC spreadsheet to determine the life stage of Atlantic sturgeon based on reported length measurements (Table 29).

Table 29. Guidance for the assignment of life stage to Atlantic sturgeon carcasses.

Stage	Minimum TL (cm)	Maximum TL (cm)
Adult	≥150	
Subadult	≥76	<150
Juvenile		<76

The DNREC spreadsheet has life stages assigned to 192 of the carcasses (unknown or vessel strike mortality) found in the Delaware River and Bay between 2005 and 2019. Upon review, NEFSC deferred to the biologists who had examined the carcasses to determine life stage and assumed that all carcasses assigned as adult Atlantic sturgeon in the spreadsheet were correct. However, except for nine carcasses reported as subadults, the DNREC spreadsheet did not distinguish between juvenile (pre-migration to the ocean) and subadult Atlantic sturgeon. A closer review of the reported total length or size of carcass segments suggests that many of those denoted as juvenile in the DNREC spreadsheet were likely subadult Atlantic sturgeon. However, several records in the spreadsheet reported TL or other length measurements but did not assign a life stage to them. Using the length guidance in Table 6, NEFSC and GARFO staff used best professional judgment to assign each fish as a juvenile or subadult life stage based on reported measurements and descriptions of each carcass in the comment section³⁴. In all, they assigned life stages to 192 of the Atlantic sturgeon carcasses (unknown or vessel strike mortality) found in the river (Table 30). The DNREC spreadsheet did not include life stage or length measurements that could be used to evaluate the life stage of 55 Atlantic sturgeon.

Table 30. Number and percentage of Atlantic sturgeon adult, subadult, and juvenile life stages.

Life Stage	Number	Percent
Adult	112	58.3%

³⁴ Generally, we determine whether a fish is juvenile or subadult based on behavior, rather than solely size, but given that behavior was unobserved in this dataset, we use size to determine life stage.

Subadult	55	28.7%
Juvenile	25	13.0%
All	192	100%

The majority (69 percent) of adult vessel mortalities were reported during May and June (Table 31). The number of reported adult carcasses has the same distribution (65 percent reported in May and June) when both vessel strike mortalities and unknown mortalities are included (Table 31). Substantially fewer subadult than adult carcasses are reported from the Delaware River and Bay. However, while subadult carcass reports also peak in May, reports of subadult carcasses continue to be relatively high through October (Table 31). The highest number (20) of reported carcasses (vessel strike and undetermined mortalities) of undetermined life stages was reported in May, but with seven carcasses reported in June, followed by a drop in numbers in July through September, and a small peak (9 carcasses) again in October. These 20 carcasses constitute 36 percent of the Atlantic sturgeon carcasses of unknown life stage (Table 31). That the carcasses of unknown life stage peak in May indicates that most of these individuals may be subadult or adult fish. In contrast to adults, juveniles were reported throughout the year, though with somewhat higher numbers during May through July.

Since some carcasses were mutilated and size was estimated from remains, it is possible that some of the sturgeon reported as adults were sub-adults and vice versa. In addition, the relatively higher percentage of sturgeon reported between spring and fall may be a result of less public activity along the river during winter. Still, despite seasonal bias in reporting rates and possible mischaracterization of life stage, the results agree with findings by others that the majority of Atlantic sturgeon mortalities are adults and that they are at high risk of vessel strike in spring when they move into the river (Balazik *et al.* 2012d, Brown and Murphy 2010, Fisher 2011). Together, this data shows that adults and subadults are at significant risk of being killed while migrating up rivers during the springtime. The reproductive value (an individual's expected contribution to population growth) for adult and subadult sturgeon is high for this long-lived species, with a very low mortality rate of older individuals and low reproductive success. Thus, vessel strike mortality may have a significant impact on the growth rate of Atlantic sturgeon populations.

Table 31. Number of Atlantic sturgeon vessel strike mortalities within the Delaware River and Bay each month over the years 2005 to 2019. Based on data provided by DNREC and NJFW. A = adult, SA = subadult, J = juvenile, Unk = unknown life stage.

MONTH	A	A%	SA	SA%	J	J%	UKN	UKN%	ALL	ALL%
January	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
February	0	0.0%	0	0.0%	0	0.0%	1	7.1%	1	0.8%
March	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
April	2	2.7%	2	6.1%	0	0.0%	2	14.3%	6	4.5%
May	30	40.0%	6	18.2%	0	0.0%	4	28.6%	40	30.1%

June	22	29.3%	9	27.3%	2	18.2%	1	7.1%	34	25.6%
July	5	6.7%	4	12.1%	5	45.5%	0	0.0%	14	10.5%
August	4	5.3%	5	15.2%	2	18.2%	0	0.0%	11	8.3%
September	3	4.0%	3	9.1%	0	0.0%	2	14.3%	8	6.0%
October	8	10.7%	3	9.1%	1	9.1%	4	28.6%	16	12.0%
November	1	1.3%	1	3.0%	0	0.0%	0	0.0%	2	1.5%
December	0	0.0%	0	0.0%	1	9.1%	0	0.0%	1	0.8%
ALL MONTHS	75	100%	33	100%	11	100%	14	100%	133	100%
May-June	52	69.3%	15	45.5%	2	18.2%	5	35.7%	74	55.6%
May-Oct	72	96.0%	30	90.9%	10	90.9%	11	78.6%	123	92.5%

Table 32. Number of both Atlantic sturgeon vessel strike and unknown mortalities within the Delaware River and Bay each month over the years 2005 to 2019. Based on data provided by DNREC and NJFW. A = adult, SA = subadult, J = juvenile, Unk = unknown life stage.

MONTH	A		SA		J		UNK	UNK%	ALL	ALL%
January	0	0.0%	1	1.8%	0	0.0%	0	0%	1	0.4%
February	1	0.9%	1	1.8%	0	0.0%	1	1.8%	3	1.2%
March	0	0.0%	1	1.8%	2	8.0%	0	0%	3	1.2%
April	3	2.7%	2	3.6%	1	4.0%	6	10.9%	12	4.9%
May	41	36.6%	11	20.0%	1	4.0%	20	36.4%	73	29.6%
June	32	28.6%	12	21.8%	5	20.0%	7	12.7%	56	22.7%
July	7	6.3%	6	10.9%	7	28.0%	3	5.5%	23	9.3%
August	7	6.3%	7	12.7%	3	12.0%	2	3.6%	19	7.7%
September	6	5.4%	5	9.1%	1	4.0%	4	7.3%	16	6.5%
October	13	11.6%	8	14.5%	2	8.0%	9	16.4%	32	13.0%
November	2	1.8%	1	1.8%	2	8.0%	1	1.8%	6	2.4%
December	0	0.0%	0	0.0%	1	4.0%	2	3.6%	3	1.2%
ALL MONTHS	112	100%	55	100%	25	100%	55	100%	247	100%
May-June	73	65.2%	23	41.8%	6	24.0%	27	49%	129	52%
May-Oct	106	94.6%	49	89.1%	19	76.0%	45	82%	219	89%

5.8.2.1.3 Atlantic Sturgeon Baseline Vessel Strike Risk

We calculate the risk of a vessel strike by dividing the number of suspected vessel mortalities during a given period by the number of vessel trips during the same period. This provides us with an estimate of vessel strike mortalities per vessel trip based on observed mortalities (M_o). However, since we expect that the number of observed mortalities is a fraction of actual mortalities within the Delaware River and Bay, we used the estimated reporting rate (4.76 percent) by Fox *et al.* (2020) to adjust the risk of vessel strikes by dividing M_o by the 4.76 percent reporting rate to produce an adjusted vessel strike risk (M_a). In previous consultations, we calculated the risk using vessel and sturgeon carcass data for the Delaware River from Trenton, NJ, to the mouth of the Delaware Bay. This was done since the projects included vessel activity occurring in the Delaware River upstream to Trenton, NJ. However, since the action area considered here only includes the Delaware River from below Wilmington, we have recalculated the vessel strike risk using data for the Philadelphia to the Sea FNP. We use the Waterborne Commerce data for the Philadelphia to the Sea Federal Navigation Channel and assign carcasses based on whether they were found within the Philadelphia to Trenton or the Philadelphia to the Sea reach of the federal navigation channel.

As described above, DNREC has maintained records of observed sturgeon mortalities within the Delaware River and Delaware Bay since 2005. However, the NJFW provided us with data on reported sturgeon carcasses spanning the years from 2013 through 2023. The combined DNREC and NJFW data represent the best available information for calculating sturgeon mortalities per vessel trip. However, in 2019, DNREC improved the public's ability to report carcasses, as well as increased outreach activities, which may have changed reporting rates since 2019. Further, we expect that the COVID pandemic significantly disrupted public reporting of carcasses in 2020 and 2021. Because of this, we only use the combined DNREC and NJFW 2013 to 2019 data together with the Waterborne Commerce vessel trip data during the same years to calculate the risk of a vessel striking a sturgeon within the Delaware River and Bay.

For the years 2013-2019, the DNREC and NJFW data sets include 110 records of Atlantic sturgeon from the Delaware River and Bay with vessel strike or unknown as the cause of mortality. Assuming that all the reported mortalities with unknown cause of death were vessel strikes, then 110 reported Atlantic sturgeon mortalities in the Delaware River and Bay were caused by vessel strikes over the 7 years (2013 through 2019). The approximate average of reported vessel strike mortalities in the Delaware River is 16 per year. To put the carcass data into context and to consider baseline risk of vessel strike, we obtained the number of vessel trips between Philadelphia and the mouth of the Delaware Bay from Waterborne Commerce data for the years 2013 through 2019. The Waterborne Commerce data does not include recreational and fishing boats and is therefore an underestimate of all vessel traffic within the action area. However, recreational vessels typically have a draft of a couple of meters or less, and recreational and fishing vessels have small propeller blades that are unlikely to entrain sturgeon. Thus, the most likely interaction between smaller vessels and sturgeon would be through hull

and propeller strike (the moving vessel and propeller hitting the fish), and not entrainment. For this to occur, the sturgeon would have to be in shallow waters or the water column near the surface (because of the shallow draft of smaller vessels) and unable to escape as the vessel approached. Recreational vessels often operate at higher speeds, and there is evidence to suggest that small, fast vessels with shallow draft can strike and kill Atlantic sturgeon and shortnose sturgeon. For instance, 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 (<6 m (<20 ft)) 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 10.7 m (35-ft) recreational vessel traveling at 33 knots on the Hudson River was reported to have struck and killed a 1.7 m (5.5-ft) Atlantic sturgeon (NYSDEC sturgeon mortality database (9-15-14)).

Since sturgeon remain close to the bottom most of the time (Balazik *et al.* 2012d, Fisher 2011, Reine *et al.* 2014), interaction with a shallow draft vessel could mostly occur in shallow waters or when sturgeon surface. For the vessel to strike a sturgeon, the vessel and the surfacing sturgeon must be at the same spot at the exact same time. Since surfacing constitutes a very small portion of a sturgeon's daily activity (0 to 12 per day, Logan-Chesney *et al.* 2018), we expect that sturgeon exposure to shallow draft vessels are extremely rare and is most likely to occur where vessels travel over reaches where a substantially high number of sturgeon are present (e.g., shortnose sturgeon overwintering holes). Conversely, cargo vessels and tugboats have large propellers that entrain large volumes of water, and the observation of many severed sturgeon carcasses suggests that most vessel strike mortalities occur when sturgeon are entrained in the water going through the propellers of large vessels (Balazik *et al.* 2012d, Brown and Murphy 2010). Since the propellers on recreational and smaller fishing vessels are too small to entrain a sturgeon in the water going through the propeller, the interaction with sturgeon would only occur if the propeller blades directly strike the sturgeon while transiting over the fish. The probability of a propeller hitting a sturgeon when surfacing, even if the vessel is directly overhead, is small because the propeller's surface area is also small. Further, while we do not know the force that would be needed to injure or kill a sturgeon by direct impact, we do assume that a recreational vessel would have to travel at considerable speed for a direct impact by the hull to kill a sturgeon. Therefore, while vessel strikes by recreational vessels and small fishing boats have occurred, we expect recreational vessel strike mortalities to be rare in the lower Delaware River estuary and Delaware Bay. As such, they do not meaningfully contribute to our evaluation of baseline vessel strike risk.

Table 33. Vessel trip and carcass report statistics for the Philadelphia to the Sea FNP reach. Years 2013 to 2019.

	Min	Max	Mean	Median	Total
Atlantic Sturgeon Mortalities	10	21	15.7	18	110
Adjusted mortalities	210	441	330	378	2,311
Vessel Trips	24,589	43,352	35,669	38,910	249,681

The number of vessel trips between Philadelphia and the mouth of the Delaware Bay during the period from 2013 to 2019 was 249,681. Given this scenario, we estimate the number of sturgeon killed per vessel trip by dividing the estimated number of Atlantic sturgeon vessel mortalities (110) by the number of vessel trips (249,681) over the same period (Table 33).

Given the known difficulties in observing deceased fish in a large, dynamic environment like the Delaware River and Estuary, it is necessary to account for unobserved mortalities. The NEFSC referred to this as the adjusted annual mortality rate (M_a), which is calculated by dividing the observed annual mortality rate (M_o) by an externally derived carcass reporting rate (Fox *et al.* 2020). This is represented by:

$$M_a = \frac{M_o}{R}$$

where M_o is the observed annual mortality rate and R is the Carcass Reporting Rate.

Fox *et al.* (2020) found that there is a Carcass Reporting Rate of 0.0467 (R) in the Delaware River. Using the carcass reporting rate calculated by Fox *et al.* (2020), we calculated an actual or adjusted mortality rate by dividing M_o by 0.0476 to get a M_a of 0.0093. As such, we estimate that on average 0.0093 sturgeon is killed per vessel trip. This equates to one Atlantic sturgeon killed on average for every 108 vessel trips. The calculations show that the probability of a vessel strike is low for any one vessel traveling on the river or in the bay. However, as noted above, the Delaware River supports a number of major port complexes with many related vessel trips occurring per year. Therefore, the high level of vessel movements overlapping with the presence of Atlantic sturgeon aggregation sites, spawning migrations, and spawning areas, causes a high risk of vessel strikes within the action area.

5.8.2.1.4 Shortnose Sturgeon Baseline Vessel Strike Risk

Early reports of potential vessel strikes of shortnose sturgeon include one incident in 2007 and one in 2008. On June 8, 2008, a dead shortnose sturgeon was collected near Philadelphia. The fish was necropsied and found to have suffered blunt force trauma. Though the injury was considered to be caused by interaction with a vessel, this was never confirmed. On November 28, 2007, a shortnose sturgeon was collected on the trash racks of the Salem Nuclear Generating facility. The fish was not necropsied; however, the pattern of lacerations on the carcass

suggested possible vessel interaction. It is unknown if those lacerations were caused pre- or post-mortem. The DNREC data includes eight shortnose sturgeon mortalities in the Delaware River during the years from 2013 through 2019. The number of reported mortalities ranged from zero to three shortnose sturgeon per year over the ten years. Of the eight shortnose sturgeon, four were reported as likely vessel mortalities and four had no cause of death reported.

The NJFW data (2013 to 2019) includes four shortnose sturgeon that were reported from the Delaware River and Bay. The information provided to us by NJFW did not include any description of injuries, and the cause of death is unknown.

If we assume that mortalities of unknown cause were vessel strike mortalities and that only 4.76 percent of carcasses are reported, then there were approximately 252 shortnose sturgeon vessel strike mortalities in the Delaware River during those seven years. With 249,681 vessel trips during the same period, approximately 0.001 shortnose sturgeon are killed per vessel trip. This equates to one shortnose sturgeon vessel strike mortality occurring for every 991 vessel trips.

The low number of shortnose sturgeon carcasses reported from the Delaware River basin may be related to several factors: little overlap between vessel activity and shortnose sturgeon distribution; low numbers of large fish present in areas with high vessel activity; fewer observed and reported remains due to their smaller size relative to Atlantic sturgeon; a combination of these factors; or other unknown factors. However, we do not have data to correct for these uncertainties.

5.8.2.2 Impacts to Bottom Substrate from Vessel Activity

The largest commercial vessels (e.g., oil tankers, container ships, etc.) pass through the navigation channel daily. Upon approaching the channel in the lower Delaware Bay from the Atlantic Ocean, many oil tankers have drafts exceeding 13.7 m (45 ft) because of their cargo. Once they lighten the load so the vessel may pass upstream during high tide with the required 0.6 m (2 ft) of draft clearance, they continue to their ports of call. Most of the largest tankers make their port calls before the Walt Whitman Bridge in Philadelphia. Given the size of the vessels and the proximity of the propeller to the bottom of the channel, there is a constant disturbance regime (increased turbidity and TSS) throughout the navigation channel. Vessels occasionally strike shoaled areas, but are still able to pass through. Given this, the baseline condition of the bottom substrate in the Delaware River is consistently distributed the foraging habitat and water quality are likely degraded.

5.8.2.3 Vessel Activity within Upper and Lower NY Bay

There are several Waterborne Commerce datasets available for the action area in the Upper and Lower NY Bay. We used data for the NY and NJ Channels from 2014 to 2023 to determine the baseline vessel traffic transiting from the Atlantic Ocean through the Upper and Lower NY Bay to Pier J in Brooklyn, NJ. The data encompasses a 33-mile area that includes the Main Ship

Channel northwest of Sandy Hook through Lower NY Bay, Raritan Bay, Perth Amboy Anchorage, Arthur Kill and Kill Van Kull to Upper NY Bay, which includes the main shipping channel (Ambrose Channel) into NY Harbor. All operational vessels that will be traveling to Pier J will transit through Ambrose Channel from the Atlantic Ocean into Lower NY Bay. Therefore, although some of the areas included in the dataset are outside of the action area, specifically Raritan Bay, Perth Amboy Anchorage, Arthur Kill and Kill Van Kull, this data provides the most accurate estimate of the total number of vessel trips that occur in this high density area for vessels within the action area. The annual number of trips for all vessels (self-propelled and non-self-propelled, all drafts) in the NY and NJ Channels ranged from 22,579 to 28,768 with a total of 289,656 vessel trips during the period from 2014 through 2023 (Table 34). The annual number of self-propelled vessel trips in the NY and NJ Channels ranged from 10,023 to 12,943 with a total of 129,602 trips over the period from 2014 to 2023 (Table 35).

Table 34. Annual self-propelled and non-self-propelled vessel trips in the NY and NJ Channels (USACE Waterborne Commerce data 2025).

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Vessel Trips	26,464	28,495	28,124	26,727	24,511	25,452	22,579	26,243	28,159	28,768	289,656

Table 35. Annual self-propelled vessel trips in the NY and NJ Channels (USACE Waterborne Commerce data 2025).

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Vessel Trips	12,023	12,943	12,639	11,947	10,644	11,305	10,023	12,222	12,378	12,478	129,602

5.8.2.3.1 Information on Sea Turtle Mortality Resulting from Vessel Strike in Upper and Lower NY Bay

The STSSN database was queried for records of stranded sea turtles with evidence of vessel strike throughout the areas encompassed by the NY and NJ Channels dataset to determine vessel strike risk to sea turtles in the general area where the majority of project vessel trips will occur. From 2014 through 2023, there were 102 records of sea turtle standings that had either definitive evidence from vessel strikes or blunt force trauma, which indicates probable vessel collision. The majority of strikes and blunt force traumas were of loggerheads (n = 88) with a smaller number of leatherbacks (n = 8), Kemp's ridleys (n = 5), and green (n = 1) turtles. A similar rate of strike is expected to continue in the action area over the life of the project and that vessel strike will continue to be a source of mortality for sea turtles in the action area.

5.8.2.3.2 Information on Sturgeon Mortality Resulting from Vessel Strike in Upper and Lower NY Bay

Atlantic sturgeon are known to be struck and killed in portions of the action area that will be transited by project vessels including the Upper and Lower NY Bay. Risk is thought to be highest in areas with reduced opportunity for escape and from vessels operating at a high rate of speed or with propellers large enough to entrain sturgeon, as discussed previously. 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. As discussed, a study that intentionally placed Atlantic sturgeon carcasses along the Delaware River in areas used by the public, suggests that most Atlantic sturgeon carcasses are not found and, when found, many are not reported to NMFS or to our sturgeon salvage co-investigators (Balazik, pers. comm. in ASMFC 2017b, Balazik *et al.* 2012d, Fox *et al.* 2020).

From 2014 to 2023, the Sturgeon Salvage Program, NYSDEC, and NJ Fish and Wildlife reported a total of 23 Atlantic sturgeon or unknown species (most likely Atlantic sturgeon) carcasses in Raritan Bay, Lower NY Bay, and Jamaica Bay that had some evidence of a possible vessel strike. Most of these carcasses were not examined and we do not have an estimate of the total number of vessel strikes in this area annually. The majority of the locations only witnessed one or two carcasses over the last ten years while there was a reoccurrence of carcasses reported near Miller Field/New Dorp Beach, Staten Island, NY, which is on the shoreline adjacent to the action area where operational vessels will transit and close to where sturgeon are expected to migrate to and from the Hudson River. Some carcasses were not examined and we do not have an estimate of the total number of vessel strikes in this area annually. While we are not able to use these reports to estimate the total number of Atlantic sturgeon struck in this year, the number of carcasses reported and detected in an area that has high volumes of vessel traffic, accessible and well populated shorelines and waterways, and an established reporting system (through the Sturgeon Salvage Program, NYSDEC, and NJ Fish and Wildlife), indicates that risk of vessel strike in this area may be lower than in the Delaware River. This may be due to the deep depths of the waterways in this area, the transient nature of Atlantic sturgeon in the Lower and Upper NY Bay area (*i.e.*, sturgeon use of this area is limited to individuals migrating in and out of the Hudson River), and the lack of constrictions that would increase the potential for co-occurrence of deep draft vessels and individual sturgeon. Similar to the Delaware River, we expect that only a portion of Atlantic sturgeon carcasses related to vessel strike mortalities are found or reported and that the number of vessel strike mortalities is likely higher than 23 sturgeon mortalities over a 10-year period in this portion of the action area, however, no studies have been conducted to determine the reporting rate for this area. We did not use the same methodology as we used in the Delaware portion of the action area because the Upper and Lower New York Bay portion of the action area comprises different environmental conditions (depth, width of the waterbody, etc.) and different accessibility to the waterbody (likely impacting reporting rates). Therefore, we will use the observed carcasses to determine the risk of vessel strike in this portion of the action area. We expect that Atlantic sturgeon will continue to be struck and killed in the action area at the same frequency over the life of the proposed action.

The number of vessel trips within NY / NJ Channels during the period from 2014 to 2023 was 129,602 (Table 35). Given this scenario, we estimate the number of sturgeon killed per vessel trip by dividing the estimated number of Atlantic sturgeon vessel mortalities (23) by the number of vessel trips (129,602) over the same period. While we used the Fox et al. (2020) reporting rate in our analysis for the Delaware River and Bay sturgeon vessel strike mortalities, given the different environmental conditions and accessibility noted above, we use the total carcasses to calculate the risk of vessel strike. Thus, using the observed data, each vessel trip (M_o) killed 0.00017747 sturgeon. The calculations show that the probability of a vessel strike is low for any one vessel traveling on the river or in the bay.

5.9 Reducing Threats to ESA-Listed Sea Turtles

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

5.9.1 Use of a Chain-Mat Modified Scallop Dredge in the Mid-Atlantic

In response to the observed capture of sea turtles in scallop dredge gear, including serious injuries and sea turtle mortality as a result of capture, NMFS proposed a modification to scallop dredge gear (70 FR 30660, May 27, 2005). The rule was finalized as proposed (71 FR 50361, August 25, 2006) and 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 when fishing in Mid-Atlantic waters south of 41°9’N from the shoreline to the outer boundary of the EEZ during the period of May 1–November 30 each year. The requirement was subsequently modified by emergency rule on November 15, 2006 (71 FR 66466), and by a final rule published on April 8, 2008 (73 FR 18984). On May 5, 2009, NMFS proposed additional minor modifications to the regulations on how chain mats are configured (74 FR 20667). Since 2008, the chain mat gear modifications have reduced the severity of most sea turtle interactions with scallop dredge gear (Murray 2011, 2015a). However, these modifications are not expected to reduce the overall number of sea turtle interactions with scallop dredge gear.

5.9.2 Sea Turtle Handling and Resuscitation Techniques

NMFS has developed and published sea turtle as a final rule in the *Federal Register* (66 FR 67495, December 31, 2001) sea turtle handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities. 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.

5.9.3 Sea Turtle Entanglements and Rehabilitation

A final rule (70 FR 42508) published on July 25, 2005, allows any agent or employee of NMFS the U.S. FWS, the U.S. Coast Guard, or 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 or her official duties, to take endangered sea turtles encountered in the marine environment if such taking is necessary to aid a sick, injured, or entangled endangered sea turtle, or dispose of a dead endangered sea turtle, or salvage a dead endangered sea turtle that may be useful for scientific or educational purposes. NMFS already affords the same protection to sea turtles listed as threatened under the ESA (50 CFR 223.206(b)).

5.9.4 Education and Outreach Activities

Education and outreach activities do not directly reduce the threats to ESA-listed sea turtles. However, education and outreach are a means of better informing the public of steps that can be taken to reduce impacts to sea turtles (*i.e.*, reducing light pollution in the vicinity of nesting beaches) and increasing communication between affected user groups (*e.g.*, the fishing community). For the HMS fishery, NMFS has been active in public outreach to educate fishermen regarding sea turtle handling and resuscitation techniques. For example, NMFS has conducted workshops with longline fishermen to discuss bycatch issues including protected species, and to educate them regarding handling and release guidelines. NMFS intends to continue these outreach efforts in an attempt to increase the survival of protected species through education on proper release techniques.

5.9.5 Sea Turtle Stranding and Salvage Network (STSSN)

As is the case with education and outreach, the STSSN does not directly reduce the threats to sea turtles. However, the extensive network of STSSN participants along the Atlantic and Gulf of America coasts not only collects data on dead sea turtles, but also rescues and rehabilitates live stranded turtles. Data collected by the STSSN are used to monitor stranding levels and identify areas where unusual or elevated mortality is occurring. 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 (either via the stranding network through incidental takes or in-water studies). Tagging studies help improve our understanding of sea turtle movements, longevity, and reproductive patterns, all of which contribute to our ability to reach recovery goals for the species.

5.10 Reducing Threats to Atlantic Sturgeon

Several conservation actions aimed at reducing threats to Atlantic sturgeon are currently

ongoing, including dam removals, moratoria on commercial and recreational fishing, and the implementation of a Sturgeon Salvage Network and educational programs for sturgeon throughout the U.S. Atlantic (*e.g.*, SCUTES: Students Collaborating to Undertake Tracking Efforts for Sturgeon). In 2018, NMFS produced a preliminary outline for recovery of all Atlantic sturgeon DPSs (<https://www.fisheries.noaa.gov/resource/document/recovery-outline-atlantic-sturgeon-distinct-population-segments>). 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 populations and ways to minimize these threats, including bycatch and water quality, and to develop population estimates for each population. Fishing gear research is underway to design fishing gear that minimizes interactions with shortnose and Atlantic sturgeon while maximizing retention of targeted fish species. Several states are in the process of preparing ESA Section 10 Habitat Conservation Plans aimed at minimizing the effects of state fisheries on sturgeon.

6 CONSEQUENCES OF THE ACTION

This section of the biological opinion assesses the consequences of the proposed action on ESA-listed threatened or endangered species and designated critical habitat. Consequences of the action are all effects to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR §402.02 and § 402.17).

6.1 Sound Energy from Pile Driving

In this section, we provide background information on underwater noise and how it affects listed species, establish the underwater noise that listed species are likely to be exposed to, and then establish the expected response of the individuals exposed to that noise. This section contains a brief technical background on sound, the characteristics of certain sound types, and metrics used in this consultation inasmuch as the information is relevant to the specified activity and to consideration of the potential effects of the specified activity on listed species found later in this document.

Pile driving that is proposed as part of the project is expected to result in increased underwater noise during the period when pile driving equipment is active. Sea turtles are not expected to be present where pile driving will occur, based on salinity levels at the Port site. As such, we have determined that effects to sea turtles from exposure to pile driving noise are extremely unlikely to occur. Therefore, this effects analysis will focus on Atlantic and shortnose sturgeon.

The proposed action involves installation of 216 AZ steel sheet piles (27.5 in, 460 ft total length)

and 180 16-in diameter steel pipe piles. The sheet piles will be installed by a vibratory hammer in pairs, for a total of 108 pile driving events. Installation of the steel pipe piles will begin with vibratory hammering to the maximum extent possible, depending on the conditions at each pile site, and finish with impact hammering if necessary. As stated in the BA, no in-water work, including pile driving, will be conducted from March 15 through June 30.

6.1.1 Basic Background on Acoustics and Fish Bioacoustics

This section contains technical background on sound, the characteristics of certain sound types, and metrics used in this consultation when the information is relevant to the specified activity and to consideration of the potential effects of the specified activity on listed species found later in this document.

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in hertz (Hz) or cycles per second. Wavelength is the distance between two peaks or corresponding points of a sound wave (length of one cycle). Higher frequency sounds have shorter wavelengths than lower frequency sounds, and typically attenuate (decrease) more rapidly, except in certain cases in shallower water. Amplitude is the height of the sound pressure wave or the “loudness” of a sound and is typically described using the relative unit of the decibel (dB). A sound pressure level (SPL) in dB is described as the ratio between a measured pressure and a reference pressure (for underwater sound, this is 1 microPascal (μPa)), and is a logarithmic unit that accounts for large variations in amplitude; therefore, a relatively small change in dB corresponds to large changes in sound pressure. The source level (SL) typically represents the SPL referenced at a distance of 1 m from the source, while the received level is the SPL at the listener’s position (referenced to 1 μPa).

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse. Root mean square is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urlick, 1983). Root mean square accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper, 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

Sound exposure level (SEL; represented as dB re 1 $\mu\text{Pa}^2\text{-s}$) represents the total energy in a stated frequency band over a stated time interval or event, and considers both intensity and duration of exposure. The per-pulse SEL is calculated over the time window containing the entire pulse (*i.e.*, 100 percent of the acoustic energy). SEL is a cumulative metric; it can be accumulated over a single pulse, or calculated over periods containing multiple pulses. Cumulative SEL represents the total energy accumulated by a receiver over a defined time window or during an

event. Peak sound pressure (also referred to as zero-to-peak sound pressure or 0-pk) is the maximum instantaneous sound pressure measurable in the water at a specified distance from the source, and is represented in the same units as the rms sound pressure.

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in a manner similar to ripples on the surface of a pond and may be either directed in a beam or beams or may radiate in all directions (omnidirectional sources), as is the case for sound produced by the pile driving activity considered here. The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

Even in the absence of sound from the specified activity, the underwater environment is typically loud due to ambient sound, which is defined as environmental background sound levels lacking a single source or point (Richardson *et al.*, 1995). The sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (*e.g.*, wind and waves, earthquakes, ice, atmospheric sound), biological (*e.g.*, sounds produced by marine mammals, fish, and invertebrates), and anthropogenic (*e.g.*, vessels, dredging, construction) sound. A number of sources contribute to ambient sound, including wind and waves, which are a main source of naturally occurring ambient sound for frequencies between 200 hertz (Hz) and 50 kilohertz (kHz) (Mitson, 1995). In general, ambient sound levels tend to increase with increasing wind speed and wave height. Precipitation can become an important component of total sound at frequencies above 500 Hz, and possibly down to 100 Hz during quiet times. Marine mammals can contribute significantly to ambient sound levels, as can some fish and snapping shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz. Sources of ambient sound related to human activity include transportation (surface vessels), dredging and construction, oil and gas drilling and production, geophysical surveys, sonar, and explosions. Vessel noise typically dominates the total ambient sound for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly.

The sum of the various natural and anthropogenic sound sources that comprise ambient sound at any given location and time depends not only on the source levels (as determined by current weather conditions and levels of biological and human activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor, and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10-20 decibels (dB) from day to day (Richardson *et al.*, 1995). The result is that, depending on the source type and its intensity,

sound from the specified activity may be a negligible addition to the local environment or could form a distinctive signal that may affect a particular species. The Port of Salem action area lies within a dynamic ambient noise environment, with natural background noise contributed by natural wind and wave action and a diverse community of vocalizing organisms. Anthropogenic noise sources, including commercial shipping traffic in high-use shipping lanes, also contribute ambient sound.

Sounds are often considered to fall into one of two general types: pulsed and non-pulsed. The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (*e.g.*, Ward, 1997 in Southall *et al.*, 2007). Non-impulsive sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or intermittent (ANSI, 1995; NIOSH, 1998).

Pulsed sound sources (*e.g.*, impact pile driving) produce signals that are brief (typically considered to be less than one second), broadband, atonal transients (ANSI, 1986, 2005; Harris, 1998; NIOSH, 1998; ISO, 2003) and occur either as isolated events or repeated in some succession. Pulsed sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features.

Non-pulsed sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or intermittent (ANSI, 1995; NIOSH, 1998). Some of these non-pulsed sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.*, rapid rise time). Examples of non-pulsed sounds include those produced by vessels, aircraft, drilling or dredging, and vibratory pile driving.

Specific to pile driving, the impulsive sound generated by impact hammers is characterized by rapid rise times and high peak levels. Vibratory hammers produce non-impulsive, continuous noise at levels significantly lower than those produced by impact hammers. Rise time is slower, reducing the probability and severity of injury, and sound energy is distributed over a greater amount of time (*e.g.*, Nedwell and Edwards, 2002; Carlson *et al.*, 2005).

The hearing range for most fish ranges from a low of 20 Hz to 800 to 1,000 Hz. Most fish in the Delaware River fit into this hearing range, although catfish may hear up to about 3,000 or 4,000 Hz and some of the herring-like fishes can hear sounds to about 4,000 Hz, while a few, and specifically the American shad, can hear to over 100,000 Hz (Bass and Ladich 2008, Popper *et al.* 2003, Popper and Schilt 2008).

An acoustic field from any source consists of a propagating pressure wave, generated from particle motions in the medium that causes compression and rarefaction. This sound wave

consists of both pressure and particle motion components that propagate from the source. All fishes have sensory systems to detect the particle motion component of a sound field, while fishes with a swim bladder (a chamber of air in the abdominal cavity) may also be able to detect the pressure component. Pressure detection is primarily found in fishes where the swim bladder (or other air chamber) lies very close to the ear, whereas fishes in which there is no air chamber near the ear primarily detect particle motion (Popper *et al.* 2003). Sturgeon have swim bladders, but they are not located very close to the ear; thus, sturgeon are assumed to detect primarily particle motion rather than pressure.

6.1.2 Criteria for Assessing the Potential for Physiological Effects

There is limited data from other projects to demonstrate the circumstances under which immediate mortality occurs: mortality appears to occur when fish are close (within 0.9 m to 9.1 m (3 ft to 30 ft)) to driving of relatively large diameter piles. Studies conducted by the California Department of Transportation (Caltrans) showed some mortality for several different species of wild fish exposed to the driving of steel pipe piles 2.4 m (8 ft) in diameter, whereas Ruggerone *et al.* (2008) found no mortality to caged yearling coho salmon (*Oncorhynchus kisutch*) placed as close as 0.6 m (2 ft) from a 0.5 m (1.5 ft) diameter pile and exposed to over 1,600 strikes. As noted above, the data indicates that species have different tolerances to noise and may exhibit different responses to the same noise source.

Potential physiological consequences are highly diverse. Sound exposure that may result in mortality-inducing physiological consequences could in one species result in physiological effects that would have no effect on fish survival in another. Potential consequences range from very small ruptures of capillaries in fins (which are not likely to have any consequences on survival) to severe hemorrhaging of major organ systems such as the liver, kidney, or brain (Stephenson *et al.* 2010). Other potential consequences include rupture of the swim bladder (the bubble of air in the abdominal cavity of most fish species that is involved in maintenance of buoyancy). See (Halvorsen *et al.* 2011) for a review of potential injuries from pile driving.

Consequences on body tissues may result from barotrauma or result from rapid oscillations of air bubbles. Barotrauma occurs when there is a rapid change in pressure that directly affects the body gasses. Gas in the swim bladder, blood, and tissue of fish can experience a change in state, expand and contract during rapid pressure changes, which can lead to tissue damage and organ failure (Stephenson *et al.* 2010).

Related to this are changes that result from very rapid and substantial excursions (oscillations) of the walls of air-filled chambers, such as the swim bladder, striking nearby structures. Under normal circumstances the walls of the swim bladder do not move very far during changes in depth or when exposed to normal sounds. However, very intense noise, and particularly those with very sharp onset (also called “rise time”) will cause the swim bladder walls to move a much greater distance and thereby strike nearby tissues such as the kidney or liver. Rapid and frequent

striking (as can occur during one or more sound exposures) may result in bruising, and ultimately in damage, to the nearby tissues.

The Fisheries Hydroacoustic Working Group (FHWG) was formed in 2004 and consists of biologists from NMFS, U.S. Fish and Wildlife Service (U.S.FWS), U.S. Federal Highway Administration (FHWA), California Department of Fish and Game, USACE, 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 NMFS, U.S.FWS, FHWA, and the state agencies signed an MOA documenting criteria for assessing physiological consequences of pile driving on fish (Molnar *et al.* 2020). The criteria were developed for the acoustic levels at which physiological consequences to fish could be expected. It should be noted that these are the onset of physiological consequences (Molnar *et al.* 2020), and not levels at which fish are necessarily mortally damaged. These criteria were developed to apply to all fish species, including listed green sturgeon, which are biologically similar to Atlantic sturgeon and shortnose sturgeon and for these purposes can be considered a surrogate. The interim criteria are:

- Peak SPL: 206 decibels relative to 1 micro-Pascal (dB re 1 μ Pa).
- cSEL: 187 decibels relative to 1 micro-Pascal-squared second (dB re 1 μ Pa²-s) for fishes above 2 grams (0.07 ounces).

The FHWG developed the interim criteria because resource agencies needed immediate thresholds to guide the evaluation of the consequences of pile driving in order to ensure protection of threatened and endangered fish. However, at the time when the FHWG developed the interim criteria, the FHWG recognized that more data and research was necessary to further consider and refine the thresholds. Studies of noise consequences on fish do demonstrate that individual species possess different “tolerances” to varying noise sources and that for some species and in unique situations, fish can be exposed to noise levels greater than the FHWG criteria and exhibit little or no negative consequences. For instance, recent research summarized in Popper *et al.* (2014) suggests that SEL_{CUMULATIVE} thresholds for injury may be well above 200 dB. Molnar *et al.* (2020) noted that “during the time that has passed since the interim injury thresholds were first established in 2008, there has not been a single documented (in the field or lab studies) instance of even minor injury to fish that have been exposed to sound pressure levels in excess of the SEL_{CUMULATIVE} threshold.” However, for different reasons, the FHWG discussions related to modifications of the interim thresholds, though warranted, have not proceeded and the 2008 criteria remain in place. Given this, at this time, we consider the FHWG criteria to represent the best available information on the thresholds at which physiological consequences to sturgeon are likely to occur. Thus, for the purposes of this Opinion, we consider the potential for physiological consequences upon exposure to 206dB re 1 μ Pa peak and 187 dB re 1 μ Pa²-s cSEL. It is important to note that physiological consequences may range from minor injuries that individuals are anticipated to completely recover from with no impact to overall 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 to the source and the greater the duration of the exposure, the higher likelihood of significant injury.

6.1.3 Available Information for Assessing Behavioral Consequences

Empirical studies on the hearing of fishes, amphibians, birds, and mammals (including humans), in general, show that behavioral responses vary substantially. Even within a single species, depending on a wide range of factors (e.g., the motivation of an animal at a particular time, the nature of other activities that the animal is engaged in when it detects a new stimulus, the hearing capabilities of an animal or species) responses demonstrate variability (Brumm and Slabbekoorn 2005). Thus, it may be difficult to assign a single criterion above which behavioral responses to noise would occur.

For purposes of assessing behavioral consequences of pile driving at several West Coast projects, we have employed a 150dB re 1 μ Pa RMS SPL criterion at several sites including the San Francisco-Oakland Bay Bridge and the Columbia River Crossings. Based on our professional judgment and the best available information, for the purposes of this consultation, we will use 150 dB re 1 μ Pa RMS as an indicator of the noise level at which there is the potential for behavioral consequences. That is not to say that exposure to noise levels of 150 dB re 1 μ Pa RMS will always result in behavioral modifications or that any behavioral modifications will rise to the level of take (*i.e.*, harm or harassment), but that there is the potential, upon exposure to noise at this level, to experience some behavioral response. Behavioral responses could range from a temporary startle to avoidance of an ensonified area.

As hearing generalists, sturgeon rely primarily on particle motion to detect sounds (Lovell *et al.* 2005), which does not propagate as far from the sound source as does pressure. However, a clear threshold for particle motion was not provided in the Lovell study. In addition, flanking³⁵ of the sounds through the substrate may result in higher levels of particle motion at greater distances than would be expected from the non-flanking sounds. Unfortunately, data on particle motion from pile driving is not available at this time, and we must rely on sound pressure level criteria. Although we agree that more research is needed, the studies noted above support the 150 dB re 1 μ Pa RMS criterion as an indication for when behavioral consequences could be expected. With the exception of studies carried out during the Tappan Zee Pile Installation Demonstration Project in the Hudson River, NY, (Krebs *et al.* 2012, 2016), we are not aware of any studies that have considered the behavior of shortnose or Atlantic sturgeon in response to peak pile driving noise levels. Given this and the available information from studies on other fish species, we consider 150 dB re 1 μ Pa RMS to be a reasonable estimate of the noise level at which exposure may result in behavioral modifications.

6.1.4 Exposure to Increased Underwater Noise

³⁵ Flanking sound (or flanking noise) is sound that transmits between spaces indirectly, going over or around, rather than directly through the main separating element.

Atlantic and shortnose sturgeon (juveniles, subadults, and adults) may occasionally be present in the Salem River; however, it is not known to be an area frequented by either species and it is outside the primary habitats in the mainstem Delaware River. As explained above, seasonal limits are in place for pile driving which limits the time of year that sturgeon could be exposed to pile driving noise.

We used the acoustic tool developed by our Office of Protected Resources (Multi-Species Pile Driving Calculator) that uses proxy projects to assist in estimating the ensonified area for piles of different types and sizes, driven with different hammers, and with different attenuations³⁶. This tool uses representative data from installation of similar pile types; many of the examples rely on data compiled for the California Department of Transportation from tests conducted by others under similar conditions (Molnar *et al.* 2020).

The calculator incorporates a Practical Spreading Loss Model (PSLM) which requires an estimate of the number of strikes needed to install a pile (or the number of seconds with a vibratory hammer). For this Opinion, we use the Multi-Species Pile Driving Calculator and the PSLM to estimate intensity and spatial extent of sound levels to analyze the consequences of the proposed pile driving (summarized in Tables below).

Table 36 provides the project’s piling specifications and relevant project details used to calculate pile driving sound levels. Table 37 uses the parameters and proxy data provided through the calculator that was used to calculate estimated distances from piles where noise will exceed thresholds of concern (in this case the distance from the pile where noise is expected to exceed the identified noise levels where there is a risk of physiological or behavioral response). Input data (source levels) for all pile types, sizes, and hammer types were not available in the pile driving calculator, and in these cases the next largest size pile was used as a proxy, when available, to avoid underestimating distances to thresholds of concern. For example, data were not available for 16 in steel pipe piles for vibratory installation, so the next size steel pipe pile (18 in) was used. In addition, source level information for 27.5 in AZ steel sheet piles was not available for vibratory installation and 24 in AZ steel sheet pile proxy data were used as that was the best available information and a larger steel sheet pile was not available. Given the small difference, we would not expect the results to be significantly different.

Table 36. Pile Specifications and Installation Details.

Pile Type	Pile Size (in)	Number of Piles Driven per Day	Installation Method	Number of Strikes per Pile	Estimated Duration to Drive Single Pile (min)	Total Number of Piles to be Driven

³⁶ The spreadsheet is available at <https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance>

AZ steel sheet	27.5	9 pairs	Vibration	N/A	5	216/2 (108 pile driving events)
Steel pipe	16	3	Vibration	N/A	10	180
			Impact	200	30	

Table 37. Estimated distances to Atlantic and shortnose sturgeon injury and behavioral thresholds.

Type of Pile (Proxy)	Hammer Type	Impact and Vibratory Hammer Thresholds		
		Distance (m) to Behavioral reaction 150 dB re 1 μ Pa RMS	Distance (m) to Onset of PTS SEL _{cum} 187 dBcSEL injury - fish ≥ 2 g	Distance (m) to Onset of PTS Peak 206 dB re 1 μ Pa RMS
16 in steel pipe pile	Impact	158.5	15.3	0.3
18 in steel pipe	Vibratory	34.1	N/A	N/A
24 in AZ steel sheet	Vibratory	73.6	N/A	N/A

Injury is not an expected outcome of exposure of sturgeon to vibratory pile driving noise. For vibratory installation of pipe piles and sheet piles, the peak injury threshold for sturgeon is not exceeded. The pile driving of the 16 in steel pipe piles with an impact hammer is expected to result in increased underwater noise that would exceed the threshold when a physiological response (injury) to a sturgeon could occur (≥ 206 dBpeak) within only 0.3 m (0.8 ft) of the pile. This means that in order to be exposed to noise that could result in injury, a sturgeon would need to be within 0.3 m of the pile for a single strike. As noted above, the cSEL threshold accounts for multiple exposures. The cSEL is a measure of the accumulated energy over a specific period of time (e.g., the period of time it takes to install a pile), rather than an instantaneous maximum noise threshold (Buehler *et al.* 2015). For the 16 in steel piles, a sturgeon would need to remain within 15.3 m (50.2 ft) of each of the 16 in steel pipe piles installed during a workday in order to accumulate enough noise exposure to experience injury. During active pile driving, the area within 34.1 – 158.5 m of the pile being installed is expected to experience underwater noise above 150 dB RMS. Sturgeon are expected to react behaviorally to noise above this threshold.

6.1.5 Response to the Proposed Pile Driving

It is reasonable to assume that sturgeon, on hearing pile driving, will either not approach the source or will move around it. Transient sturgeon in the area are expected to leave the area when pile driving begins facilitated by the use of a “soft start” or system of “warning strikes” where the pile driving will begin at only 50 percent of its total energy. These “warning strikes” are designed to cause fish to leave the area before the pile driving begins at full energy.

Studies on sturgeon behavior towards noise from pile driving in relation to the construction of the Tappan Zee Bridge over Hudson River found that sturgeon avoid or move out of the ensonified area (NMFS 2017c). Thus, we expect the sturgeon to avoid an ensonified area upon exposure to increased underwater noise levels, if fish do not completely leave after the warning strikes. Behavioral modification (avoidance) for sturgeon is expected upon detection of noise above 150 dB RMS, which for these piles, is expected to occur at a distance of 34.1 m to 158.5 m (520 ft) from the piles being driven.

Given the expected behavioral avoidance (expected to result in sturgeon avoiding the area within 34.1 to 158.5 m depending on the pile/installation type) and that a sturgeon would need to be extremely close to a pile to be injured during a single strike (less than 1 meter) and would need to stay within 50 m for the full duration of pile driving in order for there to be a potential for injury, injury is extremely unlikely to occur. Any sturgeon present in the area during the start of pile driving are expected to leave the area and not be close to any pile driving activity for long enough to experience injuries or mortality.

6.1.6 Consequences of Behavioral Responses

As noted above, available information suggests that behavioral responses (avoidance) may begin upon exposure to noise at levels of 150 dB re 1 μ Pa RMS.

Depending on the pile installation technique, the 150 dB re 1 μ Pa RMS isopleth (radius) would extend from 34.1 to 158.5 m (approximately 112 to 520 ft) from the piles being driven. Sturgeon use of the Salem River is expected to be limited to occasional transient individuals that are opportunistically (where forage is present), resting, or otherwise moving through the area. We consider two scenarios here; (1) sturgeon near the pile being installed swim away from the pile to move out of the area where noise is greater than 150 dB re 1 μ Pa RMS; and, (2) sturgeon outside of the area where noise is greater than 150 dB re 1 μ Pa RMS at the onset of pile driving would avoid this area when pile driving was ongoing.

In the first scenario, sturgeon exposed to noise greater than 150 dB re 1 μ Pa RMS are expected to move away from the ensonified area and have their foraging, resting or migrating behaviors disrupted. Even at a slow sustained speed of 0.18 m (0.6 ft) per second (mps), all sturgeon would be able to swim out of the area where noise is 150 dB re 1 μ Pa RMS within 14.7 minutes. Thus, we expect any disruption to normal behaviors to last for no longer than 15 minutes. Foraging is expected to resume as soon as sturgeon leave the area and find another area with forage. Resting and movements can also continue as soon as the individual has moved away from the disturbing level of noise. It is extremely unlikely that a short-term (in the longest scenario of no more than 15 minutes, and generally much shorter) disruption of foraging, resting or migrating will have any impact on the health of an individual sturgeon. In addition, because we expect these movements to occur at normal sustained swim speeds, we do not expect there to be any measurable increase in energy use or increased stress response.

We have no information to indicate that any particular portion of the Salem River is more valuable to sturgeon than another and no information to indicate that resting, foraging and migrating cannot take place in any portion of the Salem River or that any area is better suited for these activities than any other area. Based on this analysis, we have determined that any changes in behavior resulting from exposure to increased underwater noise associated with pile installation be so small that they cannot be meaningfully measured, detected, or evaluated and, therefore, are insignificant.

6.2 Dredging

The proposed action includes dredging an approximately 1.30 acres (56,800 ft²) area of the Salem River immediately outshore of the proposed bulkhead from an existing depth of approximately -18 ft MLW to a depth of -22 ft MLW plus 2 ft allowable over-dredge. Dredging will be conducted using a mechanical bucket dredge. Dredging will generate approximately 7,000 cy of dredged material. Dredged material will be loaded into a scow that will be transported by tug and scow to White's Basin in Logan Township, NJ.

6.2.1 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, a sturgeon must be on the bottom directly below the dredge bucket as it contacts the substrate and remain stationary as the bucket closes. Sturgeon 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. Sturgeon captured and emptied out of the bucket can suffer stress or injury, which can lead to mortality. As established above, sea turtles are not expected to occur in this portion of the action area. Thus, effects to sea turtles from dredging are extremely unlikely to occur and therefore discountable.

6.2.1.1 *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 occurred at mechanical 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; however, based on available data the risk even in these areas is very low. 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 overwintering aggregation site for sturgeon.

Most mobile organisms, including adult, subadult, and juvenile Atlantic and shortnose 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 sturgeon is extremely small. As such, effects to either Atlantic or shortnose sturgeon are extremely unlikely to occur and are therefore, discountable.

6.3 Effects of Suspended Sediment

6.3.1 Mechanical Dredging

Dredging suspends sediment into the water column. Resuspension of sediment may increase total suspended sediment (TSS) load and turbidity above ambient baseline levels. Turbidity relates to the optical quality of light transmission through a fluid containing sediment particles (most often measured as nephelometric turbidity units) and TSS concentration is the gravimetric measure of particles in suspension (generally measured as milligrams per liter).

High concentration of TSS or turbidity may affect fish through many pathways (Johnson 2018, Kjelland *et al.* 2015). Increased TSS and turbidity in the water column can affect fish directly by reducing the gill's ability to take up oxygen, causing acute toxic reactions, resulting in physiological stress, and reducing foraging efficiency and/or predator avoidance. Resuspension of fine sediment with high organic content can affect fish indirectly by reducing dissolved oxygen levels. For all fish species in which consequences to early life stages have been measured, it is clear that eggs and larvae (which are not present in the action area) are the most sensitive to increased TSS and sediment deposition.

Consequences of dredging will vary based on site-specific conditions (Wilber and Clarke 2001). Site-specific conditions (*e.g.*, bathymetry, currents) and material (*e.g.*, sand versus silt) should be taken into consideration as it may influence turbidity and re-suspended sediment at a site. Assessing exposure of sturgeon to elevated levels of turbidity or TSS concentration requires an understanding of the sources (*e.g.*, dredge type), factors that influence the duration and intensity of exposure (*e.g.*, sediment type and/or current), as well as the individual species tolerance to the anticipated level of exposure at a given life stage. In our analysis, we consider information from earlier studies of sediment resuspension and turbidity to understand the intensity and extent of increased TSS and turbidity impacts. However, we also consider site-specific information to understand how local conditions influence turbidity and re-suspended sediment.

6.3.1.1 *Thresholds for Total Suspended Sediment (TSS) and Turbidity*

Literature reviews of the consequences of increased TSS on fish show that consequences vary greatly among species and suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993, Kjelland *et al.* 2015, Wilber and Clarke 2001). Burton (1993) evaluated consequences of bucket dredging in the Delaware River and determined that lethal effects on fish due to turbid waters can occur at levels between 580 mg/L to 700,000 mg/L, depending on the species. The studies reviewed by Kjelland *et al.* (2015) found that, depending on species, reported mortality ranged from 10 to 100 percent when exposed to TSS levels ranging from 300 to 300,000 mg/L after exposure periods ranging from 24 to 48 hours. Wilber and Clarke (2001) found that for adult estuarine species, TSS effects ranged from “no effect” when exposed to 14,000 mg/L for a duration of three days for two species to the lowest observed concentration that caused mortality at 580 mg/L after one day of exposure for Atlantic silverside. The concentration of suspended sediment is not the only factor determining consequences but also the duration at which a fish is exposed. Most studies report response after exposure ranging from 24 to 48 hours.

There have been no directed studies on the physiological consequences of increased TSS on sturgeon. However, Kjelland *et al.* (2015) noted that benthic species in general are more tolerant to suspended sediment than pelagic species. Sturgeon adults are often documented in turbid water. As such, Atlantic and shortnose sturgeon are assumed to be at least as tolerant to suspended sediment as other estuarine fish. Therefore, we expect sublethal and lethal consequences on sturgeon to occur when exposed to 24 hours of concentrations at or above 580 mg/L.

High TSS levels can cause a reduction in DO levels. 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 time periods. 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.

As is the case with physiological consequences, behavioral response to increased TSS and turbidity plumes varies among species and depends on their specific biology such as sensory capabilities and adaptive strategies. Studies of how fish respond to suspended sediment have detected behavioral consequences of turbidity on feeding and vulnerability to predation (Kjelland *et al.* 2015, Wilber and Clarke 2001). High turbidity may affect feeding efficiency for species using visual detection during foraging, which again can result in reduced growth, fecundity or increase stress, and susceptibility to disease and parasites. However, increased TSS and turbidity, at levels below what would cause physiological consequences, is not likely to substantially affect sturgeon foraging. Sturgeon typically occur in turbid waters and sturgeon forage by rooting along the bottom with their snout in search for benthic prey that they grasp with their protuberant mouth (Kynard *et al.* 2016). During foraging, they use their barbels as sensory organs to detect prey (Hilton *et al.* 2016, Kynard *et al.* 2016). Atlantic sturgeon also actively forage during night (Dadswell *et al.* 1984). Based on foraging method, tolerance to high turbidity and foraging during night it is unlikely that visual detection of prey is of major importance for sturgeon foraging success. Elevated TSS levels resulting in physiological consequences may elicit avoidance behavior and movement away from turbidity plumes. Studies on another anadromous species, striped bass, showed that pre-spawners did not avoid TSS concentrations of 954 mg/L to 1920 mg/L to reach spawning sites (Combs 1979 in Burton 1993, Summerfelt and Mosier 1976).

6.3.2 Extent and Intensity of Water Quality Changes from Construction Activities

6.3.2.1 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 ft (152, 305, 610, and 1006 m) 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 ft (610 m) from the dredge site. In support of the NY/NJ Harbor Deepening Project, the U.S. Army Corps of Engineers conducted extensive monitoring of mechanical dredge plumes (USACE 2015). The dredge sites included the Upper NY 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 ft (183 m) of the source in the upper water column and 2,400 ft (732 m) in the lower water column. Based on these studies, elevated TSS 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 ft (732 m) radius of the dredge location.

Dissolution of contaminants during dredging could degrade water quality and affect foraging habitat value. In addition, the release of effluent during the dewatering of dredged sediment may temporarily increase TSS concentrations, thus elevating turbidity in the receiving waterbody. During dredging in San Francisco Bay, it was found that dissolution of metals or organic contaminants was limited and resulted in concentrations too low to be of ecological concern (Jabusch *et al.* 2008). Massport and the USACE monitored dissolved contaminants downstream of CAD (confined aquatic disposal) cell disposal operations in Boston Harbor during the Boston Harbor Navigation Improvement Project (BHNIP) and found similar results. There were no violations of water quality criteria during dredging or disposal of silt material during the BHNIP (Roux 2024).

6.3.2.2 Pile Driving

The installation of piles will disturb bottom sediments and may cause a temporary increase in TSS in the action area. Using available information collected from a project in the Hudson River, we expect pile driving activities to produce TSS concentrations of approximately 5.0 to 10.0 mg/L above background levels within approximately 91 m (300 ft) of the pile being driven (FHWA 2012). The small resulting sediment plume is expected to settle out of the water column within a few hours.

6.3.2.3 Stormwater Effluent

The release of stormwater from the Port site during operations may temporarily increase TSS concentrations, thus elevating turbidity in the receiving waterbody. Stormwater effluent from the Port could affect water quality for aquatic species, including sturgeon.

One 24-in diameter stormwater outfall is proposed as part of the Port redevelopment project.

The proposed actions are required, and would be permit authorized, to provide water quality management to current standards, and to alleviate localized flooding. The stormwater at the site will be managed by a single water quality structure using a proprietary system called the Jellyfish Filter Stormwater Treatment system³⁷, manufactured by CONTECH. The stormwater treatment system will remove approximately 80 percent of TSS, floatables, trash, oils, and a high percentage of particulate-bound pollutants including phosphorus, nitrogen, metals, and hydrocarbons. The system will require quarterly active maintenance by the Port. The system has been certified by the NJ Corporation for Advanced Technology (NJCAT) – Field Performance per TARP Tier II Protocol. The system will be designed to control the 2- year storm (1.25 in of rain in two hours). These treatment practices will remove or reduce pollution from stormwater runoff prior to being discharged to the Salem River. The proposed stormwater management work would result in overall improvements from existing stormwater water quality conditions. Furthermore, given the strong tidal currents in the Salem River, the effluent would continue to be rapidly diluted after discharge to the receiving water.

6.3.2.4 Vessel Operation

Hayes *et al.* (2010) estimated that tugs supporting dredging and construction activities can cause significant scour and resuspension of bottom sediments, potentially more than the dredging itself, because they often work in shallow water where the riverbed consists of fine, soft sediment. They modeled resuspension of highly erodible bottom sediment of indefinite depth from various types of vessels at various propeller clearance. They estimated that an 1,800 horsepower (HP) tug operating at 25 percent power and moving forward at one knot could resuspend from 8,300 kilograms per second (kg/s) at 7.7 m propeller clearance to 14,000 kg/s at 1.7 m propeller clearance (Hayes *et al.* 2010). A small push boat with a 180 HP engine could potentially resuspend 1,000 to 5,000 kg/s at 1.4 m propeller clearance depending on power used. Even with a 3.4 m propeller clearance, the small push boat could resuspend up to 70 kg/s if operating at full power. Based on the model results, Hayes *et al.* (2010) concluded that resuspension flux by support vessels (tugs) could exceed that of the dredging itself. The tugs supporting dredging and construction of the Port will have a draft of approximately up to 12ft. Tugs will not be restricted to the dredge footprint and we expect these to operate throughout the action area.

Similar to most of the sediment transport observations in open-channel flow, the maximum concentration from propeller disturbance of bottom sediment is located near the surface of the riverbed with the suspended-sediment concentration gradually decreasing toward the water surface. Additionally, at any level in the water column, the concentration also decreases with time. Clarke *et al.* (2015) measured TSS concentrations after deep draft vessel passage in the Newark Bay, NJ, of 90 mg/l over broad areas following vessels maneuvers. TSS levels remained detectable against ambient levels at least 50 minutes where tidal currents could disperse plumes. Residual plumes (maximum 40 mg/l) in the lower two meters remained detectable at least 65

³⁷ <https://www.conteches.com/stormwater-management/filtration/jellyfish-filter/>

minutes after deep draft vessel passage. Field measurements of suspended sediment concentration behind a container vessel departing through a restricted fairway at a port in Hamburg, Germany, reached 550 mg/l (Stoschek *et al.* 2014). Concentrations at the focal point of propeller scour when a vessel with little clearance is maneuvering (*e.g.*, at start of movement from a still position) can exceed 1,000 mg/l but the plume will quickly dilute as the vessel start moving and the plume disperses (PIANC 2008, Stoschek *et al.* 2014). The vessels described above are larger with more powerful engines and have deeper draft than the tug vessels analyzed here, therefore, we expect the measured TSS levels above to be the maximum TSS levels generated by tugs operating in action area with little clearance.

6.3.2.5 Fill Placement

Backfill will be placed below the MHWL landward of the sheet pile bulkhead within a 0.087 acre (3,770 ft²) area. The placement of fill for construction of the Port could result in temporary, localized increases in suspended sediment at the site. Suspended sediment concentrations and sediment plumes associated with the construction fill placement are expected to be lower than those associated with dredging. As a proxy to evaluate potential sediment concentrations and turbidity plume, we use turbidity associated with beach nourishment.

Wilber *et al.* (2006) reported that elevated total suspended sediment (TSS) concentrations associated with an active beach nourishment site were limited to within 1,312 ft (400 m) of the discharge pipe in the swash zone (defined as the area of the nearshore that is intermittently covered and uncovered by waves). Another study, conducted five years later, found that the turbidity plume and elevated TSS levels were expected to be limited to a narrow area of the swash zone up to 1,640 ft (500 m) down-current from the discharge pipe (Burlas *et al.* 2001). Considering beach nourishment materials consist primarily of coarse sands, plumes from the discharge should settle rapidly and not affect large areas. Based on this and the best available information, TSS concentrations created by beach nourishment operations along an open coastline are expected to be between 34.0-64.0 mg/L; limited to an area approximately 1,640 ft (500 m) down-current from the discharge pipe; and, settle within several hours after discharge cessation.

6.3.3 Exposure to Suspended Sediment

Stormwater effluent discharge from the new stormwater outfall could occur any time of the year. However, we expect the filtration system will eliminate listed species exposure to elevated concentrations of suspended sediment. Dredging, pile driving, and fill placement will occur where adult, subadult, and juvenile Atlantic sturgeon and adult and juvenile shortnose sturgeon may be present. Thus, these activities, including vessel operations, may expose all these life stages to elevated sediment concentration and turbidity, as detailed previously.

6.3.4 Response to Exposure

Adult and subadult sturgeon are frequently found in turbid water and would be capable of avoiding any sediment plume by swimming higher in the water column. Laboratory studies (Niklitschek 2001, Secor and Niklitschek 2002) have demonstrated shortnose sturgeon are able to actively avoid areas with unfavorable water quality conditions and that they will seek out more favorable conditions when available. Additionally, the highest TSS levels expected for any of the dredging is up to 445 mg/L (mechanical dredging), which is below those shown to have lethal and sublethal consequences on estuarine fish (typically up to 1,000.0 mg/L; see summary of scientific literature in Burton 1993, Wilber and Clarke 2001). Occasionally, some localized, short-term concentrations above 1,000 mg/l can occur at the propeller scour focal point behind a vessel during vessel maneuvering with very little clearance in an area with highly erodible fines but we expect sturgeon to avoid the turbidity plume. Thus, we do not expect them to be exposed to the higher concentrations near the scour. Even for suspended sediment concentrations above 1,000 mg/l, the fish will have to be exposed for hours or days before physical injury occurs. Based on this, we expect consequences to sturgeon exposed to the sediment plume to be so small that they cannot be meaningfully measured, detected, or evaluated and therefore, insignificant.

Elevated TSS is most likely to affect sturgeon if a plume causes a barrier to normal behaviors. However, the increase in TSS levels expected are below those shown to have adverse consequences on fish. Moreover, sturgeon are likely to avoid the sediment plume at the focal point where the propeller jet hits the bottom and suspended sediment concentrations are highest. Thus, we expect sturgeon to either swim through the plumes or make small evasive movements to avoid them.

Even if sturgeon avoid the turbidity plume, this will not be a barrier to migrations because sturgeon are not known to use the entirety of the Salem River, but may opportunistically forage at the mouth of the River. Elevated suspended sediment levels at the Port site in the Salem River that may cause avoidance will be the sediment plumes generated by pile driving, mechanical dredging, and fill placement, with radii of 91 m (298.5 ft), 732 m (2,400 ft), and 500 m (1,640 ft), respectively. The sediment suspended during dredging will quickly decrease to low concentrations as the distance increases from the dredging area and the sediment falls out of the water column. Any TSS levels that may cause avoidance will be closer to the construction / dredging area than the full extent of the sediment plume. Therefore, the resulting sediment plumes are not expected to extend into the Delaware River. Any avoidance of the plume will not impact or delay upstream or downstream migration of sturgeon in the Delaware River and is not expected to hinder sturgeon foraging in the Salem River.

Sturgeon feed on a large range of prey and actively move over the riverbed in search of forage when foraging. The small evasive movements that would be necessary to avoid elevated TSS concentrations would be within their normal range of movements and we do not expect this to increase normal energy use. Thus, it is extremely unlikely that these movements will result in any effect on the health of any sturgeon. Furthermore, elevated TSS would be temporary, brief,

and limited in area – elevated TSS is expected to extend a maximum of 732 m (2,400 ft) from the dredge area.

6.3.5 Consequences of Interaction with Suspended Sediment

Construction and operation of the Port may expose Atlantic sturgeon and shortnose sturgeon to TSS concentrations and turbidity above baseline conditions. However, TSS concentrations will remain below concentrations that cause physiological consequences; effects to the health of any sturgeon are extremely unlikely to occur. The increased turbidity expected to only temporarily impact foraging. Sturgeon may avoid turbidity plumes, but this will not be a barrier to migration. Sturgeon may make small evasive movements to avoid turbidity plumes, but these small adjustments will be so small that effects cannot be meaningfully measured, detected, or evaluated and are therefore insignificant.

6.4 Benthic Habitat Modification and Loss of Forage

The proposed project will remove sediments and disturb the riverbed through dredging and fill placement in the Salem River. In addition, the operation of vessel propellers may result in scoring effects in portions of the action area where there is minimal depth between the river bottom and the propellers (i.e., in the Salem River and East River). However, impacts of these changes are expected to be limited given that all project activities will occur in areas that are industrialized and already disturbed. For example, the increase in trips to Pier J in the East River, scouring may result in minimal impacts to benthic habitat in that area.

Soft substrate supports a variety of benthic invertebrates that are important prey for sturgeon and sea turtles. Therefore, removal and disturbance of the bottom sediment can eliminate or reduce forage for sturgeon and sea turtles.

6.4.1 Intensity and Extent of Habitat and Forage Impacts

The action area within the Salem River consists of mainly sand, consisting of fine to medium grains with trace silt and gravel, clay laminations and interbedding. There are swift currents within the action area in the Salem River (maximum tidal currents of approximately 1.5–2.0 knots (0.77–1.03 m/sec) (NOAA 2025). Salinity within the tidal Salem River is similar to that in the adjacent Delaware River, ranging from approximately 2–10 ppt, and varying with time of year, tidal stage, and local meteorological conditions. Therefore, this habitat may support benthic invertebrates that are prey for sturgeon. Sea turtles are not expected to use the habitat in the Salem River.

The action area within the East River consists of gravel, cobble, and rocks covered with a shallow layer of soft sediment. The lower East River at Pier J, Brooklyn, NY is tidally dominated and salinity is approximately 28 ppt. Therefore, this habitat may support benthic invertebrates that are prey for sturgeon and sea turtles.

6.4.1.1 Dredging

The total dredge footprint occupies approximately 1.30 acres of the existing riverbed within the Salem River. The area of the Port is to be dredged to minimum of -16 ft below MLW to -22 ft below MLW plus an allowable two feet of over-dredge. Dredging will temporarily remove or displace all benthic invertebrates within the dredge footprint. We expect that this activity 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). Dredging is likely to entrain and kill at least some of mobile invertebrates. Further, turbidity and elevated suspended sediments from dredging activities may affect benthic resources in those areas. TSS levels expected to occur during active dredging in the immediate dredge footprint (up to 445 mg/L) exceed the levels shown to have adverse consequences on benthic invertebrates (390 mg/L) (EPA 1986).

Studies done by Wilber and Clarke (2001) demonstrate that benthic communities in temperate regions occupying shallow waters with substrate of sand, silt, or clay reported recovery times between one and 11 months after dredging. Therefore, if a dredge site remains undisturbed after dredging, the benthic invertebrate fauna within the dredged areas could recover to pre-project conditions within one year following completion of the initial dredging.

6.4.1.2 Vessel traffic

Depth in the East River ranges from 9 to 26 ft at MLLW and from 0 to 18 ft in the Salem River, therefore, vessels maneuvering in these shallow waters may result in minor erosion of the riverbed and suspension of sediment (Breedveld *et al.* 2018, PIANC 2008, Stoschek *et al.* 2014). Erosion of the riverbed and resuspension of sediment will affect the composition, density, and availability of benthic invertebrates (Gabel 2012). The strong swirling jet flow induced by a rotating ship propeller causes shear stress that can cause considerable scour to the riverbed (Breedveld *et al.* 2018, Hong *et al.* 2013, Hong *et al.* 2016, Karaki and van Hoften 1975). Because the propeller-induced bed shear stress is a main stirring force, sediment erosion, resuspension and deposition are all expected to be closely related to vessels maneuvering in narrow channels and while docking (Karaki and van Hoften 1975, PIANC 2008).

Several theoretical models and empirical methods to calculate the amount of scour and sediment transport caused by propeller shear stress and jet propulsion have been developed (Breedveld *et al.* 2018, Hong *et al.* 2016, PIANC 2008, Stoschek *et al.* 2014). However, we cannot quantify the amount of bed erosion and sediment resuspension, expected TSS by a single vessel docking at the proposed terminal, or the direction and extent of the sediment plume given that it depends on a variety of factors, including but not limited to tidal fluctuations, turbulence dynamics of the river reach, salinity layers, and the density of vessel traffic. Nevertheless, studies of berthing areas and docks show that vessels maneuvering at docks commonly result in substantial scouring of the riverbed and increased TSS in the water column (Breedveld *et al.* 2018, PIANC 2008, Stoschek *et al.* 2014). Because the propeller-induced bed velocity and shear stress is strongest when vessels start from a still position, are repositioning, or are increasing use of horsepower,

resuspension and deposition are expected to be highest during a vessel's maneuvering and docking operations, *i.e.*, situations where vessels start, stop, accelerate, and decelerate (Karaki and van Hoften 1975, PIANC 2008). We expect the propeller jets from large vessels to hit the bottom in the access channels and berths. Vessels approaching, docking at, and departing from the Port and Pier J may use Dynamic Positioning (DP) thrusters to maneuver and maintain position in the berthing areas. The water jet from thrusters have been shown to cause erosion (PIANC 2008). Thus, the DP thrusters, as well as vessel propellers and hulls, have the potential to disturb the river bottom and associated benthic invertebrate community in the access channels and berths. However, given that vessels already use these areas and that the bottom substrate is already continuously disturbed, the quality and quantity of prey for sturgeon and sea turtles is likely low. Therefore, the proposed action would only contribute minimal additional effects to the already disturbed substrate in the Salem and East River. We expect that any additional impacts to the baseline would be temporary.

6.4.2 Exposure to Changes in Habitat and Forage

As previously described, adult, subadult, and juvenile Atlantic sturgeon and adult and juvenile shortnose sturgeon may occur within the action area in the Salem River and subadult and adult Atlantic sturgeon, subadult and adult sea turtles, and adult shortnose sturgeon may occur within the action area in the East River.

Sturgeon and sea turtles will be exposed to the temporary loss and permanent reductions of benthic prey within the action area. Sturgeon will be exposed to the temporary loss 1.30 acres of benthic prey habitat due to dredging within the Salem River. Permanent aquatic resource alteration from fill placement in the Salem River will reduce sturgeon foraging within a 0.457 acre area. Based on this, the Port construction (dredging and fill placement) will temporarily expose sturgeon to reduced foraging opportunities within a 1.30 acre area and permanently reduce foraging opportunities within a 0.457 acre area, however, this area constitutes only a small percentage of the available habitat for sturgeon foraging in the Salem River. The action area also includes operational vessel routes in the Salem River, Delaware River, and East River where erosion of the riverbed and suspension of sediment may occur due to vessel activity related to Port operations, which may impact the available habitat for sturgeon and sea turtle foraging. However, given that the area between the Port in the Salem River and the Federal Navigation Channel in the Delaware River is a maintained navigation channel (Salem River Federal Navigation Channel) subject to regular maintenance dredging, we expect the baseline habitat to be degraded. Therefore, the proposed action may contribute only minimal additional effects to the already degraded benthic prey availability within the action area where disturbance of bottom habitat may occur due to vessel disturbance.

6.4.3 Response to Changes in Habitat and Forage

Sturgeon and sea turtles may forage on benthic invertebrates that are present within the action area. The loss of invertebrates and long-term disturbance of benthic habitat will limit sturgeon

and sea turtle ability to forage within the vicinity of the Port and Pier J while the Port is active. Although the action area still contains areas of soft bottom substrate, the quality of the habitat in the Salem River, Delaware River, and East River are impacted by regular maintenance dredging and vessel traffic. That said, operational vessel routes plus the dredge and fill placement footprint of this action occurs in only a small percentage of the action area. As such, the proposed project will expose sturgeon and sea turtles to an extremely small reduction in forage habitat. The reduction in forage from construction activities (dredging and fill placement) and scour from vessel traffic represents a very small percentage of foraging habitat used by the sturgeon and sea turtles.

When added to existing bottom disturbances, the proposed project will affect a relatively small portion of river bottom and may reduce the availability of benthic invertebrate prey in this area. Further, given that the habitat affected is already disturbed, it is not expected to be frequently used by foraging sea turtles or sturgeon. Given the very small area affected and the transient nature of these effects, this is not expected to result in changes in the distribution and foraging behavior of sturgeon or sea turtles in the action area. Based on this, we have determined that the consequence to individual Atlantic and shortnose sturgeon and sea turtles from the impacts to habitat and forage from construction activities (dredging and fill placement) and vessel trips to and from the Port is too small to be meaningfully measured, detected, or evaluated. Therefore, effects are insignificant.

6.5 Vessel Activity during Port Construction and Operation

Construction and operation of the Port will increase vessel trips in the action area. A temporary increase in vessel traffic will occur during the construction period, largely localized to the project area. Operational vessels trips to/from the Port as a result of the proposed upgrades will occur as a result of the action, and existing vessel transits to/from the port are expected to continue.

Moving vessels are known risks to sea turtles, Atlantic sturgeon, and shortnose sturgeon throughout their range and in the action area. Examination of sturgeon carcasses and sea turtle strandings within the action area support the existence of this risk (Balazik *et al.* 2012d, Brown and Murphy 2010; also, see discussion in previous sections of this Opinion). An operating vessel can cause injury or death to these species via hull or propeller strikes, as well as through entrainment in the propeller. In this section of the Opinion, we consider if the increase in vessel traffic caused by the action, when added to the baseline, will increase the risk of interactions with sea turtles and sturgeon in the action area.

6.5.1 Increase in Vessel Traffic from the Proposed Project

Approximately six vessels of various classes will be used during the construction phase of the project with a total of 14 one-way vessel trips from homeports located on the Delaware River to the Port (Table 1). As all in-water construction will occur between July 1 through March 15, construction vessels will only be active during that window. Dredging will utilize one barge-

mounted bucket dredge, one scow to collect dredged material, a tug, and a skiff for workers. The scow will transport dredged material from the project site to White's Basin in Logan Township, NJ, approximately 25 miles (40 km) up the Delaware River from its confluence with the Salem River. Pile driving will be supported by one barge-mounted crane, one material barge, a tug, and a skiff to transport workers. The same tug and skiff will support both pile driving and dredging operations. Tugs and barges used for construction will move at speeds less than 6 knots. The draft of construction vessels will range from 2 to 12 ft.

Prior to this action, the Port has supported an average of 64 annual one-way self-propelled vessel trips from the Port to Pier J in Brooklyn, NY. All vessel trips, existing and anticipated, supporting sand mining operations at the Port will travel the same route, during the same time period, and benefit from the extended 30-year operational life of the Port for sand transport operations (Table 2). Although these vessel trips were included as part of baseline vessel traffic in previous NMFS Opinions for the Delaware River Main Channel Deepening and maintenance dredging project (the most recent of which was issued in November 2019 (Hayes *et al.* 2019)), the effects of the vessel trips to and from this Port have never been analyzed. Furthermore, there is new information about vessel interactions with ESA species, particularly Atlantic sturgeon, that need to be considered when analyzing effects from vessel traffic in the Delaware River. Therefore, we will analyze the potential effects to species from the 64 annual one-way vessel trips from the Port to Pier J, Brooklyn, NY in this Opinion.

In addition to the 64 ongoing vessel trips for sand transport described above, the proposed Port upgrades are expected to result in an expansion of sand transport operations. As described in the BA, these future vessel transits are reasonably certain to occur and anticipated by the federal action agencies and the applicant. Over the 30-year life of the operational port, the BA describes a maximum of 70 additional one-way self-propelled vessel trips from the Port to Pier J in Brooklyn, NY for sand transport each year. Additionally, the federal action agencies and the applicant anticipate 24 annual one-way vessel trips from the Port to unknown destinations transporting general cargo and bulk material using vessels of various classes with drafts ranging from 17.9 to 20.5 ft (Table 38). In total, 158 one-way vessel trips are expected to transit from the Port each year, as described in Table 38 below.

Table 38. Total Number of Annual Self-Propelled Vessel Trips during Port Operation

Vessel Activity	Vessel Type	Number of One-Way Trips from the Port per Year	Destination
Current Sand Transport Operations	Tug (Max. L96' x W33' x D17.9') Barge (Max. L330'6" x W78" x D20'5")	64	Pier J, Brooklyn, NY
Expansion of Sand Transport	Tug (Max. L96' x W33' x D17.9') Barge (Max. L330'6" x W78" x	70	Pier J, Brooklyn, NY

Operations	D20'5")		
Cargo / Bulk Material Transport	Handymax (Max. L350' x D20') vessels or smaller	24	Unknown

Vessel Traffic in the Delaware River, Delaware Bay, and NY and NJ Channels

As explained in the *Environmental Baseline*, the areas to be transited by the vessels related to Port operations have relatively high levels of vessel traffic. The best available information indicates there were approximately 11,782 average annual self-propelled vessel trips in the NY and NJ Channels (*i.e.*, the area traveled between the Port and Pier J) between 2014 and 2023, which includes the Upper & Lower NY Harbor and East River portion of the action area. There were approximately 35,669 average annual self-propelled vessel trips from 2013 to 2019 in the Delaware River Philadelphia to the Sea Federal Navigation Channel (*i.e.*, operational and construction vessel traffic routes).

Table 39 below describes the calculated increase in vessel traffic attributable to Port operations (*i.e.*, the 158 vessel trips associated with Port operations) considering the estimates of Port vessel transits and the information on existing vessel transits in the areas where these trips will occur.

Table 39. Percent increase above baseline vessel traffic in the action area by Port of Salem vessels (USACE Waterborne Commerce 2021).

Location	Vessel Type	Annual Project-Related One-Way Self-Propelled Vessel Trips	Annual	Phase	Percent
Delaware River & Delaware Bay	All Operational Vessels *	Ongoing 64	35,669	30 years	0.180%**
		New 94			0.264%
Delaware River	Construction Vessels	Temporary construction vessel trips 14	35,669***	3 years	0.039%
Upper & Lower NY Harbor and East River	Sand Transport Operation Vessels ****	Ongoing 64	11,782	30 years	0.543%**
		New 70			0.594%

*All operational vessels will transit in the Delaware River and Bay (n = 158), regardless of destination. There will

be 94 new trips annually and 64 trips will continue to occur annually.

** Given that these trips are ongoing and will continue to occur in the future, we calculate the percentage of the total baseline for these trips, not the percent increase.

*** As discussed in Environmental Baseline, the USACE's Waterborne Commerce data for the Philadelphia to the Sea range was used in this analysis of baseline vessel traffic because it most closely overlaps with the action area for construction vessels.

**** Of the 158 projected trips per year leaving the Port, a total of 134 trips annually will occur between the Port and Pier J, Brooklyn, NY for sand operations. These vessels will transit in the channels of Upper and Lower NY Harbor.

6.5.2 Minimization and Monitoring Measures for Vessel Operations

As described above, there are a number of measures that the applicant is proposing to take or MARAD / USACE is proposing to require that are designed to avoid, minimize, or monitor effects of vessel traffic on ESA-listed species. Although some of these measures were intended to reduce vessel strike risk to whales, they may also minimize potential for interactions with sea turtles, shortnose sturgeon, and Atlantic sturgeon. The complete list of required measures is provided in Section 3 above. These measures can be grouped into two main categories: vessel speed reductions and increased vigilance/animal avoidance. These measures are all considered part of the proposed action including those otherwise required by regulation (62 FR 6729, February 13, 1997), (66 FR 58066, November 20, 2001), (73 FR 60173, October 10, 2008).

6.5.3 Background Information on the Risk of Vessel Strike to Sea Turtles

While research is limited on the relationship between sea turtles, ship collisions, and ship speeds, sea turtles are at risk of vessel strike where they co-occur with vessels. Sea turtles are vulnerable to vessel collisions because they regularly surface to breathe, and often rest at or near the surface. Sea turtles, with the exception of hatchlings and pre-recruitment juveniles, spend a majority of their time submerged (Renaud and Carpenter 1994, Sasso and Witzell 2006). Although, Hazel *et al.* (2007) demonstrated sea turtles preferred to stay within the one ft (3 m) of the water's surface, despite deeper water being available. Similarly, Stokes *et al.* (2024) concluded that sea turtles swim at depths of around three times their body depth in order to maximize efficiency in the water, deep enough to not create waves at the surface, but not much deeper to avoid travelling further than necessary up and down the water column for breath. Any of the sea turtle species found in the action area can occur at or near the surface in coastal areas, whether resting, feeding or periodically surfacing to breathe. Therefore, all ESA-listed sea turtles considered in this Opinion are at risk of vessel strike.

A sea turtle's detection of a vessel is thought to be based primarily on the animal's ability to see the oncoming vessel, which would provide less time to react to as vessel speed increases (Hazel *et al.* 2007), however, given the low vantage point of a sea turtle at the surface it is unlikely they are readily able to visually detect vessels at a distance. Hazel *et al.* (2007) examined vessel strike risk to green sea turtles and suggested that sea turtles may habituate to vessel sound and are more likely to respond to the sight of a vessel rather than the sound of a vessel, although both may play a role in eliciting responses (Hazel *et al.* 2007). Regardless of what specific stressor

associated with vessels turtles are responding to, they only appear to show responses (avoidance behavior) at approximately 10 m or closer (Hazel *et al.* 2007). This is a concern because faster vessel speeds also have the potential to result in more serious injuries (Work *et al.* 2010). Although sea turtles can move quickly, Hazel *et al.* (2007) concluded that at vessel speeds above 4 km/hour (2.1 knots) vessel operators cannot rely on turtles to actively avoid being struck. Thus, sea turtles are not considered reliably capable of moving out of the way of vessels moving at speeds greater than 2.1 knots.

Stranding networks that keep track of sea turtles that wash up dead or injured have consistently recorded vessel propeller strikes, skeg strikes, and blunt force trauma as a cause or possible cause of death (Chaloupka *et al.* 2007). Vessel strikes can cause permanent injury or death from bleeding or other trauma, paralysis and subsequent drowning, infection, or inability to feed. Apart from the severity of the physical strike, the likelihood and rate of a turtle's recovery from a strike may be influenced by its age, reproductive state, and general condition at the time of injury. Much of what has been documented about recovery from vessel strikes on sea turtles has been inferred from observation of individual animals for some duration of time after a strike occurs (Hazel *et al.* 2007, Lutcavage *et al.* 1997). In the U.S., the percentage of strandings that were attributed to vessel strikes increased from approximately 10 percent in the 1980s to a record high of 20.5 percent in 2004 (NMFS and U.S. FWS 2007b). In 1990, the National Research Council estimated that 50-500 loggerhead and 5-50 Kemp's ridley sea turtles were struck and killed by boats annually in waters of the U.S. (NRC 1990). The report indicates that this estimate is highly uncertain and could be a large overestimate or underestimate.

Vessel strike has been identified as a threat in recovery plans prepared for all sea turtle species in the action area. 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 America 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. The proportion of vessel- struck sea turtles that survive is unknown. In some cases, it is not possible to determine whether documented injuries on stranded animals resulted in death or were post-mortem injuries. However, the available data indicate that post-mortem vessel strike injuries are uncommon in stranded sea turtles. Based on data from off the coast of Florida, there is good evidence that when vessel strike injuries are observed as the principle finding for a stranded turtle, the injuries were both ante-mortem and the cause of death (Foley *et al.* 2019). Foley *et al.* (2019) found that the cause of death was vessel strike or probable vessel strike in approximately 93 percent of stranded turtles with vessel strike injuries. Sea turtles found alive with concussive or propeller injuries are frequently brought to rehabilitation facilities; some are later released and others are deemed unfit to return to the wild and remain in captivity. Sea turtles in the wild have been documented with healed injuries so at least some sea turtles survive without human intervention. As noted in 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 America. In general, the overall risk of strike for sea turtles in the Northwest Atlantic is considered greatest in areas with high densities of sea turtles and small, fast moving vessels such as recreational vessels (NRC 1990). This combination of factors in the action area is limited to nearshore areas and the transit routes to the Port where the vast majority of vessel traffic will occur.

We queried the NMFS' Sea Turtle Stranding and Salvage Network (STSSN) database for records of sea turtles with injuries consistent with vessel strike (recorded as definitive vessel and blunt force trauma in the database) by location in the action area (*i.e.*, NY / NJ Channels, Delaware Bay). Within Delaware Bay and the lower Delaware River waters between 2013 and 2019, there were 77 records of sea turtles with either definitive evidence from vessel strikes or blunt force trauma, which indicates probable vessel collision (loggerheads ($n = 58$), leatherbacks ($n = 1$), Kemp's ridleys ($n = 9$), green ($n = 4$) turtles, and 5 unknown species). These years provide the best available timeseries for vessel traffic and sea turtle mortalities in the Delaware River and Bay, because we expect that the COVID pandemic significantly disrupted public reporting of sea turtle carcasses and the total annual number of vessel trips decreased during in 2020 and 2021 in the Delaware River (USACE Waterborne Commerce 2021), as discussed in the *Environmental Baseline* section. Given that five of the mortalities are of unknown species, we will not consider these five mortalities in the estimate of vessel strike morality below. Within NY / NJ Channels (Upper and Lower NY Bay and East River portion of the action area) from 2014 through 2023, there were 102 records of sea turtle standings that had either definitive evidence from vessel strikes or blunt force trauma (loggerheads ($n = 88$), leatherbacks ($n = 8$), Kemp's ridleys ($n = 5$), and green ($n = 1$)). As discussed previously, the COVID pandemic significantly disrupted public reporting of sea turtle carcasses in 2020 and 2021, however, total annual vessel trips that occurred within the NY / NJ Channels throughout those years remained consistent with previous years (USACE Waterborne Commerce 2021), therefore, data for 2014 and 2023 were used in this analysis. As anticipated, based on abundance of turtle species in the action area, the majority of these records are of loggerhead sea turtles. While we recognize that some vessel strikes may be post-mortem, the available data indicate that post-mortem vessel strike injuries are uncommon in stranded sea turtles (Foley *et al.* 2019).

6.5.4 Consequences of Vessel Transits on Sea Turtles

As described above, STSSN data for records of sea turtles with injuries consistent with vessel strike by location in the action area (*i.e.*, NY / NJ Channels, Delaware Bay). These geographic areas include the waters that will be transited by operational vessels traveling routes from the Port to either Pier J, Brooklyn, NY (sand transport operations) in the East River or an unknown destination (general bulk cargo operations). While the area encompassed in the NY / NJ Channels dataset is larger than the area where those vessel transits will occur (Upper and Lower NY Bay and East River), this area is considered the best representation of the area where sea

turtles struck by vessels operating in that area would strand. The results from this query are presented in Table 40.

Given that construction vessels will transit in the Delaware River from the Port to White’s Basin, these vessel trips will not overlap with the areas where sea turtles are expected to occur, therefore, impacts from construction vessel trips to sea turtles will not be considered further.

Consequences of Vessel Transits on Sea Turtles in the Atlantic Ocean between Delaware Bay and Upper and Lower NY Bay/East River

Sea turtles are expected to be highly dispersed in offshore waters and, given that project vessels will transit five miles offshore, the likelihood of co-occurrence is low in these waters. Project vessels have the greatest chance to co-occur with sea turtles in the nearshore waters, near major ports, or in the shipping lanes. An estimated 74,000 vessel transits a year occur in the Mid-Atlantic area, a 0.18 percent increase annually in vessel traffic along the coast of NJ is expected as a result of the proposed Port over a 30-year period. Given the very small increase in vessel traffic and associated very small increase in subsequent risk, effects of this increase in traffic resulting in vessel strikes of sea turtles is extremely unlikely, and therefore, discountable.

Consequences of Vessel Transits on Sea Turtles in Delaware Bay, the lower Delaware River, Upper and Lower NY Bay, and the lower East River

Based on the findings of Foley *et al.* (2019) that found vessel strike was the cause of death in 93 percent of strandings with indications of vessel strike, we consider that 93 percent of the sea turtle strandings recorded in the STSSN database as “definitive vessel” and “blunt force trauma” had a cause of death attributable to vessel strike. Therefore, to estimate the number of interactions where vessel strike was the cause of mortality, we used the total number of “definitive vessel” and “blunt force trauma” cases to get a total number of sea turtle strandings with indications of vessel strike for both the Delaware Bay/ lower Delaware River, the Upper and Lower NY Bay, and East River. Then, we calculated 93 percent of the total to estimate the total presumed vessel mortalities by location within the action area and calculated the total vessels mortalities per year by dividing the result by the total number of years used for each dataset (seven years for Delaware Bay/ Lower Delaware River data and ten years for Upper and Lower NY Bay/ East River data) (Table 40).

Table 40. Preliminary STSSN cases with evidence of propeller strike or probable vessel collision within the action area.

Location within the Action Area	Sea Turtles	Total Strandings Attributable to Vessel Strike	Total Presumed Vessel Mortalities*	Total Presumed Vessel Mortalities per Year
Delaware Bay	Loggerhead	58	53.94	7.70571

Location within the Action Area	Sea Turtles	Total Strandings Attributable to Vessel Strike	Total Presumed Vessel Mortalities*	Total Presumed Vessel Mortalities per Year
and lower Delaware River	Green	4	3.72	0.53142
	Leatherback	1	0.93	0.13286
	Kemp's	9	8.37	1.21957
Upper and Lower NY Bay and East River	Loggerhead	88	81.84	8.184
	Green	1	0.93	0.093
	Leatherback	8	7.44	0.744
	Kemp's	5	4.65	0.465

Source: STSSN (2013 to 2023)

*93 percent of the total vessel plus blunt force trauma

The data in Table 40 reflect stranding records, which represent only a portion of the total at-sea mortalities of sea turtles. Sea turtle carcasses typically sink upon death, and float to the surface only when enough accumulation of decomposition gasses cause the body to bloat (Epperly *et al.* 1996). Though floating, the body is still partially submerged and acts as a drifting object. The drift of a sea turtle carcass depends on the direction and intensity of local currents and winds. As sea turtles are vulnerable to human interactions such as fisheries bycatch and vessel strike, a number of studies have estimated at-sea mortality of marine turtles and the influence of nearshore physical oceanographic and wind regimes on sea turtle strandings. Although sea turtle stranding rates are variable, they may represent as low as five percent of total mortalities in some areas but usually do not exceed 20 percent of total mortality, as predators, scavengers, wind, and currents prevent carcasses from reaching the shore (Koch *et al.* 2013). Strandings of dead sea turtles from fishery interaction have been reported to represent as low as seven percent of total mortalities caused at sea (Epperly *et al.* 1996). Remote or difficult to access areas may further limit the amount of strandings that are observed. Because of the low probability of stranding under different conditions, determining total vessel strikes directly from raw numbers of stranded sea turtle data will vary between regions, seasons, and other factors such as currents.

To estimate unobserved vessel strike mortalities, we relied on available estimates from the literature. Based on data reviewed in Murphy and Hopkins-Murphy (1989), only six of 22 loggerhead sea turtle carcasses tagged within the South Atlantic and Gulf of America region were reported in stranding records, indicating that stranding data represent approximately 27 percent of at-sea mortalities. In comparing estimates of at-sea fisheries induced mortalities to estimates of stranded sea turtle mortalities due to fisheries, Epperly *et al.* (1996) estimated that strandings represented 7 to 13 percent of all at-sea mortalities.

Based on these two studies, both of which include waters of the U.S. East Coast, stranding data likely represent 7 to 27 percent of all at-sea mortalities. While there are additional estimates of the percent of at-sea mortalities likely to be observed in stranding data for locations outside the action area (e.g., Koch *et al.* 2013, Peckham *et al.* 2008), we did not rely on these since stranding rates depend heavily on beach survey effort, current patterns, weather, and seasonal factors among others, and these factors vary greatly with geographic location (Hart *et al.* 2006). Thus, based on the mid-point between the lower estimate provided by Epperly *et al.* (1996) of seven percent, and the upper estimate provided by Murphy and Hopkins-Murphy (1989) of 27 percent, we assume that the STSSN stranding data represent approximately 17 percent of all at sea mortalities. This estimate closely aligns with an analysis of drift bottle data from the Atlantic Ocean by Hart *et al.* (2006), which estimated that the upper limit of the proportion of sea turtle carcasses that strand is approximately 20 percent.

To estimate the annual average of vessel strike mortalities corrected for unobserved mortalities, we adjusted our calculated total presumed vessel mortality with the detection value of 17 percent (*i.e.*, total presumed vessel mortality per year $\div$ 0.17) to obtain the annual number of reported and unreported vessel mortalities per year (Table 41). In using the 17 percent correction factor, we consider that all sea turtle species and at-sea mortalities are equally likely to be represented in the STSSN dataset. That is, sea turtles killed by vessel strikes are just as likely to strand or be observed at sea and be recorded in the STSSN database (*i.e.*, 17 percent) as those killed by other activities, such as interactions with fisheries, and the likelihood of stranding once injured or killed does not vary by species. This approach uses the best available scientific information to generate a reasonable estimate of total annual vessel strike mortalities in the geographic areas of interest.

Table 41. Estimated annual vessel strike mortalities corrected for unobserved vessel strike mortalities in the action area.

Location within the Action Area	Sea Turtles	Total Presumed Vessel Mortalities* per Year	Total Reported and Unreported Vessel Mortalities per Year (17% detection rate)
Delaware Bay and lower Delaware River	Loggerhead	7.70571	45.32771
	Green	0.53142	3.126
	Leatherback	0.13286	0.78153
	Kemp's Ridley	1.21957	7.17394
Upper and Lower NY Bay and East River	Loggerhead	8.184	48.14118
	Green	0.093	0.54706

	Leatherback	0.744	4.37647
	Kemp's Ridley	0.465	2.73529

*93 percent of the total presumed vessel related mortalities

Finally, as it is reasonable to assume a proportional relationship between vessel strikes and vessel traffic, we considered the location-specific increase in vessel traffic and increased the number of baseline strikes to account for the increase in project vessel traffic. As explained above, all operational and construction vessels related to the project are expected to occur within the Delaware River and Bay. A majority of the vessels will transit from the Port to Brooklyn, NY, while a small portion of the vessels will transit from the Port to unknown destinations once they exit the Bay. The formula used to generate the estimate of project vessel strikes over the different portions of the action area is: (annual baseline strikes by location)*(percent increase in traffic by location)*(years of the project phase). Ongoing operational vessel trips that are considered part of the baseline are calculated as (annual baseline strikes by location)*(percent of vessel traffic for ongoing trips)*(years of the project phase).

Ongoing operational vessels in the Delaware River and Bay³⁸ = 0.180 percent of vessel traffic for the next 30 years

Loggerhead sea turtles: $(45.32771)(0.00180)(30) = 2.45$ loggerhead sea turtles

Green sea turtles: $(3.126)(0.00180)(30) = 0.17$ green sea turtles

Leatherback sea turtles: $(0.78153)(0.00180)(30) = 0.04$ leatherback sea turtles

Kemp's Ridley sea turtles: $(7.17394)(0.00180)(30) = 0.39$ Kemp's Ridley sea turtles

New operational vessels in the Delaware River and Bay³⁸ = 0.264 percent increase in traffic for 30 years

Loggerhead sea turtles: $(45.32771)(0.00264)(30) = 3.59$ loggerhead sea turtles

Green sea turtles: $(3.126)(0.00264)(30) = 0.25$ green sea turtles

Leatherback sea turtles: $(0.78153)(0.00264)(30) = 0.06$ leatherback sea turtles

Kemp's Ridley sea turtles: $(7.17394)(0.00264)(30) = 0.57$ Kemp's Ridley sea turtles

Ongoing operational vessels in the Upper and Lower NY Bay and East River³⁹ = 0.543 percent of vessel traffic for the next 30 years

Loggerhead sea turtles: $(48.14118)(0.00543)(30) = 7.84$ loggerhead sea turtles

Green sea turtles: $(0.54706)(0.00543)(30) = 0.09$ green sea turtles

Leatherback sea turtles: $(4.37647)(0.00543)(30) = 0.71$ leatherback sea turtles

Kemp's Ridley sea turtles: $(2.73529)(0.00543)(30) = 0.45$ Kemp's Ridley sea turtles

New operational vessels in the Upper and Lower NY Bay and East River = 0.594 percent

³⁸ Calculated using 35,669 for the annual average baseline vessel traffic from the Waterborne Commerce dataset. See Table 39 for percent increase calculation.

increase³⁹ in traffic for 30 years

Loggerhead sea turtles: $(48.14118)(0.00594)(30) = 8.58$ loggerhead sea turtles

Green sea turtles: $(0.54706)(0.00594)(30) = 0.10$ green sea turtles

Leatherback sea turtles: $(4.37647)(0.00594)(30) = 0.78$ leatherback sea turtles

Kemp's Ridley sea turtles: $(2.73529)(0.00594)(30) = 0.49$ Kemp's Ridley sea turtles

As outlined above, the proposed action incorporates a number of measures designed to minimize the potential for strike of a protected species that will be implemented over the life of the project. These include reductions in speed in certain areas, the use of trained look outs, and slowing down if ESA-listed species are sighted. While we expect that these measures will help to reduce the risk of vessel strike for sea turtles, individual sea turtles can be difficult to spot from a moving vessel at a sufficient distance to avoid strike due to their low-lying appearance. With this information in mind, we expect that the risk reduction measures incorporated into the proposed action will reduce collision risk overall, but will not eliminate that risk. We are not able to quantify any reduction in risk that may be realized and expect that any reduction in risk may be small.

To determine the likely total number of sea turtles that will be struck by project vessels, we have added up the numbers for each phase then rounded to whole animals. As such, based on our analysis, the proposed action is expected to result in vessel strike of sea turtles up to the number identified in Table 42 below:

Table 42. Estimate of sea turtle vessel strikes as a result of the proposed action.

Species	Maximum Vessel Strike Anticipated
NWA DPS Loggerhead sea turtle	22
North Atlantic DPS green sea turtle	1
Leatherback sea turtle	2
Kemp's ridley sea turtle	2

While not all strikes of sea turtles are lethal, we have no way of predicting what proportion of strikes will be lethal and what proportion will result in recoverable injury. As such, for the purposes of this analysis, given the likelihood of vessel strike to cause serious injury or mortality, it is reasonable to assume that all strikes are likely to result in serious injury or mortality.

6.5.5 Background Information on the Risk of Vessel Strike to Atlantic and Shortnose Sturgeon

³⁹ Calculated using 11,782 for the annual average baseline vessel traffic from the Waterborne Commerce dataset. See Table 39 for percent increase calculation.

A vessel can cause injury or death to a sturgeon when the hull or propeller strikes the sturgeon, or the sturgeon becomes entrained through the propeller. Examination of sturgeon carcasses in the Delaware River and the James River shows that the majority of carcasses found have damages consistent with vessel strike (Balazik *et al.* 2012d, Brown and Murphy 2010; also, see discussion in previous sections of this Opinion). Direct observations of vessel strikes killing sturgeon have also been reported (e.g., Park 2017, personal communication). Therefore, we anticipate that increasing the amount of vessel traffic in a geographic area generally increases the risk of vessel strike for sturgeon in the area. In this section of the Opinion, we consider if the increase in vessel traffic as a result of the action, when added to the baseline, will increase the risk of interactions between sturgeon and vessels in the action area.

The timing and location of vessel traffic in the action area may influence the risk of a vessel striking a sturgeon. A significant increase in vessel traffic during spawning periods could potentially increase the risk of vessel strike for migrating adult sturgeon (Fisher 2011, Hondorp *et al.* 2017). Similarly, narrow channels or passageways with restricted clearance may increase the probability that sturgeon will be struck and killed by a vessel (Balazik *et al.* 2012d).

For sturgeon to interact with vessels and their propellers, they must overlap spatially and temporally. First, a vessel's activity has to occur in the same area where sturgeon are present. Second, an individual has to occupy the same portion (lateral location) of the river channel as the vessel (e.g., the maintained navigation channel versus the non-navigational portion of the channel or waterway). Lastly, the hull, propeller, and/or the hydrological forces around the vessel have to be at the same depth in the water column as the sturgeon. Factors relevant to determining the risk of vessel strikes are considered to include, but may not be limited to, the 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 size and behavior of sturgeon in the area (e.g., foraging, migrating, etc.). Physical characteristics of the waterbody (e.g., narrow channels, channel constrictions, etc.) may also be relevant risk factors.

For a vessel strike to occur, the sturgeon must either not respond to an approaching vessel (i.e., not moving away or trying to avoid interaction) or be unable to avoid the vessel. It is well documented that adult and juvenile sturgeon are killed by interactions with vessel propellers of vessels (Balazik *et al.* 2012d, Brown and Murphy 2010, Demetras *et al.* 2020, Killgore *et al.* 2011). Therefore, it is clear that not all sturgeon respond to an approaching vessel by moving out of its way or are not able to evade the propeller(s) even if they do attempt to move out or the way of an approaching vessel. A few studies have used VEMCO Positioning System (VPS) receiver arrays to study Atlantic sturgeon response to approaching vessels. Preliminary tracking studies in the James River indicate that Atlantic sturgeon do not seem to respond behaviorally to at least some vessel types. In other words, they do not appear to make any effort to leave the navigation channel or avoid approaching and passing deep draft vessels (Balazik 2018, Balazik *et al.* 2017a), and, occasionally, the researchers observed sturgeon move into the path of an

approaching vessel (Balazik *et al.* 2017a). DiJohnson (2019) studied Atlantic sturgeon responses to approaching vessels in the Delaware River similarly using a VEMCO Positioning System to monitor fine-scale movements of telemetered adults and subadults as large vessels approached. The authors found no evidence that Atlantic sturgeon altered their behavior in the presence of approaching commercial vessel traffic in the Delaware River (DiJohnson 2019, DiJohnson *et al.* 2015). Both Balazik *et al.* (2017a) and DiJohnson (2019) concluded that their findings suggest that either Atlantic sturgeon do not consider vessels a threat or they cannot detect a vessel until it is too late.

Vessels moving both fast and slow have been implicated in sturgeon strikes, and at this time there is no known speed threshold that can be used to ensure avoidance of an interaction. Sturgeon are considered vulnerable to being struck by both vessel hulls and propellers. The propeller may hit a sturgeon that is directly in the path of a vessel or if the force of the water being sucked through a propeller is strong enough that it entrains a sturgeon. Entrainment occurs when the propeller moves water at high velocities, creating low pressure in vicinity of the propeller which can result in the animal getting stuck. Sturgeon that cannot avoid a passing vessel, may become entrained and unable to escape that low pressure area in front the propeller, but instead go through the propeller, resulting in strike and mortality. The zone of influence is defined by the depth, width, and length in front of the propeller at which water is drawn through. Models of water entrained during maneuvering of tow vessels in the Mississippi River found the volume of water to be about twice the propeller area times the distance travelled (Wilcox 1991). 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 m (1.6 ft) in diameter, towboats and tugs commonly have propellers between 2-3 m (6.5-9.8 ft) in diameter, and tankers and bulk carrier vessels with a 12 m (40 ft) draft may have propellers that are 7-8 m (23-26 ft) in diameter. Typically, most vessel types have two propellers, but larger vessels may occasionally have three. Thus, we expect large tugboats, cargo vessels, and tankers to have a substantially larger zone of influence than recreational or smaller fishing vessels. Maynard (2000) showed that the inflow zone of a propeller surrounds the vessel in an area limited to roughly the size of the cross section of the vessel (i.e., similar to the width of the vessel). As an example, a tow with a draft of 2.7 m (8.9 ft) pushing three barges side by side (total width of 32 m (105 ft)) in 4.3 to 12 m (14 to 40 ft) deep water and a speed (relative to water) of 2 m/s (3.9 knots) had an inflow zone of about 25 m (82 ft) on either side of the center line. Thus, water within a 50 m (164 ft) wide zone could go through the propeller.

Besides vessel dimensions, the depth relative to draft determines the propeller's lateral zone of influence. In Maynard's calculations, bottom water at depths of 9.8 m (32.1 ft) or greater were not drawn into the 2.4-m (7.9 ft) diameter propeller (for a towboat with a 2.7 m (8.9 ft) draft) while water at depths of 5.6 m (18 ft) or less was drawn into the propeller, though not all flow within this zone would go through it. Therefore, a demersal sturgeon below a large vessel with a

clearance of 6 m (19.7 ft) or less would be exposed to water drawn through the vessel's propeller(s). Further, while sturgeon are benthic feeders, they also use the upper water column during non-foraging movements and migrations and sometimes jump out of the water. Therefore, we consider all sturgeon in the path of a large vessel (the width of the path being equal to the width of the vessel) to be located in the water column where the moving vessel will expose them to the water drawn through its propellers.

Whether a fish is able to avoid entrainment depends on its location relative to the velocity of the water moved by the propeller and its swimming ability relative to that velocity. It is unclear what the response of a sturgeon will be when exposed to the hydrology around the hull and propeller of a moving or maneuvering vessel. For a vessel at cruising speed, the suction in front of the propeller is moderate, but it is more pronounced if the propeller diameter is relatively small – as it often is for ships designed for operation in rivers (e.g., tugboats) and other areas with draft limitations, or if the forward speed of the ship is slow (Steen 2021). We do not have calculations of the approach velocity of water in front of the propellers of the delivery and installation vessels or the tugboats; therefore, we cannot evaluate a sturgeon's ability to escape entrainment through the propeller of these specific vessels. However, Steen theorizes that the propellers of large vessels can entrain even large sturgeon.

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 m (9 ft) 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 signs of propeller impact (only estimated for specimens ≥ 12.5 cm (≥ 5 in) 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 (Balazik *et al.* 2017a, Brown and Murphy 2010).

Killgore *et al.* (2011) found that the probability of propeller-induced injury (i.e., propeller contact with 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 to move through the propeller without being struck by a blade. Similarly, the longer the fish is, the longer time it needs to move through the propeller, thereby increasing the chance that a blade hits it. The injury probability model developed by Killgore *et al.* (2011) shows a sigmoid (or “S” shaped) relationship between fish length and injury rate at a given RPM. The model estimates probability of injury at about 150 RPM for the towboat in their study increased from 1 percent for a 12.5 cm (5 in) fish to 5 percent for a 35 cm (13.8 in) long fish, and from 50 percent for a 72 cm (28.3 in) long fish to 80 percent for a 90 cm (35.4 in) long fish. However, Killgore *et al.* (2011) did not find that the number of fish entrained by the propeller was dependent on RPM even though the percentage of fish killed increased with increasing RPM.

As described in the *Environmental Baseline*, recreational and smaller commercial vessels have

smaller diameter propellers, entrain smaller volume of water, and have a shallow draft. Consequently, they are less unlikely to entrain a larger juvenile, subadult, or adult sturgeon. Large vessels have deeper drafts, which increases the probability of vessel collision with demersal fishes like sturgeon, even in deep water (Balazik *et al.* 2012d, 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) indicates that heavy large-towboat traffic on the Mississippi River (vessels with an average propeller diameter of 2.5 m, a draft of up to 9 ft, and travel at approximately the same speed as tugboats (less than 10 knots)), kill a large number of fish by drawing them into the propellers. The study demonstrates that shovelnose sturgeon (*Scaphirhynchus platyrhynchus*), a small sturgeon (~50-85 cm (~19.7-33.5 in) 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 – including its 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 and shortnose sturgeon populations in the Delaware River, this estimate cannot directly be used for this analysis. We also cannot modify the rate for this analysis because the type of vessels traveling on the two rivers differs and we do not know (a) the difference in density of shovelnose sturgeon and shortnose and/or Atlantic sturgeon and (b) if there are risk factors that increase or decrease the likelihood of strike in the Delaware. However, this information does suggest that high vessel traffic can be a major source of sturgeon mortality. A similarly sized tugboat moving about 11 knots was observed striking and killing an adult Atlantic sturgeon female in the Federal Navigation Channel of the Delaware River in 2016 (Ian Park, DENRC, personal communication, June 2017).

Other factors affect the probability of vessel interactions with sturgeon, including channel width. (Balazik *et al.* 2012d) notes that there is an inverse relationship between channel width and the number of observed vessel strike mortalities in the James River. Sturgeon are likely to use the navigation channels during spawning migrations as well as seasonal movements between summer and overwintering areas (Fisher 2011, Hondorp *et al.* 2017). Because of these behaviors, a higher number of adult Atlantic sturgeon vessel mortalities occur in the Delaware River during spring months (see Section 6). It has also been suggested that sturgeon swimming higher in the water column during migration may increase their exposure to vessels (Balazik *et al.* 2017a, Brown and Murphy 2010, Fisher 2011).

6.5.6 Consequences of Vessel Activity on Sturgeon

The effects to Atlantic and shortnose sturgeon during Port construction and operations are considered herein. Vessel routes in the Delaware River and Bay, in Upper and Lower NY Bay, and in the Atlantic Ocean between these two areas, are analyzed for the 30-year project life.

First, we evaluated the factors determining the risk of vessel strike. We then used the calculated number of expected sturgeon mortalities relative to vessel trips as described in section 6 above (i.e., the calculated baseline mortality rate). We then used this baseline mortality rate to calculate an estimate of the number of sturgeon killed by project related vessel activity (i.e., vessel trips during Port operation; no take is expected from construction vessels).

There are neither quantitative scientific surveys regarding vessel strike mortalities nor an annual index survey that provides a time series of the relative number of vessel strikes per year. This complicates any evaluation of the relationship between vessel densities and sturgeon mortalities. The BA assumes that the increase in vessel traffic in addition to the baseline resulting from the proposed Port will increase the risk of vessel strike to shortnose and Atlantic sturgeon. Additionally, it considers that this increased risk will result in a corresponding increase in the number of sturgeon struck and killed in the action area. Based on the best available scientific information, as cited in the preceding sections, we consider these reasonable assumptions and adopt them for our analysis here.

We consider trips of self-propelled vessels only to calculate risk of vessel strike, as tugs transport non-self-propelled vessels (e.g., barges). We expect that the Waterborne Commerce data for vessel trips (USACE Waterborne Commerce) is a reasonable estimate of baseline traffic within the Delaware River and Bay and within the Upper and Lower NY Bay and lower East River. As discussed in the *Environmental Baseline* section, this is a reasonable approximation because the Waterborne Commerce data used includes self-propelled vessels of all drafts. We also consider smaller vessels to be less of a threat to sturgeon and account for an extremely small fraction of reported sturgeon mortalities. Thus, even though the data does not account for the recreational vessels and smaller fishing vessels that operate in the action area, the Waterborne Commerce data provides a reasonable approximation of the total number of vessels operating in a given area that are expected to generally pose a threat to sturgeon.

6.5.6.1 *Consequences of Vessel Transits on Sturgeon in the Atlantic Ocean between the mouth of Delaware Bay and NY Harbor*

As discussed in the *Environmental Baseline*, subadult and adult Atlantic sturgeon are present year-round along the coast of NJ and although adult shortnose sturgeon (mainly within the Gulf of Maine) have been documented making seasonal coastal migrations, this is considered to be rare. Atlantic sturgeon are known to be struck and killed by vessels in rivers and in estuaries adjacent to spawning rivers, but we have no reports of vessel strikes in the marine environment. Similarly, no shortnose sturgeon mortalities with evidence of vessel strike have been documented in the marine environment. We have considered whether Atlantic sturgeon are likely to be struck by project vessels during ongoing Port operations or if the increase in vessel traffic is likely to otherwise increase the risk of strike for Atlantic sturgeon within the vessel routes along the coast of NJ.

Vessels traveling along the coast of NJ between the Port and Brooklyn, NY will transit in the vicinity of two Atlantic sturgeon aggregation areas or “hot spots” near the mouth of the Upper NY Bay; however, these vessels will be transiting in deeper, more offshore waters (five miles from the coastline) and not actually pass through any of these aggregation areas. Atlantic sturgeon are transient, not resident, within this portion of the action area. The transient nature of Atlantic sturgeon in this area means that the potential for co-occurrence between a project vessel and an Atlantic sturgeon in time and space in this portion of the action area is extremely low.

In order to be struck by a vessel, a sturgeon needs to co-occur with the vessel hull or propeller in the water column. Given the depths in the vast majority of the marine waters that will be transited by project vessels and that sturgeon typically occur at or near the bottom while in the marine environment, the potential for co-occurrence of a vessel and a sturgeon in the water column is extremely low even if a sturgeon and vessel co-occurred generally. The areas identified in this section to be transited by the project vessels are free flowing with no obstructions; therefore, even in the event that a sturgeon was up in the water column such that it could be vulnerable to strike, there is ample room for a sturgeon to swim deeper to avoid a vessel or to swim away from it which further reduces the potential for strike. Considering this analysis, it is extremely unlikely that any project vessels transiting in marine waters off of NJ, will strike an Atlantic or shortnose sturgeon. Given the anticipated low risk of vessel strike in this area, it is extremely unlikely that an operational vessel transiting to/from the Port will increase the risk of vessel strike of Atlantic and shortnose sturgeon in this portion of the action area. As such, effects to Atlantic and shortnose sturgeon from project vessels operating in this portion of the action area are extremely unlikely to occur.

6.5.6.2 Consequences of Vessel Transits on Sturgeon in the Delaware River and Delaware Bay Atlantic Sturgeon

Atlantic sturgeon temporal and spatial distribution within the action area is described in detail in the *Environmental Baseline*. Operational and construction vessels will overlap with multiple life stages of Atlantic sturgeon. We expect Atlantic sturgeon subadults and adults from any of the five listed DPSs to be present within the Delaware Bay year-round and to be seasonally present in the Delaware River (approximately March 15 to November 30). Young of year and juvenile sturgeon are also present in the Delaware River year-round. Therefore, vessel traffic related to Port operation will expose young of year, juvenile, subadult, and adult Atlantic sturgeon to moving vessels and their propellers year-round over the 30-year life of the Port. In addition, temporary construction vessels (n = 14) may expose early life stage, young of year, and juvenile Atlantic sturgeon from the NY Bight DPS to moving vessels and their propellers from July 1 to September 30, when construction activities (July 1 to March 14) will co-occur with presence.

During early spring, mature adults migrate through the mouth of the Delaware Bay during the spawning migration. Additionally, both subadults and adults move through the mouth during seasonal migrations to and from areas of residency within the Delaware Bay (Breece *et al.* 2018).

However, during the same time period, non-spawning Atlantic sturgeon may remain in the Bay. Kuntz (2021) found a large number of Atlantic sturgeon concentrated from late spring through the fall in two locations in the lower Delaware Bay. We expect that the spawning Atlantic sturgeon will move in a relatively straight line during spawning migration through the Delaware Bay to spawning grounds. This path largely corresponds with the Philadelphia to the Sea Federal Navigation Channel. Use of the Federal Navigation Channel likely occurs because channelization modifies current direction, current velocity, and discharge that sturgeon use as hydrologic cues during riverine migration. Thus, as Atlantic sturgeon enter the Delaware River during the spawning season, they may use the Philadelphia to the Sea Navigation Channel for up and downstream spawning migration. Atlantic sturgeon at least sometimes swim closer to the surface during migration than during other directed movements (e.g., foraging or avoidance) (Balazik *et al.* 2012b, Fisher 2011, Reine *et al.* 2014). Consequently, Atlantic sturgeon are likely to occur at a depth that may overlap with the depth of the propeller of medium draft vessels (e.g., tugs) as well as deep draft vessels (e.g., cargo vessels) during periods when active movements such as spawning migration and/or seasonal movements between habitats occur.

During the temporary construction phase of the project, the action area also includes the Delaware River from the confluence of the Salem River to White's Basin where seasonal, temporary construction vessels will transit. Therefore, the action will overlap with the distribution of young of year and juvenile Atlantic sturgeon from the NY Bight DPS in the Delaware River that are present year-round. Early life stages NY Bight DPS Atlantic sturgeon are also expected to be present. Specifically, we expect post yolk-sac larvae Atlantic sturgeon to be present from April through September and eggs and yolk-sac larvae may be present in spawning locations between Claymont, DE/Marcus Hook, PA from the beginning of April through the end of August (Breece *et al.* 2013, Simpson 2008). Therefore, given that construction will occur during the period of July 1 through March 14, the overlap of construction vessels with early life stage presence will be minimized.

Shortnose Sturgeon

Shortnose sturgeon temporal and spatial distribution within the action area is described in detail in the *Environmental Baseline*. The action area overlaps with the distribution of adult shortnose sturgeon from the mouth of the Delaware Bay to White's Basin, including the Salem River, from April through November, and with young of year and juvenile shortnose sturgeon in the Delaware River year-round. Given that all in-water construction will occur during the non-restricted period of July 1 through March 14, construction vessels are not expected to transit in the Delaware River from March 15 to June 30. Vessels transiting to/from the Port during the operational period are expected to transit within the Salem River, Delaware River and, Delaware Bay year-round.

Both juvenile and adult shortnose sturgeon occur from White's Basin CDF downstream to the mouth of the Delaware River year-round with high concentrations of juveniles below Little

Tinicum Island occurring year-round and therefore may overlap with temporary construction vessels from July 1 through March 14 and operational vessels throughout the 30-year life of the project. Adults may occur frequently at the Cherry Island Flats, and can occasionally be present within Delaware Bay. Thus, inbound and outbound transport of cargo will result in temporal and spatial overlap between temporary construction and operational vessels and young of year, juvenile, and adult shortnose sturgeon from the mouth of the Delaware River to the Port, with additional potential exposure between the operational vessels and adult shortnose sturgeon within the Delaware Bay.

Since all vessels will mostly travel within the 14-m deep Federal Navigation Channel, and foraging sturgeon are likely to remain close to the bottom, direct exposure to the propellers of the 7.3-m draft cargo vessels, while actively foraging, may occur infrequently. However, we expect shortnose sturgeon to move higher in the water column during other behaviors (i.e., moving to and from foraging and spawning areas, migrations) and this will may increase the risk of co-occurrence at the same depth as the propellers of cargo vessels transiting to/from the Port

6.5.6.3 Risk

Atlantic Sturgeon

Vessel traffic, consisting of commercial cargo ships, tankers, and tugboats is a significant source of Atlantic sturgeon mortality in the Delaware and James Rivers (Balazik *et al.* 2012d, Brown and Murphy 2010). Many of the documented mortalities involve large Atlantic sturgeon with severe injuries (e.g., lacerations and amputations). Killgore *et al.* (2011) found that the risk of injury or mortality of fish going through the propeller of a tugboat increased with the size of the fish. Based on a relationship between fish size and injury risk for entrainment through the propeller developed by Killgore *et al.* (2011), entrainment through a propeller could result in mortality rates of 5 to 50 percent of entrained young of year fish, 50 to over 80 percent for entrained juvenile sturgeon, and near 100 percent for entrained subadult and adult Atlantic sturgeon. Vessels of various sizes will be calling at the proposed Port, sizes of the vessel range from tugboats to Handymax (Max. L350'), and have various propeller sizes that may be larger than tugboat propellers. Therefore, we find it unlikely that any sturgeon struck by an operational or construction vessel or entrained in the propeller of any such operational or construction vessels will survive, and we expect that all young of year, juvenile, subadult, and adult Atlantic sturgeon interactions with the operational or construction vessels traveling to and from the Port to be fatal.

Killgore *et al.* (2011) found that the probability of injury at about 150 RPM for a towboat increased from 1 percent for a 12.5 cm (5 in) fish to 5 percent for a 35 cm (13.8 in) long fish, therefore, smaller sturgeon (post yolk-sac larvae, TL approximately 3 cm, and smaller) may go through a propeller without interacting with the blades. Although they may not interact with the propeller blades, pressure changes and shear force may cause stresses to early life stages which could potentially result in injury or mortality (Killgore *et al.* 2001). Therefore, risk of

entrainment and vessel strike exists for all life stages of Atlantic sturgeon that are present within the action area and overlap with operational and construction vessels.

Vessels supporting construction activities ($n = 14$ one-way vessel trips in total) will travel from the Port to White's Basin in the Federal Navigational Channel. Given the disposal site's proximity to Atlantic sturgeon spawning areas, the construction vessel routes may overlap with early life stages. However, research by Phelps et al (2010) demonstrates that early life stages of sturgeon species favor habitat in the vicinity of artificial structures and islands with low velocity (i.e., 0.1 m/s) and moderate depths (i.e., 2–5 m) as opposed to main-channel habitat that has faster water velocity and depths of approximately 14 m, which is not present in the Federal Navigational Channel where construction vessels are expected to transit. Considering early life stage habitat preferences and the temporary (three-year construction phase of the project), seasonal nature (construction vessels will only occur from July 1 to March 14) of the 14 construction vessels that will overlap with early life stages, it is extremely unlikely that early life stage Atlantic sturgeon will interact with the 14 project vessels transiting to White's Basin for construction of the Port.

In addition, vessels supporting construction activities will overlap with young of year, juvenile, subadult, and adult Atlantic sturgeon. Construction vessels routes are adjacent to Marcus Hook, an area supporting the rearing of young of year and juvenile sturgeon, but will only occur within the Federal Navigational Channel (14 m (46 ft) in depth). Although sturgeon density is high in the Marcus Hook reach, the number of expected construction vessel trips is extremely low ($n = 14$). Furthermore, young of year are expected to remain in the bottom meter of the water column and, similarly, foraging juvenile sturgeon are expected to remain at or near the river bottom. Thus, given the depth of the Federal Navigational Channel and habitat preference for young of year and juvenile sturgeon, it is extremely unlikely that young of year and juveniles are vulnerable to entrainment and strike from the 14 temporary construction vessels. Unlike young of year and juvenile sturgeon, subadult and adult Atlantic sturgeon are expected to be present throughout the water column where construction vessels will transit. Adult Atlantic sturgeon migrating upstream to spawning areas are expected to move higher in the water column and well within the depth of drafts of tugboats (Balazik *et al.* 2012a, Fisher 2011, Reine *et al.* 2014). Therefore, we anticipate that the highest risk for a construction vessel to interact with sturgeon will occur during the spawning migration when adults swim higher in the water column. No construction vessels will operate between March 15 and June 30 and will only transit within the Federal Navigation Channel, therefore, vessel traffic in support of construction activities will not overlap with the majority of the sturgeon migration time of year or known aggregation areas. Although higher densities of subadult and adult sturgeon may be present in the vicinity of where construction vessels may occur between the Port and White's Basin, an extremely small number of vessels trips will occur in this area ($n = 14$ one-way trips), the trips will only occur seasonally (July 1 to March 14), and will only occur temporarily during the construction phase of the project (maximum of three years), therefore, vessel strike risk to subadult and adult sturgeon

from construction vessel trips is expected to be extremely unlikely.

Shortnose Sturgeon

We currently do not know of any studies regarding how shortnose sturgeon respond to approaching vessels, but based on similarities between shortnose and Atlantic sturgeon we expect that they do not actively avoid them as has been demonstrated for Atlantic sturgeon. We also expect that the water current moving through the propellers of tugs and larger vessels can entrain shortnose sturgeon, similarly to Atlantic sturgeon, exposing them to the rotating propellers. Propeller blades are most likely to strike larger adult sturgeon (Killgore *et al.* (2011). As with Atlantic sturgeon, we anticipate that any interaction with propeller blades of large vessels will be lethal for juvenile and adult shortnose sturgeon.

Vessels supporting construction activities (n = 14 one-way vessel trips in total) will travel from the Port to White's Basin within the Federal Navigational Channel, and therefore, may overlap with young of year shortnose sturgeon, in addition to juvenile and adult shortnose sturgeon. Based on research by Killgore *et al.* (2011), we expect that smaller shortnose sturgeon (young of year, up to 30 cm) have a 1 to 5 percent chance of injury if they interact with a vessel. Any young of year shortnose sturgeon that interacts with a vessel is expected to move through a propeller without interacting with the blades. Similar to Atlantic sturgeon, although higher densities of shortnose sturgeon may be present in the vicinity of where construction vessels may occur between the Port and White's Basin (Marcus Hook), there is a small number of vessels trips that will occur in this area (n = 14 one-way trips), the trips will only occur seasonally (July 1 to March 14), will only occur temporarily during the construction phase of the project (maximum of three years), and vessel will only transit within the federal navigation channel, therefore, vessel strike risk to shortnose sturgeon from construction vessel trips is expected to be extremely unlikely and effects are discountable.

Given that it is likely that shortnose sturgeon are exposed to propellers and that a propeller striking a shortnose sturgeon will kill it, we conclude that the operational vessel traffic associated with the proposed action will kill juvenile and adult shortnose sturgeon. These mortalities would not occur but for the proposed action.

6.5.6.4 Estimated Interactions between Vessels using the Port during the Operational Period and Atlantic and shortnose sturgeon

Atlantic Sturgeon in the Delaware River/Bay

Given the amount of vessel traffic, overlap with the distribution of Atlantic sturgeon, and documented risk of interactions between Atlantic sturgeon and vessels, we expect that the increase in vessel traffic will result in an increase in the number of interactions between vessels operating in the Delaware River and Bay and young of year, juvenile, subadult, and adult Atlantic sturgeon. These mortalities would not occur but for the proposed action.

The approach to calculating the number of sturgeon likely to be killed per vessel transit is explained in the *Environmental Baseline* section. Consistent with (Fox et al. 2020), we use a reporting rate of 0.0476 to adjust the observed reporting rate. We also note that Fox et al. (2020) had zero back-reports of carcasses placed in the river during their study of carcass reporting rates and that an unknown number of sturgeon carcasses may never end up on the shoreline since some carcasses are likely to sink and remain on the bottom. Therefore, carcasses that sink before ending up on a shoreline are not included in the calculation of reporting rates. Therefore, we estimate that for the Delaware River/Bay, on average 0.0093 sturgeon is killed per vessel trip, which equates to one Atlantic sturgeon killed on average for every 108 vessel trips in the Delaware River and Delaware Bay portion of the action area. MARAD estimates that 64 one-way vessel trips will continue to occur each year over the 30-year life of the Port as described in Table 38 above and that expanded Port operation will add up to 94 new one-way operational vessel trips annually in the Delaware River and Delaware Bay (i.e., vessel trips that would not occur but for the proposed Port). Using the rate described above, the ongoing 1,920 vessel trips in the Delaware River and Delaware Bay that will continue to occur as a result of the proposed action over the 30-year operational life of the Port (64 one-way trips annually) are expected to result in the mortality of 17.856 Atlantic sturgeon (i.e., 1,920 vessel trips * 0.0093 killed per trip) over the next 30-year operating life of the Port. In addition, Port operation resulting from upgrades will add up to 2,820 vessel trips in the Delaware River and Delaware Bay over the 30-year operational life of the Port (94 one-way trips annually) and are expected to result in the mortality of 26.226 Atlantic sturgeon (i.e., 2,820 vessel trips * 0.0093 killed per trip) over the operating life of the Port. In total, ongoing and new vessel trips are expected to result in the mortality of 44.082 (rounded down to 44) Atlantic sturgeon over the 30-year life of the project. We expect the 44 Atlantic sturgeon either to be subadult, adult (exposure prior to and post spawning migration), or juveniles (because of the salinity in the action area (salinity generally not lower than 2 - 10 ppt at the Salem River confluence) and relatively higher density of older juveniles that may be present within the action area as opposed to young of year).

As discussed in the *Environmental Baseline* section, NEFSC's analysis of the Atlantic sturgeon vessel strike data from DNREC and NJFW determined that 44 were adults, 15 subadults, and 19 juveniles based on fish size. Of the 11 Atlantic sturgeon in the NJFW data that we consider as struck by vessels, six were determined to be adults and five as subadults based on their length. None of the carcasses were determined to be a juvenile. Therefore, of the 89 Atlantic sturgeon killed by vessel strike in the DNREC and NJFW data that NEFSC reviewed, 19 were assigned as juveniles, 50 as adults, and 20 as subadults. Thus, of the 89 carcasses with an assigned life stage, 56.18 percent were adults, 22.47 percent were subadults, and 21.35 percent were juveniles (Table 43).

Table 43. Sturgeon vessel strike mortality by life stage in the Delaware River.

Life Stage	All Sturgeon (n)	All Sturgeon (%)	DNREC Sturgeon (n)	DNREC Sturgeon (%)
Adult	50	56.18	44	56.41
Subadult	20	22.47	15	19.23
Juvenile	19	21.35	19	24.36

Although studies by Murphy and Brown (2010) determined that 61 percent of Atlantic sturgeon vessel strike mortalities in the Delaware River were of adult size (150 cm TL), because they did not differentiate between subadult and non-migrant juveniles for the remaining non-adults, the information from Murphy and Brown (2010) only distinguishes between adults (61 percent) and non-adults (59 percent). We note that these percentages are similar to the data summarized in Table 43. We also note that there may be several reasons why larger sturgeon may be more frequently reported, and thereby skew the data to include more larger fish as opposed to smaller life stages. These may include a reporting bias for larger carcasses, a longer persistence time in the environment, and an increased likelihood of propeller strike mortality due to body size (Killgore *et al.* 2011). However, we do not have information that makes it possible to evaluate or adjust life stage mortality rates based on reporting bias or carcass persistence time. Only considering carcasses with size information to determine life stage, adults and subadults made up 78.65 percent, while 21.35 percent of the vessel strikes reported to DNREC and NJFW were juveniles.

We have considered the best available information to determine the likely DPS origin of subadult and adult individuals. In previous Opinions, we have used the determinations reached in Damon-Randall *et al.* (2013) analysis of Atlantic sturgeon in the Delaware River to determine the percentage of takes from each DPS. In this Opinion, we will use the same methodology used in the 2023 Opinion prepared for the continued operation of the Salem (NJ) Nuclear Power Plant because it is currently the best available data for approximating the DPS distribution in the Delaware River/Bay portion for the Port of Salem action area. The following summarizes the genetic results from Atlantic sturgeon collected at Salem, NJ.

The genetic analysis of 150 Atlantic sturgeon tissue samples taken from Atlantic sturgeon collected between 2011 and 2020 at the trash racks at the Salem (NJ) Nuclear Power Plant, located on the Delaware River in Salem, NJ, were used to determine the DPS distribution of Atlantic sturgeon in this location. A total of 150 tissue samples were assigned to one of 18 baseline populations, which were subsequently aggregated into DPSs. Of the samples that underwent genetic assignment testing, all of the samples taken from individuals that were less than 500 mm TL (i.e., river-resident juveniles) were assigned to the Delaware River (Kazyak *et al.* 2021). The remaining fish (subadults and adults), originated from all five DPSs at the following frequencies: New York Bight 71 percent; Chesapeake Bay 16 percent; South Atlantic

7 percent; Gulf of Maine 1 percent; and Carolina 5 percent. Given the location of these captures overlaps with the Delaware River/Bay portion of the action area, it is reasonable to expect that the DPS distribution of Atlantic sturgeon at the Salem nuclear power plant represents the DPS distribution of Atlantic sturgeon in this portion of the Delaware River/Bay generally. We recognize that there is a seasonal influence on the distribution of Atlantic sturgeon in this area and that most of the captures at Salem occurred in the winter months. However, given that all five DPSs are represented and that the pattern is consistent with other published reports of DPS distribution in the Delaware region (e.g., Kazyak et al. 2021, White et al. 2021, Wirgin et al. 2015), we consider this the best predictor of the DPS distribution of subadult and adult Atlantic sturgeon that may be affected by activities at the Port of Salem. All younger life stages would be from the New York Bight DPS as these life stages do not migrate from their natal river. Therefore, we expect that the mortalities of Atlantic sturgeon in the Delaware River and Delaware Bay resulting from the exposed to operational vessel traffic from the proposed action originate from the five DPSs at the following frequencies: New York Bight 71 percent; Chesapeake Bay 16 percent; South Atlantic 7 percent; Gulf of Maine 1 percent; and Carolina 5 percent. Based on these percentages, we have estimated that of the 44 vessel mortalities, 31 adult, subadult, or juvenile fish will belong to the New York Bight DPS, 7 adult/subadult fish will belong to Chesapeake Bay DPS, 3 adult/subadult fish will belong to the South Atlantic DPS, 2 adult/subadult will belong to the Carolina DPS, and 1 adult/subadult will belong to the Gulf of Maine DPS.

Using additional scientific references (Busch 2022, Kazyak *et al.* 2021, Wirgin *et al.* 2015a, Wirgin and King 2011)), we were able to estimate the percentage of New York Bight DPS Atlantic sturgeon originating from the Hudson and Delaware Rivers, which informs our understanding of impacts to the New York Bight DPS on a river level. These studies support the notion that the Hudson River spawning population is the more robust of the two spawning groups. This conclusion is further supported by genetic analyses that demonstrates Atlantic sturgeon originating from the Hudson River spawning population were more prevalent in mixed aggregations than sturgeon originating from the Delaware River spawning population, even when sampling occurred in areas and at times that targeted adults belonging to the Delaware River spawning population (Anonymous!!! INVALID CITATION !!! (Busch 2022, Kazyak et al. 2021b, Wirgin et al. 2015a, Wirgin and King 2011)). Wirgin *et al.* (2015b), which sampled migrating Atlantic sturgeon from an area 3 to 12 km (1.9 to 7.5 mi) from the Delaware coast, found that 10.6 percent of all the fish sampled were from the Delaware River and 44 percent were from the Hudson River. Kazyak *et al.* (2021) found that 37.5 percent of individuals sampled from the mid-Atlantic region (Cape Hatteras to Cape Cod) were assigned to populations in the New York Bight DPS. For the total sample, 11.4 percent were Delaware River fish and the remaining 26.2 percent were Hudson River fish. We note that the sample seems to include juveniles (defined as <500mm TL) from the Delaware River which suggests some in-river sampling. A recent (2022) master's thesis conducted a mixed stock analysis of tissue samples collected from adult and subadult Atlantic sturgeon caught in the Delaware River estuary,

Delaware Bay, and in coastal waters off Delaware (Busch 2022). The study found that 8.3 percent of all fish samples were Delaware River fish and 41.8 percent were Hudson River fish.

Sex ratio data specific to the Delaware River population of Atlantic sturgeon are not available. A skewed sex ratio in the river during spawning might suggest that the likelihood of a vessel striking and killing a male is greater than that for a female during certain times of the year. Males usually begin their spawning migration early and leave after the spawning season, while females make rapid spawning migrations upstream and quickly depart following spawning (Bain 1997 as cited in ASSRT 2007). Assuming that the length of time that sturgeon spend within the river is correlated with an increased risk of vessel strike, this information suggests that male sturgeon are more likely than females to be struck and killed by a vessel in the action area. The DNREC data report the sex for only five adult mortalities (all mortality causes) in the Delaware River (all years) while only one of the carcasses reported to the NJFW had a sex determination. Of these, two were determined to be female and four male. In the absence of additional information, we assume the ratio of male to female Atlantic sturgeon in the Delaware River is even (1:1) and that male sturgeon are equally as likely to be struck and killed by a vessel as female sturgeon. Therefore, the adult/subadult vessel strike mortalities estimated over 30 years of Port operation could be either male or female.

Shortnose Sturgeon

Given the amount of vessel traffic, overlap with the distribution of shortnose sturgeon, and documented risk of interactions between shortnose sturgeon and vessels, we expect that the increase in vessel traffic will result in an increase in the number of interactions between vessels operating in the Delaware River and Bay and shortnose sturgeon. The approach to calculating the number of sturgeon likely to be killed per vessel transit is explained in the Environmental Baseline. As discussed in the *Environmental Baseline*, we estimate that on average 0.001 sturgeon is killed per vessel trip in the Delaware River/Bay, which equates to one shortnose sturgeon vessel strike mortality occurring for every 991 vessel trips in the Delaware River and Delaware Bay portion of the action area.

MARAD estimates that 64 one-way vessel trips will continue to occur each year over the 30-year life of the Port as described above and that expanded Port operations will add up to 94 new one-way operational vessel trips annually in the Delaware River and Delaware Bay (i.e., vessel trips that would not occur but for the proposed Port). The ongoing 1,920 vessel trips in the Delaware River and Delaware Bay (64 one-way trips annually) are expected to result in the vessel strike mortality of 1.92 shortnose sturgeon (i.e., 1,920 vessel trips * 0.001 killed per trip) over 30 years. In addition, Port operation that will add up to 2,820 vessel trips in the Delaware River and Delaware Bay over the 30-year operational life of the Port (94 one-way trips annually) are expected to result in the mortality of 2.82 shortnose sturgeon (i.e., 2,820 vessel trips * 0.001 killed per trip). In total, Port operation will result in the mortality of 4.74 (rounded up to 5) shortnose sturgeon over the 30-year operating life. Given the salinity in the action area where

operational vessels will occur (generally not lower than 2 – 10 ppt), it is unlikely that young of year shortnose sturgeon frequent this portion of the action area, therefore, we expect that the five mortalities will be juvenile or adult shortnose sturgeon. We do not have data to calculate the probability of the shortnose sturgeon being a juvenile or adult. Therefore, we expect the mortalities may be juvenile or adult shortnose sturgeon.

6.5.6.5 *Consequences of Vessel Transits on Sturgeon in the Upper and Lower NY Bay and East River*

Atlantic Sturgeon

Atlantic sturgeon temporal and spatial distribution within the action area is described in detail in the *Environmental Baseline*. As Atlantic sturgeon enter the Upper and Lower NY Bay during the spawning season, they may use portions of the action area for up and downstream spawning migration to and from the Hudson River. Atlantic sturgeon swim closer to the surface during migration and during other directed movements (e.g., foraging or avoidance) (Balazik *et al.* 2012b, Fisher 2011, Reine *et al.* 2014) and therefore, are more likely to occur at depths that overlap with the propeller of medium draft vessels (e.g., tugs) as well as deep draft vessels (e.g., cargo vessels) during periods when active movements such as spawning migration and/or seasonal movements between habitats occur.

We expect subadult and adult Atlantic sturgeon to opportunistically forage year-round in the Upper and Lower NY Bay and lower East River portion of the action area as they migrate along the coast to and from their natal rivers (Hilton *et al.* 2016). They may aggregate in estuarine areas within the action area during certain times of year and exhibit seasonal coastal movements in the spring and fall. The action area overlaps with adults and subadult Atlantic sturgeon from any of the five listed DPSs in the Upper and Lower NY Bay and lower East River. We expect Atlantic sturgeon subadults and adults to be present within this portion of the action area year-round.

Atlantic sturgeon are transient within this portion of the action area and there are no aggregation areas in the Upper and Lower NY Bay and lower East River that may overlap with the vessel transit routes to Brooklyn, NY. However, given that Atlantic sturgeon may be migrating through this portion of the action higher in the water column as they move to and from the Hudson River for spawning, co-occurrence between a project vessel and an Atlantic sturgeon in time and space in this portion of the action area may occur.

Based on a relationship between fish size and injury risk developed by Killgore *et al.* (2011), entrainment through a propeller of a subadult and adult Atlantic sturgeon may result in close to hundred percent mortality. The vessels calling at the proposed Port have large propellers that rotate with considerable force, therefore, it is unlikely that a sturgeon exposed to the vessels and their propellers will survive. We consider that all subadult and adult Atlantic sturgeon interactions with the vessels traveling to and from the Port to be fatal.

Given the amount of vessel traffic, overlap with the distribution of Atlantic sturgeon, and documented risk of interactions between Atlantic sturgeon and vessels, we expect that the increase in vessel traffic will result in an increase in the number of interactions between vessels operating in the NY Harbor portion of the action area and Atlantic sturgeon. The approach to calculating the number of sturgeon likely to be killed per vessel transit is explained in the *Environmental Baseline* section. As discussed in the *Environmental Baseline* section, we estimate that on average 0.00017747 sturgeon is killed per vessel trip in the NY Harbor portion of the action area, based on the methodology appropriate for this geographic area. MARAD estimates that 64 one-way operational vessel trips annually will continue to occur (1,920 trips over the 30-year life of the Port) and Port operation will add up to 70 new operational vessel trips in the Upper and Lower NY Bay and lower East River annually (i.e., vessel trips that would not occur but for the proposed Port) (2,100 trips over the 30-year life of the Port). The ongoing 1,920 vessel trips in the Delaware River and Delaware Bay (64 one-way trips annually) are expected to result in the vessel strike mortality of 0.3407424 Atlantic sturgeon (i.e., 1,920 vessel trips * 0.00017747 killed per trip) over 30 years. The additional 2,100 vessel trips in this portion of the action area (70 one-way trips annually) are expected to result in the vessel strike mortality of 0.372687 Atlantic sturgeon (i.e., 2,100 vessel trips * 0.00017747 killed per trip) over the operating life of the Port. In total, in this portion of the action area, we expect the vessel strike mortality of 0.7134294 (rounded up to 1) Atlantic sturgeon.

For determining the likely DPS of origin of the single Atlantic sturgeon expected to be struck and killed by a project vessel in the Upper and Lower NY Bay portion of the action area, we use the percentages from O'Leary *et al.* (2014), because their sampling area is closest in geographic proximity to this portion of the action area. Based on O'Leary *et al.* (2014), we expect Atlantic sturgeon throughout the action area originate from the five DPSs at the following frequencies: New York Bight DPS 87 percent; Chesapeake Bay DPS 8 percent; South Atlantic DPS 3 percent; and Gulf of Maine and Carolina DPSs (combined) 2 percent. These percentages are based on genetic sampling of all individuals (n=460) captured during trawl surveys in the mid-Atlantic Bight as described in (2012), Dunton *et al.* (2010). 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 this portion of the action area. Based on these percentages, we expect that the one adult/subadult Atlantic sturgeon mortality in this portion of the action area will belong to the New York Bight DPS.

Shortnose Sturgeon

Shortnose sturgeon temporal and spatial distribution within the action area is described in detail

in the *Environmental Baseline*. Outside the Gulf of Maine, shortnose sturgeon have only rarely been documented making marine migrations. The available tagging and tracking information indicate that movements between the Hudson River and other rivers is extremely rare. Adult shortnose sturgeon have occasionally been captured in trawl surveys in Upper New York Bay. From 1998-2011, six shortnose sturgeon total were identified in the HDP Aquatic Biological Survey (ABS) program (USACE 2021); from 2003-2017, 19 shortnose sturgeon were collected in the Hudson River Utilities winter trawl survey (unpublished data). The best available information indicates that only rare transient adult shortnose sturgeon are likely to occur in the area transited by vessels traveling in the NY/NJ portion of the action area. We have no evidence of any vessel strikes of shortnose sturgeon in this area. As explained above, the number of project related vessels transiting in this portion of the action area is small. Given this, and the lack of evidence of shortnose sturgeon being struck in this area, it is extremely unlikely that a vessel transiting in this portion of the action area on its way to/from the Port will strike a shortnose sturgeon. As such, effects to shortnose sturgeon from project vessels operating in this portion of the action area are extremely unlikely to occur and are discountable.

6.5.6.6 Summary of Consequences of Vessel Traffic

Table 44. Number of shortnose sturgeon and Atlantic sturgeon of each DPS expected to be killed by vessel traffic during operation of the proposed Port. No take is expected for construction vessel activity.

Species	DPS	Juvenile, Subadult, or Adult	Either Subadult or Adult	Either Juvenile or Adult
Atlantic sturgeon	GOM	-	1	-
	NYB	31	1	-
	CB	-	7	-
	SA	-	3	-
	CA	-	2	-
Shortnose sturgeon	N/A	-	-	5

6.5.7 Ballast

Ballast intake pumps are expected to be similarly sized as vessels currently operating in the action area and surrounding waters. Literature review of vessel types indicates a wide range of flow rates for ballasting systems and specifics for the vessels likely to call at the Port are not known. Vessels arriving to the project site would be partially ballasted, with ballast water taken on only locally from the federal navigation channel or Salem River / East River. After mooring at the Port and Pier J, the vessel may discharge or intake ballast water as required to align the vessel cargo deck with the docking location in order to load materials. During loading

operations, ballast water would be rechambered (moved between ballast tanks in the vessel) and discharged to maintain the vessel cargo deck level with the wharf. After loading is completed, the vessel would either take on or discharge ballast water to obtain a safe draft based on the operational criteria of the vessel. During regular port operations, inbound and outbound vessels could potentially discharge or release oil, fuel, or waste. Such discharges would result only as accidental occurrences and are considered extremely unlikely to occur. Vessels would need to implement measures in accordance with approved plans to avoid discharges and minimize effects should any unexpected discharges occur.

Transient young of year, juvenile, subadult, or adult Atlantic sturgeon and young of year, juvenile, or adult shortnose sturgeon may occur within the action area. Sturgeon eggs, yolk-sac larvae, and post-yolk-sac larvae have a higher potential of being entrained during the intake of ballast water, however, early life stages of either sturgeon species do not occur in the Salem River or in the lower East River due to salinity and distance from spawning sites. As these life stages do not occur in the area where ballast water intakes may be operated, there is no risk of impingement or entrainment of any early life stages. Furthermore, young of year, juvenile, subadult, and adult sturgeons are too large to potentially be entrained and have sufficient swimming capabilities to avoid impingement during ballast water withdrawal.

Similar to sturgeon, adult sea turtles are too large to potentially be entrained, and adults and older juveniles have sufficient swimming capabilities to avoid impingement during ballast water withdrawal. Additionally, hatchlings are not expected to be present in the action area; therefore, they are not expected to be entrained by ballast water. Therefore, any consequences of ballast water exchange on any ESA-listed species are extremely unlikely.

7 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.

The effects of future state and private activities in the action area that are reasonably certain to occur are continuation of recreational fisheries, fisheries authorized by states, use of the action area by private vessels, discharge of wastewater and associated pollutants, and coastal development authorized by state and local governments. We do not anticipate any effects to occur over the time period of the proposed action that were not already captured in the *Status of the Species* or *Environmental Baseline* of this Opinion.

Cumulative effects, as defined in 50 CFR § 402.02, are those effects of future State or private activities, not involving Federal activities, which are reasonably certain to occur within the

action area. Future Federal actions are not considered in the definition of “cumulative effects.” Actions carried out or regulated by the States of New Jersey, Delaware and Pennsylvania within the action area that may affect shortnose and Atlantic sturgeon include the authorization of state fisheries and the regulation of point and non-point source pollution through the National Pollutant Discharge Elimination System (NPDES). Other than those captured in the *Status of the Species* and *Environmental Baseline* sections above, 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 effects⁴⁰.

State Water Fisheries – Future recreational and commercial fishing activities in state waters may take shortnose and Atlantic sturgeon. In the past, it was estimated that over 100 shortnose sturgeon were captured annually in shad fisheries in the Delaware River, with an unknown mortality rate (O’Herron and Able 1985); no recent estimates of captures or mortality are available. Atlantic sturgeon were also likely incidentally captured in shad fisheries in the river; however, estimates of the number of captures or the mortality rate are not available. Recreational shad fishing is currently allowed within the Delaware River with hook and line only; commercial fishing for shad occurs with gill nets, but only in Delaware Bay. In 2012, only one commercial fishing license was granted for shad in New Jersey. Shortnose and Atlantic sturgeon continue to be exposed to the risk of interactions with this fishery; however, because increased controls have been placed on the shad fishery, impacts to shortnose and Atlantic sturgeon are likely less than they were in the past.

Information on interactions with shortnose and Atlantic sturgeon for other fisheries operating in the action area is not available, and it is not clear to what extent these future activities would affect listed species differently than the current state fishery activities described in the *Status of the Species/Environmental Baseline* section. However, this biological opinion assumes that future effects would be similar to those in the past and, therefore, are reflected in the anticipated trends described in the status of the species/environmental baseline section.

State PDES Permits – The states of New Jersey, Delaware and Pennsylvania have been delegated authority to issue NPDES permits by the EPA. These permits authorize the discharge of pollutants in the action area. Permit holders include municipalities for sewage treatment plants and other industrial users. The states will continue to authorize the discharge of pollutants through the State PDES permits. However, this biological opinion assumes effects in the future would be similar to those in the past and, therefore, are reflected in the anticipated trends described in the status of the species/environmental baseline section.

⁴⁰ 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.”

8 INTEGRATION AND SYNTHESIS

The *Integration and Synthesis* section is the final step in our assessment of the effects and corresponding risk posed to ESA-listed species and designated critical habitat as a result of implementing the proposed action. In Section 4.1, we determined that the project will have no effect on critical habitat designated for the North Atlantic right whale and is not likely to adversely affect Giant Manta Ray, Oceanic whitetip shark, sei whale, blue whale, sperm whale, fin whale, the North Atlantic right whale, or critical habitat designated for the New York Bight DPS of Atlantic sturgeon. Those species and critical habitat for which we reached a “not likely to adversely affect” conclusion are addressed in Section 4 of this Opinion.

In this section, for species not addressed in Section 4 (i.e. those species for which we have determined the proposed action may affect and is likely to adversely affect), we add the *Effects of the Action* to the *Environmental Baseline* and the *Cumulative Effects*, while also considering effects in the context of the *Status of the Species*, to formulate the agency’s biological opinion as to whether the proposed action “reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing its numbers, reproduction, or distribution” (50 CFR §402.02). The purpose of this analysis is to determine whether the action is likely to jeopardize the continued existence of shortnose sturgeon, the five DPSs of Atlantic sturgeon, the Northwest Atlantic DPS of loggerhead sea turtles, North Atlantic DPS of green sea turtles, or leatherback or Kemp’s ridley sea turtles.

Below, we summarize the status of the species and consider whether the action will result in reductions in reproduction, numbers, or distribution of the species. We then consider whether any reductions in reproduction, numbers, or distribution resulting from the action would reduce appreciably the likelihood of both the survival and recovery of these species, consistent with the definition of “jeopardize the existence of” (50 C.F.R. §402.02) for purposes of Sections 7(a) (2) and 7(b) of the federal Endangered Species Act and its implementing regulations. In addition, we use the following guidance and regulatory definitions related to survival and recovery to guide our jeopardy analysis. In the NMFS/USFWS Section 7 Handbook, for the purposes of determining whether jeopardy is likely, 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 in regulation 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” 50 C.F.R. §402.02.

8.1 Northwest Atlantic DPS of Loggerhead Sea Turtles

We have determined that the actions under consideration in this Opinion will result in the mortality of up to 22 loggerhead sea turtles over a 30-year period. All other effects to loggerhead sea turtles, including effects to prey, are expected to be insignificant or extremely unlikely.

The NWA DPS of loggerhead sea turtles is listed as threatened under the ESA. Based on nesting data and population abundance and trends at the time, NMFS and USFWS 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, 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.

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. As described in the *Status of the Species*, recent assessments have evaluated the nesting trends for each recovery unit. 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. 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.

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 population studies are consistent with the definition of the Northwest Atlantic DPS.

The Atlantic Marine Assessment Program for Protected Species (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 Northwest Atlantic which is an indication of the size of the Northwest Atlantic DPS.

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 mortality of 22 loggerhead Northwest Atlantic DPS sea turtles in the action area over the 30-year life of the project would reduce the number of loggerhead sea turtles from the recovery unit of which they originated as compared to the number of loggerheads that would have been present in the absence of the proposed actions (assuming all other variables remained the same). 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 (Ceriani and Meylan 2017, NMFS and U.S. FWS 2008). Considering the genetic analyses summarized above, we expect that the majority of loggerheads in the action area originated from the Peninsular Florida Recovery Unit (PFRU) or the Northern Recovery Unit (NRU).

The NRU, from the Florida-Georgia border through southern Virginia, is the second largest nesting aggregation in the DPS, with annual nest totals for this recovery unit from 1983 to 2019 have ranging from a low of 520 in 2004 to a high of 5,555 in 2019 (Bolten *et al.* 2019). There was an average of 5,215 nests from 1989-2008, and approximately 1,272 nesting females (NMFS and U.S. FWS 2008). For the NRU, 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 and statistically significant (Bolten *et al.* 2019).

Annual nest totals for the PFRU averaged 64,513 nests from 1989-2007, representing approximately 15,735 females per year (NMFS and U.S. FWS 2008). Annual index beach nest counts from 1989 to 2023 ranged from a low of 28,876 in 2007 to a high of almost 71,000 in 2023 (Bolten *et al.* 2019, FFWCC 2024). An increase in the number of loggerhead nests in the PFRU has been observed since 2007 and long-term nesting data from 1989-2023 reveal a complex pattern with three distinct phases: increasing (1989-1998), decreasing (1998-2007), and increasing (2007-2023) (FFWCC 2024).

The loss of 22 NWA DPS loggerheads over the 30-year project life represents an extremely small percentage of the number of sea turtles in the PFRU or NRU. Even if the total population of the PFRU was limited to 15,735 loggerheads (the number of nesting females), the loss of 22 individuals would represent approximately 0.14 percent of the population. If the total NRU population was limited to 1,272 sea turtles (the number of nesting females), and all 22 individuals originated from that population, the loss of those individuals would represent approximately 1.7 percent of the population. Even just considering the number of adult nesting females this loss is extremely small and would be even smaller when considered in the context of the total recovery unit and represents an even smaller percentage of the DPS as a whole.

As noted in the *Environmental Baseline*, the status of loggerhead Northwest Atlantic DPS sea turtles in the action area is expected to be the same as that of each recovery unit over the life of the project (stable to increasing). The loss of such a small percentage of the individuals from any of these recovery units represents an even smaller percentage of the DPS as a whole. Considering the extremely small percentage of the populations that will be killed, it is unlikely that these deaths will have a detectable effect on the numbers and population trends of loggerheads in these recovery units or the number of loggerheads in the Northwest Atlantic DPS. We make this conclusion in consideration of the status of the DPS as a whole, the status of NWA DPS loggerhead sea turtles in the action area, and in consideration of the threats experienced by NWA DPS loggerheads in the action area as described in the *Environmental Baseline* and *Cumulative Effects* sections of this Opinion. Changing environmental conditions may result in changes in the distribution or abundance of loggerheads in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated changes to environmental conditions.

Any effects on reproduction are limited to the future reproductive output of the individuals that die. Even assuming that all of these losses were reproductive females (which is unlikely given the expected even sex ratio in the action area), given the number of nesting adults in each of these populations, it is unlikely that the expected loss of loggerheads would affect the success of nesting in any year. Additionally, this extremely small reduction in potential nesters is expected to result in a similarly small reduction in the number of eggs laid or hatchlings produced in future years and similarly, an extremely small effect on the strength of subsequent year classes with no detectable effect on the trend of any recovery unit or the DPS as a whole. The proposed actions will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting. Additionally, given the small percentage of the DPS that will be killed as a result of the proposed action, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity. The proposed action is also not likely to reduce distribution in the action area.

While generally speaking, the loss of a small number of individuals from a subpopulation or 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 this DPS of loggerheads because the DPS is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the DPS population and the number of loggerheads in the DPS is likely to be stable or increasing over the time period considered here.

Based on the information provided above, the death of 22 NWA DPS loggerheads over the 30-year life of the project will not reduce appreciably the likelihood of survival (*i.e.*, it will not

decrease the likelihood that the DPS will continue to persist into the future with sufficient resilience to allow for recovery and eventual delisting). The actions will not affect NWA DPS loggerheads in a way that prevents the DPS from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent loggerheads in this DPS from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of 22 loggerheads represents an extremely small percentage of the DPS as a whole; (2) the death of 22 loggerheads will not change the status or trends of any recovery unit or the DPS as a whole; (3) the loss of 22 loggerheads is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of 22 NWA DPS loggerheads is likely to have an extremely small effect on reproductive output that will be insignificant at the recovery unit or DPS level; (5) the action will not have any effect on the distribution of NWA DPS loggerheads in the action area and no effect on the distribution of the DPS throughout its range; and, (6) the action will have no effect on the ability of loggerheads to shelter and only an insignificant effect on individual foraging loggerheads.

In certain instances, an action may not reduce appreciably the likelihood of a species survival (persistence) but may 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 reduce appreciably the likelihood that this DPS of loggerhead sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the NWA DPS of loggerheads can rebuild to a point where listing is no longer appropriate. In 2008, NMFS and the U.S. FWS issued a recovery plan for the NWA DPS of loggerheads (NMFS and U.S. FWS 2008). The plan includes demographic recovery criteria as well as a list of tasks that must be accomplished. Demographic recovery criteria are included for each of the five recovery units. These criteria focus on sustained increases in the number of nests laid and the number of nesting females in each recovery unit, an increase in abundance on foraging grounds, and ensuring that trends in neritic strandings are not increasing at a rate greater than trends in in-water abundance. The recovery tasks focus on protecting habitats, minimizing and managing predation and disease, and minimizing anthropogenic mortalities.

Loggerheads have a stable trend; as explained above, the loss of 22 NWA DPS loggerheads over the life span of the proposed action will not affect the population trend. The number of loggerheads likely to die as a result of the proposed action is an extremely small percentage of any recovery unit or the DPS as a whole. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed action will not affect the likelihood that the demographic criteria will be achieved or the timeline on which they will be achieved. The action area does not include

nesting beaches; all effects to habitat will be insignificant; therefore, the proposed action will have no effect on the likelihood that habitat-based recovery criteria will be achieved. The proposed action will also not affect the ability of any of the recovery tasks to be accomplished.

The effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the action will not prevent this DPS of the species from growing in a way that leads to recovery and the action will not change the rate at which recovery can occur. This is the case because while the action may result in a small reduction in the number of loggerheads and a small reduction in the amount of potential reproduction due to the loss of these individuals, these effects will be undetectable over the long-term and the action is not expected to have long term impacts on the future growth of the DPS or its potential for recovery. Therefore, based on the analysis presented above, the proposed action will not reduce appreciably the likelihood that the NWA DPS of loggerhead sea turtles can be brought to the point at which they are no longer listed as threatened or endangered; that is, the proposed action will not reduce appreciably the likelihood of recovery of the NWA DPS of loggerhead sea turtles.

Based on the analysis presented herein, the effects of the proposed action are not likely to reduce appreciably the likelihood of both the survival and recovery of the NWA DPS of loggerhead sea turtles. These conclusions were made in consideration of the threatened status of NWA DPS loggerhead sea turtles, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of changing environmental conditions on the abundance, reproduction, and distribution of loggerhead sea turtles in the action area.

8.2 Kemp's ridley sea turtles

In this Opinion, we have considered the potential impacts of the proposed action on Kemp's ridley sea turtles. The impacts to Kemp's ridley sea turtles from the proposed action are expected to result with two Kemp's ridley sea turtles being struck and killed by a project vessel over the 30-year life of the project. We determined that all other effects of the action would be insignificant or extremely unlikely to occur. In total, we expect the proposed action to result in the mortality of two Kemp's ridley sea turtles over the 30-year life of the project.

Kemp's ridley sea turtles are listed as a single species and classified as endangered under the ESA. Kemp's ridleys occur in the North Atlantic Ocean and Gulf of America. the only major nesting site for Kemp's ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963, NMFS and USFWS 2015, USFWS and NMFS 1992).

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 (as cited in NMFS 2020b) 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. The most recent year of available data (2023) found 2,121 nests (Sea Turtle Early Restoration Project Team 2023). A small nesting population is also emerging in the United States, primarily in Texas, rising from 6 nests in 1996 to 42 in 2004 to a record high of 353 nests in 2017 (NPS Data). It is worth noting that nesting in Texas has somewhat 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 2020c) and decreases in nesting in 2018 and 2019. In 2023, there were 256 Kemp's ridley nests counted, down from 284 nests in 2022 (NPS Data).

Estimates of the adult female nesting population reached a low of approximately 250-300 in 1985 (NMFS and U.S. FWS 2015, TEWG 2000). 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 (NMFS *et al.* 2011), a remigration interval of two years (Epperly *et al.* 2013, NMFS and U.S. FWS 2015, Snover *et al.* 2007), 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 America (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).

Fishery interactions are the main threat to the species. The species' limited range and low global abundance make its resilience to future perturbation low. The status of Kemp's ridley sea turtles in the action area is the same as described in the *Status of the Species*. As described in the *Environmental Baseline* and *Cumulative Effects*, fisheries bycatch and vessel strike are likely to continue to occur in the action area over the life of the project. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different than those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion. Changing environmental conditions may result in changes in the distribution or abundance of loggerheads in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated changes to environmental conditions.

The proposed action is expected to result in the mortality of two Kemp's ridleys over a 30-year period. This 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 two sea turtles in a 30-year period represents a small fraction (0.009 percent) of the number of mature animals and an even smaller fraction of the overall population which includes multiple year classes of younger life stages. Even taking into account just nesting females (7-8,000), the death of two Kemp's ridleys represents less than 0.03 percent of the nesting female population. While the death of two Kemp's ridleys will reduce the number of Kemp's ridleys compared to the number that would have been present absent the proposed actions, it is not likely that this reduction in numbers will change the status of this species or its stable to increasing trend as this loss represents a very small percentage of the population. Reproductive potential of Kemp's ridleys is not expected to be affected in any other way other than through a reduction in numbers of individuals. A reduction in the number of Kemp's ridleys would have the effect of reducing the amount of potential reproduction, as any dead Kemp's ridleys would have no potential for future reproduction. In 2006, the most recent year for which data is available, there were an estimated 7-8,000 nesting females. While the species is thought to be female biased, there are likely to be several thousand adult males as well. Given the number of nesting adults, it is unlikely that the loss of two Kemp's ridley over 30 years would affect the success of nesting in any year. Additionally, this small reduction in potential nesters is expected to result in a small reduction in the number of eggs laid or hatchlings produced in future years and similarly, a very

small effect on the strength of subsequent year classes. Even considering the potential future nesters that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be very small and would not change the stable to increasing trend of this species. Additionally, the proposed action will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting.

As the proposed action will not result in any loss of access to habitat or affects the number of individuals in a way that would affect distribution, no reduction in the distribution of Kemp's ridley sea turtles is expected from the proposed action. Additionally, given the small percentage of the species that will be killed as a result of the proposed action, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

While generally speaking, the loss of a small number of individuals from a subpopulation or 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 Kemp's ridleys because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of Kemp's ridleys is likely to be increasing and at worst is stable.

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 two Kemp's ridleys during a 30-year period is not expected to change the trend in nesting, the distribution of, or the reproduction of Kemp's ridley sea turtles.

Based on the information provided above, the death of two Kemp's ridley sea turtles over 30 years will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The proposed action will not affect Kemp's ridleys in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which

would prevent Kemp's ridleys from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the species' nesting trend is increasing; (2) the death of two Kemp's ridley represents an extremely small percentage of the species as a whole; (3) the death of two Kemp's ridley will not change the status or trends of the species as a whole; (4) the loss of these Kemp's ridley is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of these Kemp's ridley is likely to have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; (5) the actions will have no effect on the distribution of the species throughout its range; and, (6) the actions will have no effect on the ability of Kemp's ridleys to shelter and only an insignificant effect on individual foraging Kemp's ridleys.

In rare instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may 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 Kemp's ridley sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that Kemp's ridleys can rebuild to a point where listing is no longer appropriate. In 2011, NMFS and the USFWS issued a recovery plan for Kemp's ridleys (NMFS et al. 2011). The plan includes a list of criteria necessary for recovery. These include:

1. An increase in the population size, specifically in relation to nesting females⁴¹;
2. An increase in the recruitment of hatchlings⁴²;
3. An increase in the number of nests at the nesting beaches;
4. Preservation and maintenance of nesting beaches (i.e. Rancho Nuevo, Tepehuajes, and Playa Dos); and,
5. Maintenance of sufficient foraging, migratory, and inter-nesting habitat.

With respect to the demographic recovery objective, the nesting numbers in the most recent year of available data (2023) found 2,121 nests (Sea Turtle Early Restoration Project Team 2023) on the main nesting beaches in Mexico. Based on 2.5 clutches/female/season, this number represents approximately 6,967 nesting females for that season. Although there has been a substantial increase in the Kemp's ridley population within the last few decades, the number of

⁴¹A 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 in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos) is attained in order for downlisting to occur; an average of 40,000 nesting females per season over a 6-year period by 2024 for delisting to occur

⁴² Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos).

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 two Kemp's ridley sea turtle during a 30-year period is not likely to have any detectable effect on nesting trends, we do not expect the proposed action to impede progress toward achieving this recovery objective. The loss of two Kemp's Ridley sea turtles would not measurably affect the adult female nesting population or number of nests per nesting season. Thus, we assert that the proposed action will not reduce appreciably the likelihood of Kemp's ridley sea turtle recovery in the wild.

Kemp's ridleys have an increasing trend; as explained above, the loss of two Kemp's ridley over the 30-year life of the project will not affect the population trend. The number of Kemp's ridleys likely to die as a result of the proposed actions is an extremely small percentage of the species. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed action will not affect the likelihood that criteria one, two, or three will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; therefore, the proposed actions will have no effect on the likelihood that recovery criteria four will be met. All effects to habitat will be insignificant or extremely unlikely to occur; therefore, the proposed actions will have no effect on the likelihood that criteria five will be met.

The effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction. Further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of Kemp's ridleys and a small reduction in the amount of potential reproduction, these effects will be undetectable over the long-term and the actions are not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed action will not appreciably reduce the likelihood that Kemp's ridley sea turtles can be brought to the point at which they are no longer listed as endangered or threatened; that is, the proposed action will not appreciably reduce the likelihood of recovery of Kemp's ridley sea turtles.

Despite the threats faced by individual Kemp's ridley sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed action in light of the status of the species, Environmental Baseline and cumulative effects explained above, including changing environmental conditions, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change.

8.3 North Atlantic DPS of Green Sea Turtle

We anticipate up to one green sea turtle will be struck and killed by a project vessel over the 30-year life of the project. All other effects to green sea turtles, including effects to their prey and habitat and from active acoustic sources, are expected to be insignificant or extremely unlikely.

The North Atlantic DPS of green sea turtles is listed as threatened under the ESA. As described in the *Status of the Species*, the North Atlantic DPS of green sea turtles is the largest of the 11 green turtle DPSs with an estimated abundance of over 167,000 adult females from 73 nesting sites. All major nesting populations demonstrate long-term increases in abundance (Seminoff et al. 2015b). Green sea turtles face numerous threats on land and in the water that affect the survival of all age classes. While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue for this DPS, the DPS appears to be somewhat resilient to future perturbations. As described in the *Environmental Baseline* and *Cumulative Effects*, North Atlantic DPS green sea turtles in the action area are exposed to pollution and experience vessel strike and fisheries bycatch. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to changing environmental conditions.

There are four regions that support high nesting concentrations in the North Atlantic DPS: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), United States (Florida), and Cuba. Using data from 73 nesting sites in the North Atlantic DPS (with some representing numerous individual beaches), nester abundance was estimated at 167,528 total females (Seminoff et al. 2015). The years used to generate the estimate varied by nesting site but were between 1998 and 2012. It should be noted that not all female green sea turtles nest in a given year (Seminoff et al. 2015) so the count of nesters does not represent the total number of adult females. The largest nesting site (Tortuguero, Costa Rica) hosts 79 percent of total nest abundance. Nesting in the area has increased considerably since the 1970s, and nest count data from 1999-2003 suggested that 17,402-37,290 females nested there per year (Seminoff et al. 2015). In 2010, an estimated 180,310 nests were laid at Tortuguero, the highest level of green sea turtle nesting estimated since the start of nesting track surveys in 1971. This equated to somewhere between 30,052 and 64,396 nesters in 2010 (Seminoff et al. 2015). More recent nesting numbers at Tortuguero, Costa Rica, the largest nesting assemblage for the North Atlantic DPS, have shown declining trends. Restrepo et al. (2023) modelled the long-term trend in annual clutch numbers from 1971 to 2021 and found that Tortuguero's clutch abundance trend increased steadily through 2000, then slowed gradually until 2008, after which the trend shifted downwards. Nesting sites in Cuba, Mexico, and the U.S. were either stable or increasing (Seminoff et al. 2015). More recent data is available for the southeastern U.S.; nest counts at Florida's core index beaches have ranged from less than 300 to more than 61,000 in 2023. The Index Nesting Beach Survey (INBS) is carried out on a subset of beaches surveyed during the Statewide Nesting Beach Survey (SNBS) and is designed to measure trends in nest numbers. Overall, the nest numbers show a typical biennial peaks in abundance and has been generally

increasing (<https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/>). The SNBS is broader but is not appropriate for evaluating trends. In 2023, over 77,000 green turtle nests were counted in Florida, which was a record high.

NMFS recognizes that the nest count data available for green sea turtles in the Atlantic indicates increased nesting at many sites. However, we also recognize that the nest count data, including data for green sea turtles in the Atlantic, only provides information on the number of females currently nesting and is not necessarily a reflection of the number of mature females available to nest or the number of immature females that will reach maturity and nest in the future.

The death of one NA DPS green sea turtle, whether a male or female, immature or mature, would reduce the number of green sea turtles as compared to the number of green that would have been present in the absence of the proposed actions assuming all other variables remained the same. The loss of one green sea turtle represents a very small percentage of the DPS as a whole. The loss of one green sea turtle represents a very small percentage of the DPS as a whole. Even compared to the number of nesting females (17,000-37,000), which represent only a portion of the number of greens worldwide, the mortality of one green sea turtles represents less than 0.01 percent of the DPS's nesting population. The loss of this sea turtle would be expected to reduce the reproduction of green sea turtles as compared to the reproductive output of green sea turtles in the absence of the proposed action. As described in the *Status of the Species* section above, we consider the trend for green sea turtles to be stable. As noted in the *Environmental Baseline*, the status of green sea turtles in the action area is expected to be the same as that of each recovery unit over the life of the project. As explained below, the death of this green sea turtle will not appreciably reduce the likelihood of survival for this DPS of the species for the reasons outlined below. We make this conclusion in consideration of the status of the species as a whole, the status of green sea turtles in the action area, and in consideration of the threats experienced by green sea turtles in the action area as described in the *Environmental Baseline* and *Cumulative Effects* sections of this Opinion.

While generally speaking, the loss of a small number of individuals from a subpopulation or 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 greens because: this DPS of the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of greens is likely to be increasing and at worst is stable. These actions are not likely to reduce distribution of greens because the actions will not cause more than a temporary disruption to foraging and migratory behaviors.

Based on the information provided above, the death of one NA DPS green sea turtles over the

30-year life of the project, will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that this DPS of 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 green sea turtles in a way that prevents this DPS of the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent green sea turtles from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the DPS for this species' nesting trend is increasing; (2) the death of one green sea turtle represents an extremely small percentage of the DPS as a whole; (3) the loss of one green sea turtle will not change the status or trends of the DPS as a whole; (4) the loss of one green sea turtle is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of one green sea turtle is likely to have an undetectable effect on reproductive output of the DPS as a whole; (6) the action will have no effect on distribution throughout the DPS's range; and (7) the action will have no effect on the ability of green sea turtles to shelter and only an insignificant effect on individual foraging green sea turtles.

In rare instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that this DPS of green sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that this DPS of the species can rebuild to a point where listing is no longer appropriate. A Recovery Plan for Green sea turtles was published by NMFS and USFWS in 1991. The plan outlines the steps necessary for recovery and the criteria, which, once met, would ensure recovery. In order to be delisted, green sea turtles must experience sustained population growth, as measured in the number of nests laid per year, over time. Additionally, "priority one" recovery tasks must be achieved, nesting habitat must be protected (through public ownership of nesting beaches), and stage class mortality must be reduced. The recovery plan for Atlantic green sea turtles (NMFS and U.S. FWS 1991) lists the following recovery objectives which are relevant to the proposed action in this Opinion, and must be met over a period of 25 continuous years:

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

The proposed actions will not appreciably reduce the likelihood of survival or recovery of green sea turtles in this DPS. Also, it is not expected to modify, curtail or destroy the range of the DPS since it will result in an extremely small reduction in the number of green sea turtles in any

geographic area and since it will not affect the overall distribution of green sea turtles other than to cause minor temporary adjustments in movements in the action area. As explained above, the proposed actions are likely to result in the mortality of one green sea turtle; however, as explained above, the loss of this individual over this time period is not expected to affect the persistence of green sea turtles or the trend for this DPS of the species. The actions will not affect nesting habitat and will have only an extremely small effect on mortality. The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent this DPS of the species from growing in a way that leads to recovery, and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of greens and a small reduction in the amount of potential reproduction due to the loss of one individual, these effects will be undetectable over the long-term, and the action is not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that green sea turtles in this DPS can be brought to the point at which their listing as endangered or threatened is no longer appropriate; that is, the proposed action will not appreciably reduce the likelihood of recovery of this DPS of green sea turtles.

Despite the threats faced by individual NA DPS green sea turtles inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions.

These conclusions were made in consideration of the threatened status of the North Atlantic DPS of green sea turtles, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of changing environmental conditions on the abundance, reproduction, and distribution of green sea turtles in the action area.

8.4 Leatherback Sea Turtles

In this Opinion, we have considered the potential impacts of the proposed action on leatherback sea turtles. We anticipate up to two leatherback sea turtles will be struck and killed by a project vessel over the 30-year life of the project. All other effects to leatherback sea turtles, including effects to their prey and habitat and from active acoustic sources, are expected to be insignificant and extremely unlikely.

Leatherback sea turtles are listed as endangered under the ESA. Leatherbacks are widely distributed throughout the oceans of the world and are found in waters of the Atlantic, Pacific, and Indian Oceans, the Caribbean Sea, Mediterranean Sea, and the Gulf of America (Ernst and Barbour 1972). Leatherback nesting occurs on beaches of the Atlantic, Pacific, and Indian Oceans as well as in the Caribbean (NMFS and USFWS 2013). Leatherbacks face a multitude

of threats that can cause death prior to and after reaching maturity. Some activities resulting in leatherback mortality have been addressed.

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

In the 2020 status review, the authors identified seven leatherback populations that met the discreteness and significance criteria of DPSs (NMFS and USFWS 2020). These include the Northwest Atlantic, Southwest Atlantic, Southeast Atlantic, Southwest Indian, Northeast Indian, West Pacific, and East Pacific. The population found within the action is area is that identified in the status review as the Northwest Atlantic DPS. While NMFS and USFWS concluded that seven populations met the criteria for DPSs, the species continues to be listed at the global level (85 FR 48332, August 10, 2020) as the agencies have taken no action to list one or more DPSs. Therefore, while we reference the DPSs and stocks to analyze the status and trends of various populations, our jeopardy analysis is based on the range-wide status of the species as listed.

Previous assessments of leatherbacks concluded that the Northwest Atlantic population was stable or increasing (TEWG 2007, Tiwari *et al.* 2013b). However, as described in the *Status of the Species*, more recent analyses indicate that the overall trends are negative (Northwest Atlantic Leatherback Working Group 2018). At the stock level, the Working Group evaluated the Northwest Atlantic – Guianas-Trinidad, Florida, Northern Caribbean, and the Western Caribbean. The Northwest Atlantic – Guianas-Trinidad stock is the largest stock and declined significantly across all time periods evaluated, which was attributed to an exponential decline in abundance at Awala-Yalimapo, French Guiana as well as recent declines in Guyana, Suriname, Cayenne, and Matura. Declines in Awala-Yalimapo were attributed, in part, due to beach erosion and a loss of nesting habitat (Northwest Atlantic Leatherback Working Group 2018). The Florida stock increased significantly over the long-term, but declined from 2008-2017. While lower than the nest numbers documented during the 2009-2014 period, 486 nests were reported in 2023 (FFWCC 2024). 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).

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

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

The primary threats to leatherback sea turtles include fisheries bycatch, harvest of nesting females, and egg harvesting; of these, as described in the *Environmental Baseline* and *Cumulative Effects*, fisheries bycatch occurs in the action area. Leatherback sea turtles in the action area are also at risk of vessel strike. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to changing environmental conditions.

The mortality of two leatherback sea turtles over 30 years will reduce the number of leatherback sea turtles as compared to the number that would have been present in the absence of the proposed action (assuming all other variables remained the same). The death of two leatherbacks over the life span of the project represents an extremely small percentage of the number of leatherbacks in the North Atlantic, less than 0.01 percent even when considering the lowest population estimate of nesting females (20,659; NMFS and USFWS 2020) and an even smaller percentage of the species as a whole. Considering the extremely small percentage of the

population that will be killed, it is unlikely that these deaths will have a detectable effect on the numbers and population trends of leatherbacks in the North Atlantic or the species as a whole.

Any effects on reproduction are limited to the future reproductive output of the individual killed. Even assuming that the mortality is to a reproductive female, given the number of nesting females in this population (20,659), it is unlikely that the expected loss of no more than two leatherbacks over 30 years would affect the success of nesting in any year. Additionally, this extremely small reduction in a potential nester is expected to result in a similarly small reduction in the number of eggs laid or hatchlings produced in future years and similarly, an extremely small effect on the strength of subsequent year classes with no detectable effect on the trend of any nesting beach or the population as a whole. The proposed action will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting. Additionally, given the small percentage of the species that will be killed as a result of the proposed action, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

While generally speaking, the loss of a small number of individuals from a subpopulation or 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 leatherbacks because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of leatherbacks is likely to be stable or increasing over the period considered here.

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

As explained in the *Environmental Baseline*, although no direct leatherback impacts (*i.e.*, oiled sea turtles or nests) from the Deepwater Horizon oil spill in the northern Gulf of America were observed, some impacts from that event may be expected. However, there is no information to indicate, or basis to conclude, that a significant population-level impact has occurred that would change the species' status to an extent that the expected interactions from the proposed action would result in a detectable change in the population status of leatherback sea turtles. Any

impacts are not thought to alter the population status to a degree in which the number of mortalities from the proposed action could be seen as reducing the likelihood of survival and recovery of the species.

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

Based on the information provided above, the loss of up to two leatherback sea turtles in the Atlantic over 30 years as a result of the proposed action will not reduce appreciably the species' likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for recovery and eventual delisting). The actions will not affect leatherbacks in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent leatherbacks from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of two leatherbacks represents an extremely small percentage of the Northwest Atlantic population and an even smaller percentage of the species as a whole; (2) the death of two leatherbacks will not change the status or trends of any nesting beach, the Northwest Atlantic population or the species as a whole; (3) the loss of two leatherback is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of two leatherbacks is likely to have an extremely small effect on reproductive output that will be insignificant at the nesting beach, population, or species level; (5) the actions will have no effect on the distribution of the species throughout its range; and, (6) the actions will have no effect on the ability of leatherbacks to shelter and only an insignificant effect on individual foraging leatherbacks.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that leatherback sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that leatherbacks can rebuild to a point where listing is no longer appropriate. In 1992, NMFS and the USFWS issued a recovery plan for leatherbacks in the U.S. Caribbean, Atlantic, and Gulf of America (NMFS and

USFWS 1992). The plan includes three recovery objectives:

- 1) The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, USVI, and along the east coast of Florida.
- 2) Nesting habitat encompassing at least 75 percent of nesting activity in USVI, Puerto Rico and Florida is in public ownership.
- 3) All priority one tasks have been successfully implemented.

The recovery tasks focus on protecting habitats, minimizing and managing predation and disease, and minimizing anthropogenic mortalities.

Because the death of two leatherbacks over the 30-year life of the project is such a small percentage of the population and is not expected to affect the status or trend of the species, it will not affect the likelihood that the adult female population of loggerheads increases over time. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed actions will not affect the likelihood that the demographic criteria will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; all effects to habitat will be insignificant or extremely unlikely to occur; therefore, the proposed actions will have no effect on the likelihood that habitat based recovery criteria will be achieved. The proposed actions will also not affect the ability of any of the recovery tasks to be accomplished.

The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of leatherbacks and a small reduction in the amount of potential reproduction due to the loss of these individual, these effects will be undetectable over the long-term and the actions are not expected to have long term impacts on the future growth of the species or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that leatherback sea turtles can be brought to the point at which they are no longer listed as endangered. Despite the threats faced by individual leatherback sea turtles inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of the status of the species rangewide and in the action area, the environmental baseline, cumulative effects explained above, including changing environmental conditions, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached here do not change.

Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of leatherback sea turtles. These conclusions were made in consideration of the endangered status of leatherback sea turtles, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of changing environmental conditions on the abundance and distribution of leatherback sea turtles in the action area; that is, the proposed action will not appreciably reduce the likelihood of recovery of leatherback sea turtles.

Despite the threats faced by individual leatherback sea turtles inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of the status of the species rangewide and in the action area, the environmental baseline, cumulative effects explained above, including changing environmental conditions, 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 effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of leatherback sea turtles. These conclusions were made in consideration of the endangered status of leatherback sea turtles, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of changing environmental conditions on the abundance, reproduction, and distribution of leatherback sea turtles in the action area.

8.5 Atlantic sturgeon

In the *Consequences of the Action* above, we determined that the proposed action is likely to result in the mortality of up to 45 Atlantic sturgeon: 32 from the New York Bight DPS (juvenile, subadult, or adult), 7 subadult/adults from the Chesapeake Bay DPS, 3 subadult/adults from the South Atlantic, 2 subadult/adults from the Carolina DPS; and 1 subadult/adult from the Gulf of Maine. All mortalities are expected to result from vessel strike and will occur over the 30-year operational life of the Port. We determined that all effects to eggs, larvae (yolk sac or post-yolk sac), and young of the year will be insignificant or extremely unlikely to occur. All other consequences to Atlantic sturgeon, including consequences to habitat and prey, from dredging, entrapment, noise, and water quality will be insignificant or extremely unlikely.

8.5.1.1 Gulf of Maine DPS

The proposed action is expected to result in the death of one Atlantic sturgeon from the Gulf of Maine DPS over a 30-year period. All other effects of the action on this DPS will be insignificant or extremely unlikely.

The Gulf of Maine DPS is listed as threatened. While Atlantic sturgeon occur in several rivers of the Gulf of Maine DPS, recent spawning has only been documented in the Kennebec River. The estimated effective population size of the Kennebec River is less than 70 adults, which suggests a relatively small spawning population (NMFS 2022). NMFS estimated adult and subadult abundance of the Gulf of Maine 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) and concluded that subadult and adult abundance of the Gulf of Maine DPS was 7,455 sturgeon (NMFS 2013). This number encompasses many age classes since, across all DPSs, subadults can be as young as one year old when they first enter the marine environment, and adults can live as long as 64 years (Balazik et al. 2012a; Hilton et al. 2016).

Gulf of Maine DPS Atlantic sturgeon are subject to numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage or for the DPS as a whole. The ASMFC (2024) stock assessment update concluded that the abundance of the Gulf of Maine DPS is “depleted” relative to historical levels. The Commission also noted that the Gulf of Maine is particularly data poor among all five DPSs. The assessment concluded that there is a 45 percent probability that the abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium. The Commission also concluded that there is a relatively high likelihood (55.5 percent probability) that mortality for the Gulf of Maine DPS exceeds the mortality threshold used for the assessment ASMFC (2017b), (ASMFC 2024). However, the Commission noted that there was considerable uncertainty related to these numbers, particularly concerning trends data for the Gulf of Maine DPS. For example, the stock assessment notes that it was not clear if: (1) the percent probability for the trend in abundance for the Gulf of Maine DPS is a reflection of the actual trend in abundance or of the underlying data quality for the DPS; and, (2) the percent probability that the Gulf of Maine DPS exceeds the mortality threshold actually reflects lower survival or was due to increased tagging model uncertainty owing to low sample sizes and potential emigration.

As described in the 5-Year Review for the Gulf of Maine DPS (NMFS 2022), the demographic risk for the DPS is “moderate”⁴³ because of its low productivity (i.e., relatively few adults compared to historical levels), low abundance (i.e., only one known spawning population and low DPS abundance, overall), and limited spatial distribution (i.e., limited spawning habitat within the one river known to support spawning). There is also new information indicating genetic bottlenecks as well as low levels of inbreeding. However, the recovery potential is considered high.

Here, we consider the consequences of the loss of up to one Atlantic sturgeon over a 30-year period from the Gulf of Maine DPS in addition to ongoing threats (e.g., capture in fisheries,

⁴³ 84 FR 18243; April 30, 2019 - Listing and Recovery Priority Guidelines.

coastal development, habitat loss, contaminants, etc.) in the action area. The reproductive potential of the Gulf of Maine DPS will not be affected in any way other than through the loss of a single individual. The loss of up to one individual over a 30-year period will have the consequence of reducing reproduction potential within the DPS because any dead Gulf of Maine DPS Atlantic sturgeon has 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 individuals that will 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 Gulf of Maine DPS fish spawn, because it will occur outside of those identified areas. Additionally, the action will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by Gulf of Maine DPS fish for the same reasons.

Because we do not have a population estimate for the Gulf of Maine DPS, it is difficult to evaluate the consequences of mortality on this species caused by this action. However, because the proposed action will result in the loss of no more than one individual over a 30-year period, it is extremely unlikely that this death will have detectable consequences on the numbers and population trend of the Gulf of Maine 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 Gulf of Maine 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, due to construction activities, and limited to the avoidance of the area where the impacts occur because of the action.

Based on the information provided above, the death of up to one Gulf of Maine DPS Atlantic sturgeon over a 30-year period will not appreciably reduce the likelihood of survival of the Gulf of Maine 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 potential recovery and delisting). The action will not affect Gulf of Maine DPS Atlantic sturgeon in a way that prevents the species from maintaining a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring. Additionally, it will not result in consequences to the environment which prevent Atlantic sturgeon from completing their entire life cycle, including reproducing, sustenance, and shelter. This is the case because: (1) the death of one Gulf of Maine DPS Atlantic sturgeon as a result of this action in any year will not change the status or trends of the species as a whole; (2) the loss of these one Gulf of Maine DPS Atlantic sturgeon as a result of this action are 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 Gulf of Maine DPS Atlantic sturgeon in the action area due to construction activities and no consequence on the distribution of the species throughout its range; and, (4) the action will have no consequence on the ability of Gulf of Maine DPS Atlantic sturgeon to shelter with only an insignificant consequence on any foraging Gulf of Maine 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 Gulf of Maine 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 Gulf of Maine DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the Gulf of Maine DPS has been published at this time. As defined, a Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. In January 2018, NMFS published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018⁴⁴). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. In general, to recover, a species must have a sustained positive increasing population trend over time and an increase in population size. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning.

Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For Gulf of Maine DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and, in the ocean, where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the Gulf of Maine DPS likelihood of recovery.

⁴⁴ Available online at: https://media.fisheries.noaa.gov/dam-migration/ats_recovery_outline.pdf

We do not expect the proposed action to modify, curtail or destroy the range of the species, or to change the status or trend of the Gulf of Maine DPS, since it will result in an extremely small reduction in the number and overall distribution. 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 30 years (one individual) and a subsequent extremely small and likely undetectable reduction in future reproductive output. For these reasons, we do not expect the action to affect the persistence of the Gulf of Maine DPS of Atlantic sturgeon. The action will not change the status or trend of the Gulf of Maine DPS of Atlantic sturgeon, nor will a very small reduction in numbers and future reproduction resulting from the proposed action reduce the likelihood of improvement in the status. 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 Gulf of Maine DPS of Atlantic sturgeon can be brought to the point at which listing as threatened is no longer necessary. 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 Gulf of Maine DPS Atlantic sturgeon inside and outside of the action area, including the potential of increased vessel strikes discussed in the cumulative effects section, 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 changing environmental conditions, 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 Gulf of Maine DPS Atlantic sturgeon over a 30-year period, is not likely to appreciably reduce the likelihood of the survival and recovery of the Gulf of Maine DPS of Atlantic sturgeon.

8.5.1.2 *New York Bight DPS*

The proposed action is expected to result in the death of up to 32 Atlantic sturgeon from the New York Bight DPS over a 30-year period. All other effects of the action on this DPS will be insignificant or extremely unlikely.

The New York Bight DPS is listed as endangered. While Atlantic sturgeon occur in several rivers in the New York Bight DPS, only the Hudson and Delaware rivers are known to support spawning populations. The essential physical features necessary to support spawning and recruitment are also present in the Connecticut and Housatonic Rivers (82 FR 39160; August 17, 2017). Young of year Atlantic sturgeon have been captured in the Connecticut River (Savoy *et al.*

2017). Genetic analysis suggests that the young of year belonged to the South Atlantic DPS and at this time, we do not know if these fish were the result of a single spawning event due to unique straying of the adults from the South Atlantic DPS's spawning rivers.

The 2022 5-Year review concluded that the status of the DPS has likely neither improved nor declined from what it was when we listed the DPS in 2012, that the DPS's demographic risk is "High," and that no changes to the listing status and listing recovery priority number are needed (NMFS 2022c). As noted in the 5-year review, low productivity (e.g., relatively few adults compared to historical levels and irregular spawning success), low abundance (e.g., only a few known spawning populations and low DPS abundance, overall), and limited spatial distribution (e.g., limited spawning habitat within each of the few known rivers that support spawning) puts the New York Bight DPS at risk of extinction. There is also new information indicating genetic bottlenecks as well as low levels of inbreeding in the Hudson and Delaware spawning populations. However, the recovery potential is considered high.

The effects of the action are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, boat strikes, coastal development, habitat loss, contaminants, and changing environmental conditions. Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to changing environmental conditions. Changing environmental conditions may result in changes in the distribution or abundance of Atlantic sturgeon in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated changing environmental conditions.

As noted in the *Status of the Species* section, both the Delaware River and the Hudson River current abundance is believed to be a fraction of historic levels (also see Secor (2002) and Kahnle *et al.* (2007)). An estimated 3,656 age-1 individuals used the Delaware Estuary as a nursery in 2014 (since oceanward migration begins at age two or older, these juveniles would be of Delaware River origin). An estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson River riverine population based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.* 2007). In a more recent study, Kazyak *et al.* (2020a) estimated the 2014 Hudson River spawning run size to be 466 sturgeon (95 percent CRI = 310-745). In our analysis below, we use a Delaware River spawner abundance of between 125 and 250 adults and a Hudson River spawner abundance of between 400 and 500 adults. However, it should be noted that this estimate of Delaware River spawners does not include individuals that failed to spawn (e.g., male to male competition), spawners that did not have offspring surviving to the young of year age stage, and spawners who offspring

remained outside of the sampling area. Thus, we expect the actual total number of spawners to be higher.

Estimates of effective population size (see *Status of the Species* section) as well as a study that used samples from juvenile Atlantic sturgeon captured in the Delaware from 2009-2019 to infer annual run size estimates, and new genetic analyses for sturgeon collected in mixed aggregations continue to support that the New York Bight DPS is primarily comprised of Atlantic sturgeon that originate from the Hudson River. The results of the coast wide mixed stock analysis and the Delaware River Estuary genetic analysis both indicate that the number of sturgeon that originated from the Delaware River spawning population was approximately one-third of those that originated from the Hudson River (Wirgin et al. 2015a; Wirgin et al. 2015b; Kazyak et al. 2021). The estimates of effective population size⁴⁵ for the Hudson River spawning population from separate studies and based on different age classes are relatively similar to each other: 198 (95% CI=171.7-230.7) based on sampling of subadults captured off of Long Island across multiple years, 156 (95% CI=138.3-176.1) based on sampling of natal juveniles in multiple years (O’Leary et al. 2014; Waldman et al. 2019), and 144.2 (95% CI=82.9-286.6) based on samples from a combination of juveniles and adults (ASMFC 2017). Estimates for the Delaware River spawning population by the same authors and using the same methods were: 108.7 (95% CI=74.7-186.1) and 40 (95% CI=34.7-46.2) for samples from subadults and natal juveniles, respectively (O’Leary et al. 2014; Waldman et al. 2019), and 56.7 (95% CI=42.5-77.0) based on samples from a combination of juveniles and adults (ASMFC 2017). Based on the genetic analysis of 45 of the captured juveniles in the Connecticut River, the effective population size for the Connecticut River was estimated to be 2.4 sturgeon (Savoy et al. 2017); the CT DEEP is further investigating the presence of and origins for a spawning population in the Connecticut River.

Because the proposed action will result in the loss of no more than 32 individuals over a 30-year period, and we expect this to occur at a rate of approximately 1 mortality per year, it is extremely unlikely that these deaths will have detectable consequences on the numbers and population trend of the New York Bight DPS as a whole.

We expect that 32 juvenile, subadult, or adult Atlantic sturgeon mortalities from the New York Bight DPS will occur as a result of vessel transits to/from the Port over the 30-year operational life of the Port. As addressed in the *Effects of the Action*, we expect that the subadult and adult New York Bight DPS Atlantic sturgeon killed as a result of the proposed action will originate from both the Delaware River and Hudson River, while all juveniles would originate from the Delaware River. The loss of juveniles will theoretically reduce the number of adults in the

⁴⁵ Effective population size 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.

future. However, the probability of a juvenile contributing to the adult population in the future is also small when taking into account mortality enroute to maturity. Thus, we do not expect the loss of up to 32 juvenile Atlantic sturgeon to have a detectable effect on the status, trends, or future population growth of the Delaware River population. Using the best available information, we expect that the Delaware River spawning runs consist of between 125 and 250 individuals and the Hudson River runs consist of approximately 400 to 500 individuals (as described above and in section 5). Given the low effective population size (N_e) in these populations, genetic drift poses a threat to future genetic diversity of these populations. O'Leary *et al.* (2014) concluded that the populations likely would retain 95 percent of their alleles over the next century under current conditions. However, a decrease in longevity of mature adults would result in severe loss of genetic diversity (O'Leary *et al.* 2014). We anticipate that the reduction in numbers from either river will be spread out over 30 years and will be too small to affect genetic drift or inbreeding in a way that can be meaningfully evaluated. This is because of variation in the biological characteristics (number of progeny, male contribution, sex ratio, and population size) that affects the N_e and it is not possible to evaluate the contribution of one individual or the effect of losing an overage of less than one individual from either population in a given year.

We expect the reduction in numbers in the Delaware River population and the Hudson River population over 30 years to be too small to increase the populations' vulnerability to demographic stochasticity, Allee effect, or other small population impacts on population genetics in a way that we can meaningfully measure or determine for either river or for the DPS as a whole. We expect that any vulnerability to catastrophic events will mostly depend on spatial structure of the populations and life history of the species and would not be affected by such a small reduction in numbers over the 30-year period. Current information from both the Delaware and Hudson River indicate that both rivers have multiple spawning sites. The loss of up to 32 New York Bight DPS fish from the Delaware River and Hudson River populations over 30 years is unlikely to measurably increase the vulnerability during an in-river catastrophic event. This is because we expect the effects of a catastrophic event (e.g., oil spill, pollutant release, etc.) to be more related to the concentration of spawners within a particular area than to the total number of spawners, and it is not possible to evaluate how a loss of these spawners spread out over 30 years will increase the vulnerability from a catastrophic event. Since Atlantic sturgeon adults do not spawn every year, it is unlikely that the lost adults would have participated in the same spawning runs and migrating adults will buffer against catastrophic loss of a spawning population by reintroducing spawning individuals in following years. However, even if there was a catastrophic event affecting Atlantic sturgeon spawning areas, we do not expect that the loss of 32 fish from the Delaware River and Hudson River populations over 30 years would significantly affect the outcome and consequences of a catastrophic event in either river considering the number of expected spawners in both the Delaware River and Hudson River together with the fecundity of adult female sturgeon and multiple rearing sites. Also, in

the case of a catastrophic event, we do not have enough information to determine if the loss of spawners may affect the vulnerability of young of year fish at the rearing site.

The ASMFC's 2024 benchmark stock assessment update concluded that there was a relatively high probability (59 percent) that the abundance of the New York Bight DPS has increased since the implementation of the 1998 fishing moratorium (ASMFC 2024). However, there was considerable uncertainty expressed in the stock assessment and in its peer review report. As described in the 2022 5-year review, we expect that this conclusion about the New York Bight DPS primarily reflects the status and trend of only the DPS's Hudson River spawning population (NMFS 2022c). Annual surveys for Atlantic sturgeon juveniles in the Hudson River conducted by the New York State Department of Environmental Conservation (NYDEC) since 2004 suggests that the catch rate of juvenile Atlantic sturgeon has increased, with double the average catch rate for the period from 2012-2019 compared to the previous eight years, from 2004-2011 (Pendleton and Adams 2021). However, recent research by Stich *et al.* (2025) demonstrated that the juvenile population does not show an increasing trend. We do not have enough information to discern the Hudson River population's growth rate, but recent research seems to indicate that it is trending downward (Stich *et al.* 2025). For a population to recover, population growth rate has to be positive and a species remains prone to extinction as long as the population remains small and, thus, the rate of population growth, even if positive, will influence survival and recovery. For Atlantic sturgeon, ASMFC (2007) concluded that a 5 percent bycatch mortality of adults was not sustainable. Brown and Murphy (2010) similarly concluded that the loss of 2.5 percent of females per year from vessel strikes would hamper recovery of the Delaware River Atlantic sturgeon population. Variations in mortality, fecundity, and generation time can result in variations in abundance over time, which affects extinction risk. No data exists that can be used to determine productivity for the Delaware River since the time the New York Bight DPS was listed. While DO conditions in the river have improved over past decades, significant vessel traffic, industrial activity, and contaminated bottom substrate in these reaches exposes sturgeon to multiple threats, as discussed in the *Environmental Baseline*.

Here, we consider how these mortalities will affect productivity when added to other anthropogenic mortalities of females from the two river populations. Bycatch in federal fisheries account for one of the largest known number of anthropogenic mortalities. Bycatch and mortality also occur in state fisheries; however, the primary fishery that impacted juvenile sturgeon (the shad fishery) has now been closed in the Hudson River and there is no indication that it will reopen. New York Bight DPS Atlantic sturgeon are killed as a result of other anthropogenic activities in the Hudson, Delaware, and other rivers within the DPS as well, including vessel strikes, entrainment in dredges, and entrainment in cooling water intakes at power stations. We do not have an estimate of the total number of anthropogenic mortalities per year, we do not expect that the additional mortality of adult females from this proposed action will change the status of either river population or the DPS as a whole. This is because they contribute a very small number of mortalities relative to the total populations and these

mortalities will occur over time. As previously discussed, individual females do not spawn every year, thus allowing time for new spawning events to occur after mortalities occur over time. Based on the above considerations, we do not expect the proposed action, and the mortality of up to 32 Atlantic sturgeon over a 30-year period, to affect productivity of either the Delaware River or Hudson River populations or the DPS as a whole. In conclusion, even considering the potential future female spawners that would be produced by an individual that would be killed as a result of the proposed action, any consequences to future year classes of both riverine populations and the New York Bight as a whole is anticipated to be small and would not change the status of this species.

The proposed action is not likely to reduce distribution because the action will not impede New York Bight DPS Atlantic sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the Delaware River or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of areas near in-water construction activities.

As described above, over the long term, global environmental changes may affect New York Bight DPS Atlantic sturgeon by affecting the location of the salt wedge, distribution of prey, water temperature and water quality. Any activities occurring within and outside the action area that contribute to changes in environmental conditions are also expected to affect New York Bight DPS Atlantic sturgeon in the action area. However, there is significant uncertainty, due to a lack of specific scientific data, on the degree to which these effects may be experienced and the degree to which New York Bight DPS Atlantic sturgeon will be able to successfully adapt to any such changes. While we can make some predictions on the likely effects of environmental changes on these species and critical habitat, without modeling and additional scientific data, these predictions remain speculative, and we have concluded that changes in environmental conditions will not change our determinations.

The New York Bight 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. However, since the proposed Port is unlikely to affect the viability of the Delaware River or Hudson River populations, we do not expect the expected loss of 32 adult, subadult, or juveniles to diminish the DPS' numbers, reproduction, or distribution so that the likelihood of survival is appreciably reduced.

Based on the above, we have determined that the action will not affect New York Bight DPS Atlantic sturgeon in a way that will change the status of the DPS or prevent the species from achieving a sufficient population represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring. It also will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death

of these New York Bight DPS Atlantic sturgeon as a result of this action over a 30-year period will not reduce the current status the Delaware River and Hudson River populations; (2) the death of these New York Bight DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of these New York Bight DPS Atlantic sturgeon is not likely to have effects on the levels of genetic heterogeneity in the species; (4) the loss of these New York Bight DPS Atlantic sturgeon is likely to have such small effects 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 New York Bight DPS Atlantic sturgeon in the action area due to construction activities and no consequence on the distribution of the species throughout its range; and (6) the action will have no consequence on the ability of New York Bight DPS Atlantic sturgeon to shelter with only an insignificant consequence on individual foraging New York Bight DPS Atlantic sturgeon when considering that the footprint of the dredging site is small relative to available forage within the action area and the lower estuary.

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 New York Bight 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 New York Bight DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the New York Bight DPS has been published, at this time. As defined, the Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained, will allow the species to be delisted. In January 2018, we published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting, migration and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For New York Bight DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and, in the ocean, where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and

genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the New York Bight DPS likelihood of recovery.

We do not expect the proposed action to modify, curtail or destroy the range of the species, or to change the status or trend of the New York Bight DPS, since it will result in an extremely small reduction in the number and overall distribution. 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 not limit forage to the species as ample forage exists to support the Atlantic sturgeon using the Delaware River estuary. The proposed action will result in a small amount of mortality (no more than 32 individuals over 30 years) and a subsequent small reduction in future reproductive output. For these reasons, the action is not expected to affect the persistence of the New York Bight DPS of Atlantic sturgeon. Additionally, the action will not change the status or population trend of the New York Bight 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 New York Bight 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 New York Bight 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 New York Bight 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 changing environmental conditions 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 32 New York Bight DPS Atlantic sturgeon over a 30-year period, is not likely to appreciably reduce the survival and recovery of this species.

8.5.1.3 *Carolina DPS*

The proposed action is expected to result in the death of up to two Atlantic sturgeon from the

Carolina DPS over a 30-year period. All other effects of the action on this DPS will be insignificant or extremely unlikely.

The Carolina DPS is listed as endangered. Atlantic sturgeon from the Carolina DPS spawn in the rivers of North Carolina south to the Cooper River, South Carolina. There are currently seven spawning subpopulations within the Carolina DPS: Roanoke River, Tar-Pamlico River, Neuse River, Northeast Cape Fear and Cape Fear Rivers, Waccamaw and Great Pee Dee Rivers, Black River, Santee and Cooper Rivers. We estimated adult and subadult abundance of the Carolina DPS based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters and concluded that subadult and adult abundance of the Carolina DPS was 1,356 sturgeon (339 adults and 1,017 subadults) (NMFS 2013). This number encompasses many age classes since, across all DPSs, subadults can be as young as two years old when they first enter the marine environment, and adults can live as long as 64 years (Balazik *et al.* 2012; Hilton *et al.* 2016).

In the 2024 Stock Assessment, the ASMFC concluded that abundance of the Carolina DPS is "depleted" relative to historical levels. They also concluded that the average probability that the Carolina DPS indices were greater than the reference year (i.e., that relative abundance in 2022 was greater than relative abundance in 1998) was high (77 percent). The ASMFC also concluded that there is a relatively low likelihood (18.2 percent probability) that mortality for the Carolina DPS does not exceed the mortality threshold used for the Stock Assessment (ASMFC 2024).

As described in the 5-Year Review for the Carolina DPS (NMFS 2023), the demographic risk for the DPS is "high"⁴⁶ because of its productivity (i.e., relatively few adults compared to historical levels and irregular spawning success), abundance (i.e., riverine populations vary significantly and abundance is generally low in the DPS, overall), and spatial distribution (i.e., riverine populations and connectivity vary, creating inconsistent population coverage across the DPS and potentially limited ability to repopulate extirpated river populations). However, the recovery potential is considered high because man-made threats that have a major impact on the species' ability to persist have been identified (e.g., bycatch in fisheries, dams blocking access to spawning habitat, dredging, vessel strikes), the DPS' response to those threats are well understood, management or protective actions to address major threats are primarily under U.S. jurisdiction or authority, and management or protective actions are technically feasible even if they require further testing (e.g., gear modifications to minimize dredge or fishing gear interactions).

Here, we consider the consequences of the loss of two Atlantic sturgeon over a 30-year period from the Carolina DPS. The reproductive potential of the Carolina DPS will not be affected in

⁴⁶ 84 FR 18243; April 30, 2019 - Listing and Recovery Priority Guidelines.

any way other than through a reduction in numbers of individuals. The loss of two individual over a 30-year period will have the consequence of reducing reproduction potential within the DPS because any dead Carolina DPS Atlantic sturgeon has 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 will be killed because 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 Carolina DPS fish spawn, because it will occur outside of those identified areas. Additionally, the action will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by Carolina DPS fish for the same reasons.

Because we do not have a population estimate for the Carolina DPS, it is difficult to evaluate the consequences of mortality on this species caused by this action. However, because the proposed action will result in the loss of no more than two individuals over a 30-year period, it is unlikely that this death will have detectable effects on the numbers and population trend of the Carolina 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 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 avoidance of the area where the impacts occur because of the action.

Based on the information provided above, the death of up to two Carolina DPS Atlantic sturgeon over a 30-year period will not appreciably reduce the likelihood of survival of the Carolina DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect Carolina DPS Atlantic sturgeon in a way that prevents the species from maintaining a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring. Additionally, it will not result in consequences to the environment which prevent Atlantic sturgeon from completing their entire life cycle, including reproducing, sustenance, and shelter. This is the case because: (1) the death of two Carolina DPS Atlantic sturgeon as a result of this action in any year will not change the status or trends of the species as a whole; (2) the loss of these two Carolina DPS Atlantic sturgeon as a result of this action 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 Carolina DPS Atlantic sturgeon

in the action area due to construction activities and no consequence on the distribution of the species throughout its range; and, (4) the action will have no consequence on the ability of Carolina DPS Atlantic sturgeon to shelter with only an insignificant consequence on any foraging Carolina DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the Carolina 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. No Recovery Plan for the Carolina DPS has been published at this time.

As defined, the Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained, would allow the species to be delisted. In January 2018, NMFS published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. In general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting, migration and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For Carolina DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and, in the ocean, where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the Carolina DPS' likelihood of recovery.

This action will not change the status or trend of the Carolina DPS, and will only result in an extremely small reduction in the number of Carolina DPS Atlantic sturgeon, and will not affect

their overall distribution. 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 two individuals over a 30-year period) and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the action to affect the persistence of the Carolina DPS of Atlantic sturgeon. This action will not change the status or trend of the Carolina DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the 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 Carolina 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 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 changing environmental conditions, 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 two Carolina DPS Atlantic sturgeon over a 30-year period, is not likely to appreciably reduce the survival and recovery of the Carolina DPS of Atlantic sturgeon.

8.5.1.4 *Chesapeake Bay DPS*

The proposed action is expected to result in the death of up to seven Atlantic sturgeon from the Chesapeake Bay DPS over a 30-year period. All other effects of the action on this DPS will be insignificant or extremely unlikely.

The Chesapeake Bay DPS is listed as endangered. There are four known spawning subpopulations for the Chesapeake Bay DPS, one each for the Pamunkey River and for Marshyhope Creek, and two for the James River. At the time of listing, the James River was the only known spawning river for the Chesapeake Bay DPS and spawning was believed to occur only in the spring, from approximately April –May, based on historical and current evidence (NMFS and USFWS 2007). Subsequently, new information for when and where spawning-condition adults were captured and tracked in the river led to the conclusion that Atlantic sturgeon spawn in the James River in both the spring and fall (Balazik *et al.* 2012b, Balazik and

Musick 2015). Per Matt Balazik 2019 (pers. comms.), the updated estimated male population for the fall cohort is approximately 3,707 individuals and the estimated annual female spawning population is 1,250 individuals (Balazik 2019 pers. comms.).

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. As noted above, the estimated annual adult male population for the James River fall cohort is approximately 3,707 individuals and the estimated annual adult female spawning population is 1,250 individuals (Balazik 2019 pers. comms.) Other in-river estimates include, 75 adult Atlantic sturgeon spawning in the Pamunkey River in 2013 (Kahn *et al.* 2014) and 222 adults from 2013 to 2018, 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) (Secor *et al.* 2022). In the James River, 373 different adult-sized Atlantic sturgeon (*i.e.*, total count does not include recaptures of the same fish) were captured in the from 2009 through spring 2014 (Balazik and Musick 2015). Coleman *et al.* (2024) estimated that 32 (95% confidence interval [CRI] = 23-47) and 70 (95% CRI = 49-105) Atlantic sturgeon used the Marshyhope Creek-Nanticoke River system in 2020 and 2021, respectively.

The ASMFC (2024) stock assessment update determined that abundance of the Chesapeake Bay DPS is “depleted” relative to historical levels. The stock assessment update, while noting significant uncertainty in trend data, also determined that there is a relatively low probability (27 percent) that abundance of the Chesapeake Bay DPS has increased since the implementation of the 1998 fishing moratorium, and a 14 percent probability that mortality for the Chesapeake Bay DPS exceeds the mortality threshold used for the assessment (ASMFC 2024).

As described in the 5-Year Review for the Chesapeake Bay DPS (NMFS 2022), the demographic risk for the DPS is “High” because of its low productivity (e.g., relatively few adults compared to historical levels and irregular spawning success), low abundance (e.g., only three known spawning populations and low DPS abundance, overall), and limited spatial distribution (e.g. limited spawning habitat within each of the few known rivers that support spawning). There is also new information indicating genetic bottlenecks as well as low levels of inbreeding. However, the recovery potential is considered high.

We anticipate the mortality of up to seven adult or subadult Chesapeake Bay DPS Atlantic sturgeon as a result of vessel interactions during the 30-year operational period for the Port. The effects of the action are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, boat strikes, coastal development, habitat loss, contaminants, and changing environmental conditions. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those

considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion.

Thus, here, we consider the consequences of the loss of up to seven Atlantic sturgeon over a 30-year period from the Chesapeake Bay DPS. The reproductive potential of the Chesapeake Bay DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of up to seven individuals over a 30-year period will have the consequence of reducing the amount of reproduction potential as any dead Chesapeake Bay DPS Atlantic sturgeon has 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 seven Chesapeake Bay DPS Atlantic sturgeon 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 Chesapeake Bay DPS fish spawn, as they are outside of the action area. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by Chesapeake Bay DPS fish for the same reasons.

Because we do not have a population estimate for the Chesapeake Bay 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 seven individual sturgeon over the 30 years of Port operation, is unlikely that these deaths will have a detectable effect on the abundance and population trend of the Chesapeake Bay DPS.

The proposed action is not likely to reduce distribution of the Chesapeake Bay DPS 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 Chesapeake Bay 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 avoidance of the area where impacts of the action occur.

Based on the information provided above, the death of up to seven Chesapeake Bay DPS Atlantic sturgeon over 30 years of Port operations will not appreciably reduce the likelihood of survival of the Chesapeake Bay 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 Chesapeake Bay DPS Atlantic sturgeon in a way that prevents the species from maintaining a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring. It will also 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 seven Chesapeake Bay DPS Atlantic

sturgeon will not change the status or trends of the species as a whole; (2) the loss of these Chesapeake Bay 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 Chesapeake Bay DPS Atlantic sturgeon in the action area due to construction activities and no consequence on the distribution of the species throughout its range; and, (4) the action will have no consequence on the ability of Chesapeake Bay DPS Atlantic sturgeon to shelter with only an insignificant consequence on any foraging Chesapeake Bay 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 Chesapeake Bay 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 Chesapeake Bay DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the Chesapeake Bay DPS has been published at this time. As defined, the Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained, would allow the species to be delisted. In January 2018, NMFS published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting, migrating and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For Chesapeake Bay DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and, in the ocean, where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will

reduce the Chesapeake Bay DPS likelihood of recovery.

This action will not change the status or trend of the Chesapeake Bay DPS, and will only result in an extremely small reduction in the number of Chesapeake Bay DPS Atlantic sturgeon, and will not affect their overall distribution. 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 30 years and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the action to affect the persistence of the Chesapeake Bay DPS of Atlantic sturgeon. This action will not change the status or trend of the Chesapeake Bay 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 Chesapeake Bay 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 Chesapeake Bay 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 Chesapeake Bay 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, as well as changing environmental conditions, 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 seven Chesapeake Bay DPS Atlantic sturgeon over a 30-year period, is not likely to appreciably reduce the survival and recovery of this species.

8.5.1.5 *South Atlantic DPS*

The proposed action is expected to result in the death of up to three Atlantic sturgeon from the South Atlantic DPS over a 30-year period. All other effects of the action on this DPS will be insignificant or discountable. The South Atlantic DPS is listed as endangered and Atlantic sturgeon originate from at least six rivers where spawning is thought to still occur: the Combahee River, Edisto River, Savannah River, Ogeechee River, Altamaha River, and Satilla River. The spawning subpopulation in the St. Marys River is continues to exist, albeit at very low levels. Three of the spawning subpopulations in the South Atlantic 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.

The 2024 ASMFC stock assessment determined that abundance of the South Atlantic DPS is “depleted” relative to historical levels (ASMFC 2024). While noting significant uncertainty in trend data, the stock assessment update also determined that there is a relatively low probability (31 percent) that abundance of the South Atlantic DPS has increased since the implementation of the 1998 fishing moratorium. However, it was estimated that there is a 26.5 percent probability that mortality for the South Atlantic DPS exceeds the mortality threshold used for the assessment (ASMFC 2024). We note that the Commission expressed significant uncertainty in relation to the trends data.

As described in the 5-Year Review for the South Atlantic DPS (NMFS 2023), the demographic risk for the DPS is “high”⁴⁷ because of its productivity (i.e., relatively few adults compared to historical levels and irregular spawning success), abundance (i.e., riverine populations vary significantly and abundance is generally low in the DPS, overall), and spatial distribution (i.e., riverine populations and connectivity vary, creating inconsistent population coverage across the DPS and potentially limited ability to repopulate extirpated river populations). However, the recovery potential is considered high because man-made threats that have a major impact on the species’ ability to persist have been identified (e.g., bycatch in fisheries, dams blocking access to spawning habitat, dredging, vessel strikes), the DPS’ response to those threats are well understood, management or protective actions to address major threats are primarily under U.S. jurisdiction or authority, and management or protective actions are technically feasible even if they require further testing (e.g., gear modifications to minimize dredge or fishing gear interactions).

We anticipate the mortality of up to three South Atlantic DPS adult or sub-adult Atlantic sturgeon as a result of the proposed action over the 30-year operational life of the Port. The consequences of the action are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, boat strikes, coastal development, habitat loss, contaminants, and changing environmental conditions. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion. The reproductive potential of the South Atlantic DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of up to three individual sturgeon over a

⁴⁷ 84 FR 18243; April 30, 2019 - Listing and Recovery Priority Guidelines.

30-year period would have the consequence of reducing the amount of reproduction potential, as dead South Atlantic DPS Atlantic sturgeon 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 any individuals that are killed as a result of the proposed action, any consequence to future year classes is anticipated to be extremely small and will not change the status of this species. The proposed action will also not affect the spawning grounds within the rivers where South Atlantic DPS fish spawn because they are outside of the action area. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by South Atlantic DPS fish for the same reasons.

Because we do not have a population estimate for the South Atlantic 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 three individuals over a 30-year period, it is unlikely that this very small amount of mortality over an extended period of time will have a detectable effect on the numbers and/or population trend of the South Atlantic DPS.

The proposed action is not likely to reduce distribution because it will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by South Atlantic 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 avoidance of the action area where impacts occur.

Based on the information provided above, the death of up to three South Atlantic DPS Atlantic sturgeon over a 30-year period will not appreciably reduce the likelihood of survival of the South Atlantic 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 South Atlantic DPS Atlantic sturgeon in a way that prevents the species from maintaining 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 South Atlantic DPS Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of up to three South Atlantic DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (2) the loss of these South Atlantic DPS Atlantic sturgeon is not likely to have consequences on the levels of genetic heterogeneity in the population; (3) the loss of these South Atlantic DPS Atlantic sturgeon over a 30-year period is likely to have such a small consequence on reproductive output that the loss of these individuals

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 South Atlantic DPS Atlantic sturgeon in the action area due to construction activities and no consequence on the distribution of the species throughout its range; and, (5) the action will have no consequence on the ability of South Atlantic DPS Atlantic sturgeon to shelter with only an insignificant consequence on any foraging South Atlantic 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 South Atlantic 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 South Atlantic DPS has been published at this time. As defined, the Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained, would allow the species to be delisted. In January 2018, NMFS published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. In general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting, migration and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For South Atlantic DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and, in the ocean, where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the South Atlantic DPS' likelihood of recovery.

This action will not change the status or trend of the South Atlantic DPS, and will only result in an extremely small reduction in the number of South Atlantic DPS Atlantic sturgeon, and will not affect their overall distribution. 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 three individuals over a 30-year period) and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the action to affect the persistence of the South Atlantic DPS of Atlantic sturgeon. This action will not change the status or trend of the South Atlantic 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 South Atlantic 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 South Atlantic 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 South Atlantic 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 changing environmental conditions, 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 three South Atlantic DPS Atlantic sturgeon over a 30-year period, is not likely to appreciably reduce the survival and recovery of the South Atlantic DPS of Atlantic sturgeon.

8.6 Shortnose Sturgeon

We anticipate that the proposed action is likely to result in the mortality of up to five shortnose sturgeon (combination of juveniles and adults) over the 30-year operational life of the Port of Salem. These individuals are expected to originate from the Delaware River population. All other effects of the action on this DPS will be insignificant or extremely unlikely.

Historically, shortnose sturgeon are believed to have inhabited nearly all major rivers and estuaries along nearly the entire east coast of North America. Today, only 19 populations remain. The present range of shortnose sturgeon is disjunct, with northern populations separated from southern populations by a distance of about 400 km (248.5 mi). Population sizes range

from under 100 adults in the Cape Fear and Merrimack Rivers to tens of thousands in the St. John and Hudson Rivers. As indicated in Kynard *et al.* (2016), adult abundance is less than the minimum estimated viable population abundance of 1,000 adults for 5 of 11 surveyed northern populations and all natural southern populations. The only river systems likely supporting populations close to expected abundance are the St John, Hudson and possibly the Delaware and the Kennebec (Kynard *et al.* 2016), making the continued success of shortnose sturgeon in these rivers critical to the species as a whole.

The Delaware River population of shortnose sturgeon is the second largest in the United States. Historical estimates of the size of the population are not available as historic records of sturgeon in the river did not discriminate between Atlantic and shortnose sturgeon. The most recent population estimate for the Delaware River is 12,047 (95% CI= 10,757-13,580) and is based on mark recapture data collected from January 1999 through March 2003 (ERC Inc. 2006). Comparisons between the population estimate by ERC Inc. and the earlier estimate by Hastings *et al.* (1987) of 12,796 (95% CI=10,228-16,367) suggests that the population is stable, but not increasing.

While no reliable estimate of the size either of the shortnose sturgeon population in the Northeastern U.S. or of the species throughout its range exists, it is clearly below the size that could be supported if the threats to shortnose sturgeon were removed. Based on the number of adults in population for which estimates are available, there are at least 104,662 adult shortnose sturgeon, including 18,000 in the Saint John River in Canada. The lack of information on the status of some populations, such as that in the Chesapeake Bay, adds uncertainty to any determination on the status of this species as a whole. Based on the best available information, we consider the status of shortnose sturgeon throughout their range to be stable.

As described in the *Status of the Species*, *Environmental Baseline*, and *Cumulative Effects* sections above, shortnose sturgeon in the Delaware River are affected by impingement at water intakes, habitat alteration, dredging, bycatch in commercial and recreational fisheries, water quality, in-water construction activities, and vessel traffic. It is difficult to quantify the total number of shortnose sturgeon that may be killed in the Delaware River each year due to anthropogenic sources. Through reporting requirements implemented under Section 7 and Section 10 of the ESA, we obtain some information on the number of incidental and directed takes of shortnose sturgeon each year from specific actions. Typically, scientific research results in the capture and collection of less than 100 shortnose sturgeon in the Delaware River each year, with little if any mortality. With the exception of the five shortnose sturgeon observed during cutterhead dredging activities in the 1990s; the three shortnose sturgeon killed by hopper dredge during 2017- 2019; the shortnose sturgeon injured during the pilot relocation study; and the six shortnose sturgeon killed during blasting (for the Philadelphia to the Sea FNP deepening project) we have no reports of interactions or mortalities of shortnose sturgeon in the Delaware River resulting from dredging or other in-water construction activities. We also have no

quantifiable information on the consequences of habitat alteration or water quality. In general, water quality has improved in the Delaware River since the 1970s, when the CWA was implemented, with significant improvements below Philadelphia, which was previously considered unsuitable for shortnose sturgeon and is now well used.

Shortnose sturgeon in the Delaware River have full, unimpeded access to their historic range in the river and appear to be fully utilizing all suitable habitat; this suggests that the movement and distribution of shortnose sturgeon in the river is not limited by habitat or water quality impairments. Impingement at the Salem nuclear power plant occurs occasionally, with typically less than one mortality per year. In high water years, facilities with intakes in the upper river have impinged and entrained larvae but documented instances are rare and have involved only small numbers of larvae. The shad fishery, primarily hook and line recreational fishing, has historically caught shortnose sturgeon as bycatch, particularly because it commonly occurred on the spawning grounds. However, little to no mortality was thought to occur and due to decreases in shad fishing, impacts are thought to be less now than they were in the past. Despite these ongoing threats, the Delaware River population of shortnose sturgeon is stable at high numbers. Over the life of the action, shortnose sturgeon in the Delaware River will continue to experience anthropogenic and natural sources of mortality. However, we are not aware of any future actions that are reasonably certain to occur that are likely to change this trend or reduce the stability of the Delaware River population. If the salt line shifts further upstream, as is predicted in environmental modeling, the range of juvenile shortnose sturgeon is likely to be reduced compared to the current range of this life stage. However, because there is no barrier to upstream movement it is not clear if this will impact the stability of the Delaware River population of shortnose sturgeon; we do not anticipate changes in distribution or abundance of shortnose sturgeon in the river due to changing environmental conditions in the time period considered in this Opinion. As such, we expect that numbers of shortnose sturgeon in the action area will continue to be stable at high levels over the life of the proposed action.

As explained in the *Consequences of the Action*, we anticipate that vessel strikes up to five shortnose sturgeon will be killed by vessels utilizing the Port during its 30-year operational life. These fish are expected to be a combination of juveniles and adults. The number of shortnose sturgeon that are likely to die as a result of the project, represents an extremely small percentage of the shortnose sturgeon population in the Delaware River, which is believed to be stable at high numbers, and an even smaller percentage of the total population of shortnose sturgeon range wide, which is also considered to be stable. The best available population estimates indicate that there are approximately 12,047 shortnose sturgeon in the Delaware River (ERC 2006b). While the mortalities will reduce the number of shortnose sturgeon in the population compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this population or its stable trend as this loss represents a very small percentage of the population.

A reduction in the number of shortnose sturgeon in the Delaware River would have the effect of reducing the amount of potential reproduction in this system as the fish killed would have no potential for future reproduction. However, it is estimated that on average, approximately 1/3 of adult females spawn in a particular year and approximately 1/2 of males spawn in a particular year. Given that the best available estimates indicate that there are more than 12,000 shortnose sturgeon in the Delaware River, it is reasonable to expect that there are at least 5,000 adults spawning in a particular year. It is unlikely that, in the worst-case scenario, the loss of five juvenile or adult shortnose sturgeon over a 30-year period would affect the success of spawning in any year. The small reduction in the number of male spawners (about half of the sturgeon killed by the proposed action if we assume a 50/50 sex ratio) is not expected to affect production of eggs, as enough males will be present to fertilize eggs. Additionally, this small reduction in potential 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, a very small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be very small and would not change the stable trend of this population. Additionally, the proposed action will not adversely affect spawning habitat.

The proposed action is not likely to reduce distribution. While the action is likely to displace sturgeon within the dredge footprint and the area of the turbidity plume will temporarily affect the distribution of individual sturgeon, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas and are insignificant. Continued vessel traffic may diminish the availability of prey in the access channel and turning basin of the proposed Port; however, this area represents a very small fraction of available foraging habitat within the river and we do not expect the reduction in available prey to limit prey available to sturgeon. We do not anticipate that any impacts to habitat will impact how sturgeon use the overall action area, nor will the consequences of the action affect the distribution of the species throughout their range. As the number of shortnose sturgeon likely to be killed as a result of the action is extremely small (five individuals killed represent less than 0.04 percent of the Delaware River population), there is not likely to be a loss of any unique genetic haplotypes and it is unlikely to result in the loss of genetic diversity.

In general, the loss of a small number of individuals from a subpopulation or species can have an appreciable effect on the numbers, reproduction and distribution of the species, this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of shortnose sturgeon because the species is widely geographically distributed, it is not known to have low levels of genetic diversity (see *Status of the Species/Environmental Baseline* sections above), and there are thousands of shortnose sturgeon spawning each year.

Based on the information provided above, the death of up to five shortnose sturgeon juveniles or adults as a result of the proposed action will not appreciably reduce the likelihood of survival of this species (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 shortnose 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 effects to the environment which would prevent shortnose sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter (i.e., it will not increase the risk of extinction faced by this species). This is the case because: given that: (1) the population trend of shortnose sturgeon in the Delaware River is stable; (2) the mortality of five shortnose sturgeon represents an extremely small percentage of the number of shortnose sturgeon in the Delaware River and an even smaller percentage of the species as a whole; (3) the loss of these shortnose sturgeon is likely to have such a small effect on reproductive output of the Delaware River population of shortnose sturgeon or the species as a whole that the loss of these shortnose sturgeon will not change the status or trends of the Delaware River population or the species as a whole; and, (4) the action will have no consequence on the ability of shortnose sturgeon to shelter and only an insignificant consequence on individual foraging shortnose sturgeon.

In rare 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 shortnose sturgeon will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing under ESA Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (threatened) is no longer warranted. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that shortnose sturgeon can rebuild to a point where shortnose sturgeon are no longer in danger of extinction through all or a significant part of their range.

A Recovery Plan for shortnose sturgeon was published in 1998 pursuant to Section 4(f) of the ESA. The Recovery Plan outlines the steps necessary for recovery and indicates that each population may be a candidate for downlisting (i.e., to threatened) when it reaches a minimum population size that is large enough to prevent extinction and will make the loss of genetic diversity unlikely. However, the plan states that the minimum population size for each population has not yet been determined. The Recovery Outline contains three major tasks, (1) establish delisting criteria; (2) protect shortnose sturgeon populations and habitats; and, (3) rehabilitate habitats and population segments. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to

happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, migrating, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that affect their fitness. Here, we consider whether the proposed action will affect the Delaware River population of shortnose sturgeon in a way that would affect the species' likelihood of recovery.

The Delaware River population of shortnose sturgeon is stable at high numbers. This action will not change the status or trend of the Delaware River population of shortnose sturgeon or the species as a whole. This is because the reduction in numbers will be small and the impact on reproduction and future year classes will also be small enough not to affect the stable trend of the population. The action will have only insignificant consequences on habitat and forage and will not impact the river in a way that makes additional growth of the population less likely, that is, it will not reduce the river's carrying capacity. Impacts to habitat will be limited to the temporary loss of forage within the dredge footprint, continued degradation of forage within the dredge footprint by propeller jet scour, the increases in suspended sediment during dredging and passage of vessels, and increased water depth; however, we do not anticipate any changes to substrate type and the salinity regime. We do not anticipate that any impacts to habitat will affect how shortnose sturgeon use the action area.

The proposed action will not affect shortnose sturgeon outside of the Delaware River. Because it will not reduce the likelihood that the Delaware River population can recover, it will not reduce the likelihood that the species as a whole can recover. Therefore, the proposed action will not appreciably reduce the likelihood that shortnose sturgeon can be brought to the point at which they are no longer listed as endangered or threatened. We have also considered the consequences of the proposed action in light of cumulative effects explained above, including changing environmental conditions, 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 is not likely to appreciably reduce the survival and recovery of shortnose sturgeon.

9 CONCLUSION

After reviewing the best available information regarding the status of endangered and threatened species under our jurisdiction, the environmental baseline for the action area, the consequences of the action, and the cumulative effects, 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, leatherback, Kemp's ridley, and North Atlantic DPS green sea turtles, Atlantic sturgeon, and shortnose sturgeon. It is also our biological opinion that the proposed action may affect but is not likely to adversely affect the North Atlantic right whale, fin whale, sei whale, sperm whale,

Giant Manta Ray, Oceanic Whitetip Shark, and critical habitat designated for the New York Bight DPS of Atlantic sturgeon.

10 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations promulgated pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species of fish or wildlife, respectively, without a permit or exemption. In the case of threatened species, section 4(d) of the ESA leaves it to the Secretary's discretion whether and to what extent to extend the statutory 9(a)(1) "take" prohibitions to such species. For the threatened species addressed here (Northwest Atlantic DPS of loggerhead sea turtles, North Atlantic DPS of green sea turtles, Gulf of Maine DPS of Atlantic sturgeon), regulations have been issued under section 4(d) of the ESA to extend the section 9 "take" prohibitions. "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."

"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)). "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 must be undertaken by the action agencies so that they become binding conditions for the exemption in section 7(o)(2) to apply. MARAD and USACE, as the Federal action agencies, have a continuing duty to regulate the activity covered by this ITS. If one or more of them: (1) fails to assume and implement the terms and conditions, or (2) fails to require the project sponsor or their contractors to adhere to the terms and conditions of the ITS through enforceable terms and conditions that are included in any COP approval, grants, permits and/or contracts, the protective coverage of section 7(o)(2) may lapse. The protective coverage of section 7(o)(2) also may lapse if the project sponsor fails to comply with the terms and

conditions and the minimization and mitigation measures included in the ITS as well as those described in the *Description of the Proposed Actions On Which Consultation Was Requested* section of this Opinion as we consider those measures necessary and appropriate to minimize take but have not restated them here for efficiency. In order to monitor the impact of incidental take, MARAD, USACE, and/or the applicant must report the progress of the action and its impact on the species to us as specified in the ITS [50 CFR §402.14(i)(3)] (See U.S. Fish and Wildlife Service and National Marine Fisheries Service’s Joint Endangered Species Act Section 7 Consultation Handbook (1998) at 4-49).

10.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent of such incidental taking on the species (50

C.F.R. §402.14(i)(1)(i)). The amount and extent of take we have determined is reasonably certain to occur is identified below. No other incidental take is anticipated. We anticipate no more than the amount and type of take described below to result from the construction and operation of the Port of Salem over a 30-year period.

We calculated the number of sea turtles, Atlantic sturgeon, and shortnose sturgeon likely to be struck by project vessels based on the anticipated vessel traffic during operation of the Port. The following amount of incidental take is exempted over the 30-year life of the project (Table 45).

Table 45. Summary of total take exempted for Port operations

Species/DPS	Vessel Strike - Mortality
Northwest Atlantic DPS loggerhead sea turtles	22
North Atlantic DPS green sea turtle	1
Leatherback sea turtles	2
Kemp’s ridley sea turtles	2
New York Bight DPS Atlantic sturgeon	32 (juvenile, subadult, or adult)
Chesapeake Bay DPS Atlantic sturgeon	7 (subadult or adult)
South Atlantic DPS Atlantic sturgeon	3 (subadult or adult)
Carolina DPS Atlantic sturgeon	2 (subadult or adult)
Gulf of Maine DPS Atlantic sturgeon	1 (subadult or adult)
Shortnose sturgeon	5 (juvenile or adult)

As described above in Table 45, we calculate that over the 30-year life of the project, project vessels calling at the Port during the operations will strike and kill up to 27 sea turtles, up to 45

Atlantic sturgeon, and up to five (5) shortnose sturgeon.

We considered several methods to monitor the amount of take. We considered requiring the use of observers on project vessels; however, while some sea turtles are observable at the surface, they are often submerged and not detectable at any significant distance. Similarly, sturgeon remain under the water's surface except when occasionally breaching and are largely undetectable by observers. Combining this with their relatively small size compared to the size of transiting vessels, it is extremely unlikely that observers would be able to effectively monitor for strikes of sturgeon or sea turtles. We also considered requiring monitoring of areas along the vessel transit routes to detect sturgeon or turtles after they were struck. However, we expect that the monitoring that would be required to detect even a fraction of individuals would require sustained and intensive monitoring that would not be reasonable or practical to implement. Additionally, we note that even when a sturgeon or sea turtle carcass is found and determined to be a vessel strike mortality, it is rarely possible to determine which vessel was involved in the incident. This is particularly true in areas with heavy vessel traffic, including the Delaware River, Delaware Bay, Upper and Lower NY Bay, and East River portions of the action area.

Because we have not identified a method to monitor individual sturgeon or sea turtles that would be reasonable and prudent and necessary or appropriate, we will use a means other than counting/tracking individuals to monitor the estimated numerical level of take and provide a means for reinitiating consultation once that level has been exceeded. As established in the *Effects of the Action*, take is expected to occur as a result of some project related vessels striking and killing individual sturgeon and sea turtles. We explain in the Opinion the interaction rates that we expect to persist over the life of the project. Therefore, for this action, the extent of vessel traffic (i.e., the number of trips) provides a reasonable metric for monitoring the actual amount of incidental take that we anticipate. We expect that this will be the primary method of determining whether incidental take has been exceeded. The identified metric (number of vessel trips) can be effectively monitored and annual monitoring reports will provide a means for determining when the level of anticipated take has been exceeded. Our estimate of take is based on the application of the best available scientific information, as cited in this Opinion, which informs our take calculations.

We will consider the amount of incidental take has been exceeded if monitoring demonstrates that the extent of vessel traffic associated with the operation of the Port exceeds the amount of vessel trips identified and analyzed in this Opinion (158 one-way trips annually or 4,740 over the 30-year project life). We consider that this would indicate that the extent of vessel strike is greater than anticipated, which indicates that a greater number of sea turtles, Atlantic sturgeon, and/or shortnose sturgeon would be struck than anticipated. We also note that there is a possibility that an Atlantic sturgeon, shortnose sturgeon, or sea turtle vessel strike can be associated with a particular vessel. In those cases, the vessel strike mortality will be included in

(*i.e.*, not in addition to) the number of vessel strikes that are based on the number of vessel calls at the Port and would be considered in any determination that the amount or extent of incidental take has been exceeded. If new information on the rate of interactions becomes available, we would consider if this represented new information on the effects of the action that was not considered in this Opinion and whether reinitiation was required, consistent with the reinitiation triggers (50 CFR 402.16).

We have not identified any reasonable and prudent measures or implementing terms and conditions that would minimize the amount or extent of this incidental take: as we note below, this is primarily due to the inability to affect operational changes in a way that would comply with the requirements for reasonable and prudent measures and implementing terms and conditions. Reasonable and prudent measures (RPMs) and the Terms and Conditions (TCs) that implement them cannot alter the basic design, location, scope, duration, or timing of the action and may involve only minor changes (50 CFR§ 402. 14(i)(2)). It is possible that limiting the type, speed, location, or seasonality of vessel trips could theoretically reduce the risk of vessel strike. However, in each case we either do not have enough information to prescribe a measure that could reasonably be expected to reduce the amount or extent of take (e.g., considering a speed restriction that would reduce the potential for strike) or can only identify a measure that would be more than a minor change (e.g., limiting vessel transits to a time of year that the least number of sturgeon are expected in the action area) or that is otherwise impractical (e.g., requiring only non-motorized vessels). As such, we have not identified any measures that the action agencies or the applicant could implement that would be consistent with the requirements for RPMs and implementing TCs and would serve to minimize the amount or extent of take. The RPMs and implementing TCs below are designed to monitor the effects of the action and provide a means for determining if take has been exceeded.

10.1.1 Effects of the Take

In this Opinion, we determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to jeopardize the continued existence of any listed species under NMFS' jurisdiction.

10.2 Reasonable and Prudent Measures, Terms and Conditions, and Justifications

Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action is likely to incidentally take individuals of ESA-listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. To minimize such impacts, reasonable and prudent measures, and terms and conditions to implement the measures, must be provided. Only incidental take specified in this ITS that would not occur but for the agency actions described in the Opinion, and any specified reasonable and prudent measures and terms and conditions identified in the ITS, are exempt from the taking prohibition of section 9(a) for endangered

species, as extended to threatened species through Section 4(d) regulations, provided that, pursuant to section 7(o) of the ESA, such taking is in compliance with the terms of the ITS.

Reasonable and prudent measures (RPMs) are measures to minimize the impact (i.e., amount or extent) of incidental take (50 C.F.R. §402.02). The RPMs determined to be necessary and appropriate and implementing terms and conditions (TCs) are specified as required by 50 CFR 402.14 (i)(1) to minimize the impact of incidental take of ESA-listed species by the proposed action, to document and report that incidental take, and to specify the procedures to be used to handle or dispose of any individuals of a species actually taken. In order for the take exemption to be effective, the RPMs and their terms and conditions are nondiscretionary for the action agencies and applicant. As such, we expect MARAD will include these RPMs and TCs as mandatory enforceable mitigation measures in its grant to ensure compliance by the Port owner/operator. Likewise, we expect that the USACE will include the RPMS and TCs as mandatory enforceable conditions in its permit.

NMFS has determined that the RPMs identified here are necessary and appropriate to minimize impacts of incidental take that might otherwise result from the proposed action, to monitor document and report incidental take that does occur, and to specify the procedures to be used to handle or dispose of any individual listed species taken.

We have determined that all of the RPMs and TCs are reasonable and prudent and necessary and appropriate to minimize or document and report the level of incidental take associated with the proposed action. As explained in Table 46 below, none of the RPMs or the TCs that implement them alter the basic design, location, scope, duration, or timing of the action and all of them involve only minor changes (50 CFR§ 402.14(i)(2)).

Table 46. Reasonable and Prudent Measures and Terms & Conditions, applicable to the MARAD, USACE, consistent with each agency's legal authority and the Applicant/ Port Owner or operator⁴⁸. Referenced forms and documents can be found on the NOAA GARFO website at <https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics>

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
RPMs Applicable to Vessel Traffic		
1. MARAD and the USACE shall require that the Port Owner track the number of vessel calls at the Terminal. This information will be used to monitor the identified reinitiation trigger.	1. Until year 29 of operations of the Port (unless modified as noted below when 80% of vessel trips projected have occurred, whichever is sooner), at the beginning of each calendar year and no later than March 1, MARAD, as the lead federal agency, during the life of the grant and any subsequent grants related to the Port, or in the event that there is no MARAD grant in effect, then the Applicant/owner/operator shall contact us at nmfs.gar.incidental-take@noaa.gov to provide us with: a. The total number of vessel calls at the Port the previous year; b. The number of vessels that called at the Port by month; and c. Type of vessels and their drafts that called at the Port The correspondence must reference the	This RPM and this TCs is necessary and appropriate because we used an estimate of sturgeon and sea turtle vessel strike mortalities in relation to vessel trips to calculate take. The RPM and TCs serves to ensure that we can monitor the level of take associated with the proposed action. This is only a minor change because it is not expected to result in any delay to the project, result in any additional cost, and will merely involve occasional e-mails and reports between the Applicant or owner/operator and MARAD, the USACE and our staff.

⁴⁸ The terms "Applicant" and "Port owner" or "Port operator" are used interchangeably in this document and refer to the non-federal party with authority over the construction and operations of the Port.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	name of the project (<i>i.e.</i>, Port of Salem Redevelopment) and our file number (GARFO-2024-02358). If the grant or USACE permit is renewed, MARAD or the USACE respectively shall contact us to discuss this RPM and TCs. MARAD and the USACE shall require that when 80 percent of the estimated total vessel trips have occurred or in the final year of operation (<i>i.e.</i>, year 30), whichever comes first, the applicant shall provide the following information on a quarterly basis. This must be submitted via email to: nmfs.gar.incidental-take@noaa.gov by April 30, July 31, October 31 and January 31: a. The total number of vessel calls at the Port the previous year b. The number of vessels that called at the Port by month c. Type of vessels and their drafts that called at the Port The correspondence must reference the name of the project (<i>i.e.</i>, Port of Salem	

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	Redevelopment) and our file number (GARFO-2024-02358). If the grant is renewed, MARAD shall contact us to discuss this RPM and TCs.	
RPMs Applicable for All Activities		
2. Any injured or dead sturgeon or sea turtles observed in the Port of Salem action area must be reported to us within 24 hours.	2. In the event that any dead or injured sea turtles or sturgeon are observed with injuries (lethal or non-lethal), MARAD and the USACE must ensure that the Applicant reports the sighting to NMFS and follows the Sturgeon & Sea Turtle Take Standard Operating Procedures (SOPs) that can be downloaded from our website (https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic) MARAD and the USACE shall require the applicant/ owner to submit a completed Take Report Form for ESA-Listed Species within 24 hours of any observation and collection of a dead sturgeon or sea turtle. The form can be downloaded from our website. The completed Take Report Forms,	This RPM and these TCs 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 TCs represent only a minor change as compliance will not delay the project, or result in any additional cost.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	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. 3. In the event of any potential vessel strike of a sturgeon or a sea turtle by a vessel traveling to or from the Port, when operationally feasible, any dead specimens or body parts must be photographed, measured, and preserved (refrigerated, not frozen) until disposal procedures are discussed with us. For each observed injured or dead sturgeon or sea turtle, the information shall also include the date the sturgeon/sea turtle was first observed and, if applicable, collected; the species of the sturgeon/sea turtle; the size of the sturgeon/sea turtle; a description of injuries; and any other pertinent information such as, for instance, observation of eggs. MARAD and the USACE shall require the applicant/ owner to notify us of the location where the dead or injured sturgeon/sea turtle was observed and collected.	

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	4. The MARAD and the USACE shall require the applicant to notify us of any suspected sturgeon or sea turtle vessel strikes within 24 hours of the incident. The Applicant shall provide to the MARAD, the USACE and us the number and type of vessels leaving and entering the Port during the last 24 hours prior to when the sturgeon or sea turtle was first observed. The Applicant shall provide the information to the MARAD, the USACE and us as soon as it is available to the Applicant. We shall have the final say in determining if the take should count towards the Incidental Take Statement based on the information provided to us (e.g., location, photos, etc.).	
3. When operationally feasible, any dead sturgeon or sea turtles must be held until proper disposal procedures can be discussed with us (e.g., cold storage).	5. If operationally feasible, in the event a dead sturgeon or sea turtle is collected that potentially was killed by interaction with a vessel traveling to or leaving the Port, and MARAD, the USACE or the applicant requests concurrence that this take should not be attributed to the Incidental Take	These RPMs and TCs 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

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	Statement but we do not concur, or if it cannot be determined whether a vessel strike was the cause of death, then the dead sturgeon or sea turtle must be transferred to an appropriately permitted research facility identified by us so that a necropsy can be undertaken to attempt to determine the cause of death. In determining whether the NMFS will assign the mortality to the incidental take statement, we will consider if the necropsy determines that the death was due to injuries sustained from an interaction with a vessel, depending on whether the injury is fresh and the location of the carcass. We shall have the final say in determining if the take should count towards the Incidental Take Statement.	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 TCs represent only a minor change as compliance will not result in any increased cost.
4. If operationally feasible, all Atlantic sturgeon over 75 cm total length that are found dead within the project area must have a fin clip taken for genetic analysis. This sample must be transferred to a NMFS-approved	6. If fin clips are retrieved, MARAD and USACE must ensure that fin clips are taken according to the procedure outlined in the “Procedure for Obtaining Sturgeon Fin Clips” found on our website	This RPM and this TC is necessary and appropriate to ensure the proper handling and documentation of any interactions with listed species as well as requiring that these interactions

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
laboratory capable of performing the genetic analysis.	(https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic). The fin clips shall be 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. To the extent authorized by law, you are responsible for the cost of the genetic analysis. A copy of forms when submitting a tissue sample and results of genetic analysis once completed must be submitted to nmfs.gar.incidental-take@noaa.gov with "Sturgeon Genetic Sampling" in the subject line.	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 accurately record take of this species. This RPM and TC represent only a minor change as compliance will not result in delay of the project or decrease in the efficiency of the vessel operations. The RPM and TC will only result in a minor cost to the project and will not significantly increase in the cost of the project, as the cost of genetic analysis is extremely small relative to the cost of the project.

11 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. As such, we recommend that MARAD and the USACE consider the following Conservation Recommendations:

1. MARAD and the USACE should support the reporting and tracking of sturgeon carcasses in the Delaware River. These reports offer valuable insights into the causes of sturgeon deaths in the river. They are also crucial for understanding and estimating the effects of proposed MARAD and the USACE actions. MARAD and the USACE should work with state agencies and NMFS to develop a central multi-state reporting database. This database should standardize the procedures for reporting and tracking sturgeon carcasses.
2. Population estimates are lacking for Atlantic sturgeon. MARAD and the USACE should support studies that provide information that researchers need to develop a population estimate for the New York Bight DPS. Such information would help us analyze the consequences to sturgeon caused by projects authorized, funded, or carried out by MARAD and the USACE.
3. MARAD and the USACE should support ongoing and/or future research to determine the abundance and distribution of sea turtles, shortnose sturgeon, and Atlantic sturgeon in the Delaware River and NY and NJ waters.
4. Support research and development of technology to aid in the minimization of risk of vessel strikes sea turtles and sturgeon.

12 REINITIATION OF CONSULTATION

This concludes formal consultation on the Port of Salem. As provided in 50 CFR § 402.16, reinitiation of consultation is required and shall be requested by the Federal agency, where discretionary Federal 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 have not been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species not previously considered; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental is exceeded, Section 7 consultation must be reinitiated immediately.

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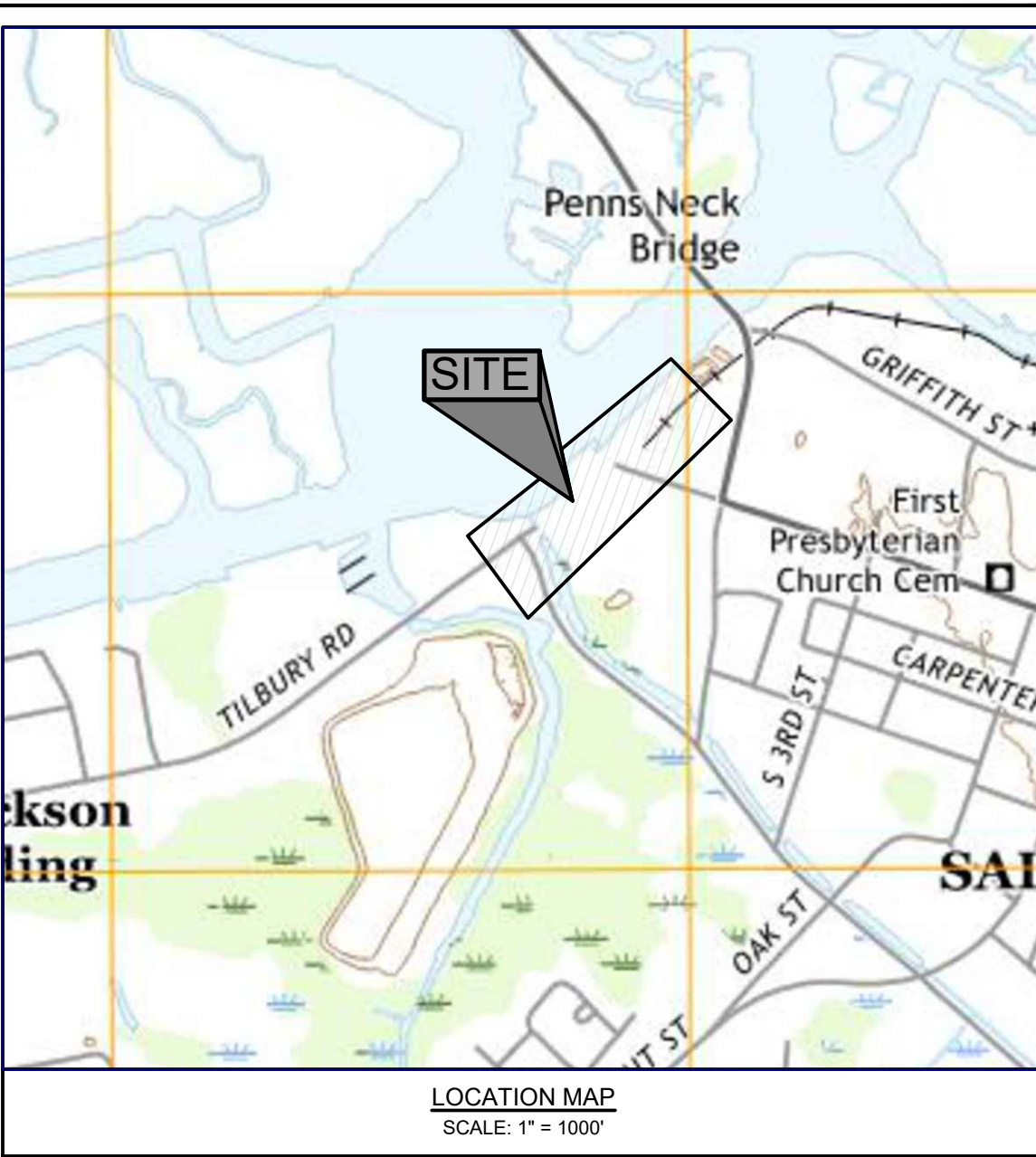
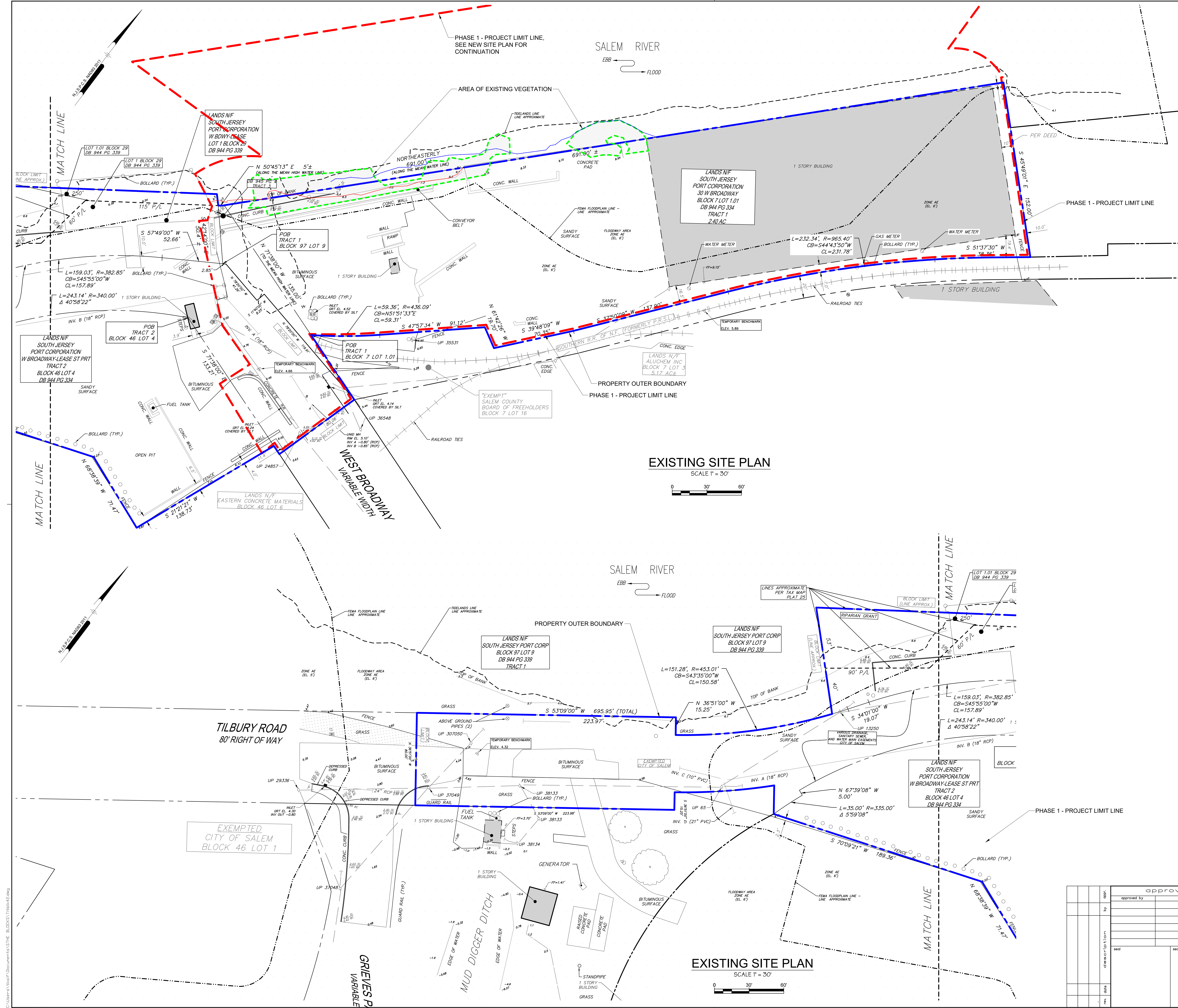
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- LEGEND**
- PROPERTY LINE
 - PROPERTY, ADJOINING LINED
 - LEGAL RIGHT-OF-WAY
 - EASEMENT
 - FEMA FLOODPLAIN LINE
 - PROPERTY MARKER
 - BUILDING
 - CURB
 - CURB DEPRESSION
 - EDGE OF PAVEMENT
 - ASPHALT PAVING
 - CONCRETE SURFACE
 - FEMA FLOODWAY AREA
 - FENCE, METAL
 - FENCE, GENERAL
 - GUIDE RAIL
 - BOLLARD
 - POST
 - SIGN
 - UTILITY POLE
 - GUY POLE
 - GUY WIRE
 - MONITOR WELL
 - BORING LOCATION
 - FLAG POLE
 - LIGHT
 - DECIDUOUS TREE
 - BRUSHLINE
 - MINOR CONTOUR
 - MAJOR CONTOUR
 - SPOT ELEVATION, SOFT SURFACE
 - SPOT ELEVATION, HARD SURFACE
 - MANHOLES
 - VALVES
 - JUNCTION BOX
 - STORM SEWER, INLET A
 - STORM SEWER, INLET B
 - SANITARY SEWER, CLEAN-OUT
 - WATER, HOSE BIB
 - WATER, FIRE HYDRANT
 - WATER, STAND PIPE CONNECTION

--- PHASE 1 - PROJECT LIMIT LINE
--- PROPERTY OUTER BOUNDARY

REFERENCE DRAWING
INFORMATION FOR THIS DRAWING WAS PROVIDED BY:
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HADDON HEIGHTS, NJ 08035
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S.T. HUDSON ENGINEERS, INC.
PROFESSIONAL ENGINEERS & CONSULTANTS
900 Dudley Avenue
Cherry Hill, N.J. 08002
Phone 856-342-6600
Fax No. 856-342-8323

SOUTH JERSEY PORT CORPORATION
PORT OF SALEM
CAMDEN, NEW JERSEY

drawn	checked	date	date	contract
STAFF	FILE	Aug 15, 2024	Sp-1539	22-001

REDEVELOPMENT PROJECT PHASE 1A

EXISTING SITE PLAN **C-1**