UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930

September 2, 2020

Tammy R. Turley
Chief, Regulatory Division
New England District
U.S. Army Corps of Engineers
696 Virginia Road
Concord, MA

RE: Reinitiation of Formal Consultation for 10-Years of Maintenance Dredging at Bath Iron Works in Bath, Maine (2020-2029) (NAE-2019-01461)

Dear Ms. Turley:

Enclosed is the biological opinion (Opinion), issued under Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended, for your (U.S. Army Corps of Engineers) permit (NAE-2019-01461) to allow Bath Iron Works Corporation (BIW) to perform maintenance dredging at a number of sites in support of their shipbuilding facility in the lower Kennebec River in Bath, Maine from 2020-2029.

In this Opinion, we conclude that the proposed action is likely to adversely affect, but not likely to jeopardize the continued existence of the threatened Gulf of Maine DPS of Atlantic sturgeon and endangered shortnose sturgeon. We also conclude that the proposed action may affect, but is not likely to adversely affect the endangered Gulf of Maine DPS of Atlantic salmon, critical habitat designated for the Gulf of Maine DPS of Atlantic salmon, and critical habitat designated for the Gulf of Maine DPS of Atlantic sturgeon.

Our Opinion includes an Incidental Take Statement (ITS), which is an exemption from the prohibition of take of listed species. Incidental take is defined as "take of listed fish or wildlife species that results from, but is not the purpose of carrying out an otherwise lawful activity conducted by a Federal agency or applicant" [50 CFR §402.02]. "Otherwise lawful activities" are those actions that meet all State and Federal legal requirements, including any state endangered species laws or regulations, except for the prohibition against taking in ESA Section 9. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not prohibited under the ESA, provided that such taking is in compliance with the terms and conditions of this ITS.

The ITS specifies reasonable and prudent measures (RPMs) necessary to minimize and monitor take of shortnose and Atlantic sturgeon. The measures described in the ITS are non-discretionary, and must be undertaken by you so that they become binding conditions for the exemption in section 7(o)(2) to apply. You have a continuing duty to regulate the activity covered by the ITS. If you (1) fail to assume and implement the terms and conditions or (2) fail to require any contractors to adhere to the terms and conditions of the ITS through enforceable terms that are added to permits and/or contracts as appropriate, the protective coverage of section

7(o)(2) may lapse. In order to monitor the impact of incidental take, you must report the progress of the action and its impact on listed 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).

This concludes formal consultation on the proposed action. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; 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 take is exceeded, section 7 consultation must be reinitiated immediately.

Once you have had an opportunity to review the Opinion, we hope to have a future conversation with you to discuss our Conservation Recommendations. 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 agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. As such, we suggest that you, consistent with your authorities, take implementation of our Conservation Recommendations under consideration.

Thank you for working cooperatively with my staff throughout the consultation process. We look forward to continuing to work cooperatively with your office to minimize the effects of maintenance dredging of the BIW facility on listed species and critical habitat. Should you have any questions about this correspondence please contact Zach Jylkka at (978) 282-8467 or by e-mail (Zachary.Jylkka@noaa.gov).

Our Habitat Conservation Division (HCD) is responsible for overseeing programs related to Essential Fish Habitat (EFH) designated under the Magnuson-Stevens Fishery Conservation and Management Act and other NOAA trust resources under the Fish and Wildlife Coordination Act (FWCA). HCD is currently coordinating with you on the EFH consultation. If you have any questions or comments regarding the EFH consultation process, please contact Mike Johnson at (978) 281-9130 or by email (Mike.R.Johnson@noaa.gov).

Sincerely,

Jennifer Anderson

Jennifer Anderson
Assistant Regional Administrator
for Protected Resources

EC: Clement, USACE
Johnson, NMFS-HCD
Jylkka, NMFS-PRD
Mahaney, USFWS

File Code: H:\Section 7 Team\Section 7\Non-Fisheries\ACOE\Formal\2020\NAE-2019-01461 Bath Iron Works Bath, Maine

ECO: GARFO-2020-00205

NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency:	U.S. Army Corps of Engineers, New England District
Activity Considered:	Bath Iron Works Maintenance Dredging in Bath, Maine (2020-2029) **GARFO-2020-00205**
Conducted by:	National Marine Fisheries Service Greater Atlantic Regional Fisheries Office
Date Issued:	September 2, 2020
Approved by:	ANDERSON.JENNIFER.1365847238 Digitally signed by ANDERSON.JENNIFER.1365847238 Date: 2020.09.02 16:21:06 -04'00'
DOI Address:	https://doi.org/10.25923/cmk4-8875

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1.0 INTRODUCTION

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) issued pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended, on the effects of your (U.S. Army Corps of Engineers) permit (NAE-2019-01461) to allow Bath Iron Works Corporation (BIW) to perform maintenance dredging at a number of sites in support of their shipbuilding facility in the lower Kennebec River in Bath, Maine from 2020-2029. This Opinion is based on the description of the effects of the proposed action on ESA-listed species and critical habitat that you provided in your Biological Assessment (BA) dated January 23, 2020. That analysis, along with scientific papers and other sources of information as cited in the references section also helped form the basis of this Opinion. A complete administrative record of this consultation will be kept at our NMFS Greater Atlantic Regional Fisheries Office.

2.0 ESA CONSULTATION HISTORY

In 1997, BIW began a project to construct a land level transfer facility (LLTF). The work proposed involved dredging the "inboard deck" and creation of a deep sinking basin for the dry dock, pile driving for "outboard deck", drilling/blasting/excavation in the landing grid and construction of landing grid blocks, dolphins, and anchor pads, in addition to shoreline improvements. In a June 10, 1998 letter, we concurred with your determination that the proposed project was not likely to adversely affect shortnose sturgeon in the Kennebec River.

We began discussing a long-term approach to managing dredging activities at BIW with you and BIW in 2005. BIW routinely dredges three locations at their facility, the dry dock sinking basin, the landing grid, and the berth area (Piers 1, 2 and 3) and authorization for this dredging has occurred under a variety of permits issued by USACE and subject to consultation with us. In a letter dated July 9, 2009, you requested initiation of consultation with us on their proposed issuance of a permit to authorize ten years of maintenance dredging at the BIW facility. We completed this consultation with the issuance of a Biological Opinion on November 4, 2009. The Opinion considered the effects of ten years of maintenance dredging on shortnose sturgeon, the Gulf of Maine Distinct Population Segment (GOM DPS) of Atlantic salmon and critical habitat designated for Atlantic salmon. In the Opinion, we concluded that the proposed action was likely to adversely affect but was not likely to jeopardize the continued existence of shortnose sturgeon. Additionally, we concluded that the proposed action was not likely to adversely affect the GOM DPS of Atlantic salmon or critical habitat designated for Atlantic salmon.

During the spring of 2012, you determined that reinitiation of the 2009 Opinion was necessary due to the listing of five DPSs of Atlantic sturgeon. Additionally, in the spring of 2012, BIW submitted an application to you for authorization to place stone rip rap on the river bottom near Pier 4 in anticipation of testing of a new U.S. Navy destroyer with a brake wheel system. On August 17, 2012, you requested reinitiation of the 2009 Opinion to consider effects of dredging on Atlantic sturgeon. Additionally, you requested that we consider effects of BIW's Brake Wheel Project, which is proposed for authorization under Permit NAE-2012-01393. This consultation was initiated on August 17, 2012. Supplemental information on underwater noise associated with brake wheel operations was provided to us by the Navy and BIW on October 18, 2012. We provided the final Opinion on September 21, 2012, and concluded that the proposed action was likely to adversely affect but is not likely to jeopardize the continued existence of shortnose sturgeon and Atlantic sturgeon (New York Bight and Gulf of Maine DPS). Additionally, we concluded that the proposed action was not likely to adversely affect the GOM DPS of Atlantic salmon or critical habitat designated for Atlantic salmon.

In 2019, BIW applied to renew their 10-year permit (USACE File No. NAE-2019-01461). A public notice to renew the permit was issued on August 6, 2019. We sent you an email on August 7, 2019 as a reminder that reinitiation of the 2012 Opinion would be required to address the new 10-year dredging authorization. On November 21, 2019, you sent us a Biological Assessment (BA) and a request for reinitiation of formal consultation (dated November 20, 2019). On December 2, 2020, we requested additional information that was necessary prior to initiation of consultation. USACE provided us with a revised BA on January 23, 2020. On February 23, 2020, we sent you a letter stating that all information required to initiate formal section 7 consultation was included in your January 23, 2020 letter and BA, or is otherwise accessible for our consideration and reference; therefore, the date of the January 23, 2020 correspondence will serve as the commencement of the formal consultation process. The ESA and the section 7 regulations (50 CFR§402.14) require that formal consultation be concluded within 90 calendar days of initiation (April 22, 2020), and that a biological opinion be completed within 45 days after the conclusion of formal consultation (June 5, 2020), unless we mutually agree on an extension.

Through a February 10, 2020 phone call and email communications with Jay Clement of your Maine Field Office, we learned that you would issue the new 10-year permit (NAE-2019-01461) prior to the completion of this formal consultation in order to allow dredging between February and April, 2020. On February 19, 2020, you provided us with a copy of your memo for the record (dated February 14, 2020) regarding your section 7(d) determination for the issuance of this permit. In this memo, you concluded that, "…there is not a reasonable likelihood that the work authorized by the permit will cause jeopardy to listed species or adversely affect their critical habitats." You also noted that you retain the authority (and will include a "reopener" provision in the permit) to modify the permit to include any reasonable and prudent measures we identify as necessary in order to prevent jeopardy to threatened or endangered species or adverse effects on their critical habitat. The new 10-year permit was issued on February 18, 2020, and dredging took place at Grid #1 of the Dry Dock from March 9 through March 31, 2020 (no ESA-listed species were observed). On April 30, 2020, we mutually agreed upon a 60-day extension to allow additional time to incorporate information from the March 2020 dredging event into this Opinion. On June 22, 2020, we mutually agreed to a further 30-day extension, after you requested by email (also June 22, 2020) that we consider a third dredge event outside of the preferred dredging window (see Section 3.0 for full description), as well as updated information on the project vessels to be used in the proposed action. With this extension, the deadline for this Opinion is September 3, 2020.

3.0 DESCRIPTION OF THE PROPOSED ACTION

3.1 Required Dredging and Disposal of Dredged Material for BIW

BIW is located on a 58-acre parcel along the west shore of the Kennebec River at Bath, Maine (Figure 1). The main yard is currently capable of constructing several ships simultaneously on their Land Level Transfer Facility (LLTF). Completed ships are then moved horizontally into a dry dock for launching into the adjacent Kennebec River. The waterfront is highly active and the yard has more than 100 buildings on the immediate upland which provide direct support to shipbuilding operations. The shoreline to the south is undeveloped marshland (Truffant Marsh) and to the north, the working waterfront of downtown Bath.

BIW proposes to renew its 10-year permit to perform periodic, facility wide maintenance dredging out to December 31, 2029. No change in dredge footprints, depths, quantities or disposal methods is proposed - up to 70,000 cubic yards (cy) will be dredged from the dry dock sinking basin; up to 4,000 cy from the dry dock landing grid; and up to 12,000 cy from berthing Piers 1, 2, and 3. All dredging will be performed by mechanical dredge. BIW projects that dredging for the sinking basin will occur every 2-3 years while the dry dock landing grid and pier berths could occur annually. These cycles may change however, and depend on both environmental conditions as well as the operational needs of the shipyard. Dredged material from the sinking basin will continue to be disposed of downstream, at an in-river site, approximately 3.25 miles downstream from Bath and north of Bluff Head. Dredged material from the other sites will continue to be disposed of at an upland, non-wetland location. Maintenance dredging at the BIW facility is necessary to accommodate the launching, berthing, and maintenance of deep draft vessels, primarily warships contracted by the U.S. Navy.

The dry dock sinking basin is a 12.6 acre area (850 ft x 280 ft with 4:1 side slopes) that will be dredged to a depth of -70 ft MLLW. The dry dock landing grid is 8 acres in size and will be dredged to a depth of -14 ft MLLW. The pier berths and ways run along the length of BIW's waterfront facility and vary in width from approximately 150 ft to 96 ft. Pier berth 1 will be dredged to -28 ft MLLW; the adjacent Ways area will be dredged to -28 ft MLLW; Pier berth 2 will be dredged to -28 ft MLLW; and Pier 3 will be dredged to -32 ft MLLW. All dredging will be conducted by barge mounted crane with a clamshell bucket. For the pier berths and ways, no overdredge is proposed. Material dredged from the berths and ways will be removed to a filter fabric lined barge, transported across the river to an off load site at Woolwich, off loaded to dump trucks and transported to one of BIW's three permitted upland sites. Erosion controls will be in place during transfer to trucks and any incidental spillage will be collected and removed as well. For the sinking basin dredging, excavated material will be placed in a dump scow which when full, will transit to the in river disposal site north of Bluff Head. A split hull scow or similar vessel will be utilized. The Corps Dredging Quality Management (DQM) system software and hardware system will be utilized to insure disposal at the correct coordinates. The Navy requires BIW to maintain the sinking basin to -68 ft MLLW but a -70 ft depth is authorized to minimize the potential for more frequent dredging. Dredging the sinking basin can be a 24-hour operation and may take up to six weeks to complete. Dredging the berths and landing grid is generally conducted over an 8-12 hour day and may take up to 2-3 weeks each. Dredging and disposal operations for any of the sites will generally occur within a November 1 to April 1 window. However, given the unpredictability of environmental conditions (e.g., sediment transport) and the operational needs of the facility (berthing and launching), there could be circumstances where any or all of the individual dredge sites would require dredging outside the above window. For purposes of this consultation, it is projected that dredging and disposal operations could occur between April 2 and October 31 every three years for a total of three times over the life of the permit.

Based on historic shoaling rates, current and projected shipbuilding schedules at BIW, and current budget forecasts, maintenance dredging is anticipated to be needed and performed at 2-3 year intervals (sinking basin), and potentially annually for the other locations (see Table 1). This equates to an average volume of up to 30,000 cy of dredging annually. Therefore, over the 10-year life of the renewed permit (December 31, 2029), the sinking basin could be dredged three to five times; and the landing grid and pier berths up to ten times.

Table 1: Dredging at Bath Iron Works (2000-Present)

Year	Dredge Volume (CY)							
	Pier 1	**Pier 2**	**Pier 3**	**Ways**	**Grids**	**Basin**	**Total**	**Total without Basin**
2000	530	3,768	--	4,128	--	--	8,426	8,426
2001	--	3,872	3,498	740	--	500,000	508,110	8,110
2002	--	1,616	--	--	--	--	1,616	1,616
2003	--	--	--	1,408	--	55,498	56,906	1,408
2004	--	--	--	--	4,000	--	4,000	4,000
2005	--	--	5,660	--	--	--	5,660	5,660
2006	--	--	--	--	--	--	0	0
2007	--	--	--	--	--	53,474	53,474	0
2008	--	--	--	--	2,500	--	2,500	2,500
2009	--	--	2,500	--	--	--	2,500	2,500
2010	--	--	6,708	--	3,808	--	10,516	10,516
2011	--	--	1,800	--	--	--	1,800	1,800
2012	--	--	--	--	2,496	--	2,496	2,496
2013	--	7,392	--	--	--	68,912	76,304	7,392
2014	--	16,968	--	--	--	--	16,968	16,968
2015	--	25,130	--	--	--	--	25,130	25,130
2016	--	--	--	--	--	--	0	0
2017	--	3,808	--	--	4,410	48,142	56,360	8,218
2018	--	--	--	--	--	--	0	0
2019	--	13,629*	--	--	10,351	--	23,980	23,980
2020	--	--	--	--	5,362	--	5,362	5,362
TOTAL	--	--	--	--	--	--	**862,554**	**136,528**
AVG/YR	--	--	--	--	--	--	**41,074****	**6,501**

*Pier 2 was dredged twice in 2019. Once from Jan. 4-Mar. 2 (11,979 cy), and then again Oct. 14-24 (1,650 cy)
**If you exclude the one time initial dredging of the sinking basin in 2001 (500,000), then the average dredged material volume per year drops to 17,264 cy.

3.2 Action Area

The action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR§402.02). For this project, the action area includes the areas to be dredged (Figure 1), vessel transit routes, as well as the area of the Kennebec River where increased suspended sediment will be present due to the removal and in-river placement of the material. Based on analysis of other mechanical dredging activities, increased suspended sediment levels are likely to be present for no more than 2,400 ft downstream of the dredge area (see Section 7.2). You expect the actual radius of turbidity around dredge efforts at BIW to be less because the material to be dredged is predominantly coarse sand; however, because any change in sediment plume will change based on the tides, the action area includes that area of the Kennebec River located within a 2,400 ft radius from the areas to be dredged. The action area also includes the short transit route to the nearby upstream dock across the river at Woolwich (3,000 ft) where material from the berthing area and landing grid will be towed and removed to trucks for eventual upland disposal. Finally, the action area includes the in-river disposal site, located approximately 3.25 miles downstream, along with a 4,000-ft radius of increased sediment levels resulting from disposal activity. You expect this action area to encompass all of the effects of the proposed project (including temporary effects from the placement of the two barges' spud anchoring systems (a total of 12 s.f. per barge), which will be covered by the dredge footprint).

As shown on the map you provided (Figure 2), the action area extends from upstream of the Route 1 bridge at Bath to approximately 4,000 ft below the in-river disposal site (approximately river mile (rm) 8.8 to 13.2, or river kilometer (rkm) 14.1 to 21.3). This is a total distance of approximately 4.5 miles and a surface area (bank to bank[1]) of 43,869,084 s.f. (1,007 acres). By comparison, the cumulative total area of the dredge sites measures approximately 780,650 s.f. (17.9 acres) and the disposal site measures approximately 250,000 s.f. (5.7 acres).

[1] We have included the bank to bank area in our estimate of the action area because the river width varies within the action area from 280-800 m (919-2,625 ft); therefore, depending on tides and flow conditions, turbidity plumes ranging from 2,400 to 4,000 ft may extend bank to bank in locations where dredging and disposal take place.

Figure 1: Photograph of Bath Iron Works Main Shipyard (Bath, Maine) Taken in December 2014 (USACE 2020)

Figure 2: Full Extent of Action Area (USACE 2020)

3.2.1 Habitat in the Action Area

From its source at Moosehead Lake in west-central Maine, to the point where it empties into the Atlantic Ocean, the Kennebec River is approximately 140 rm long (Fenster and Fitzgerald 1996). Upstream from the action area in Merrymeeting Bay, the Kennebec River Estuary receives water from six different river systems, the two largest of which are the Kennebec and Androscoggin Rivers. Together, these two rivers drain roughly a third of the land area of Maine (Moore and Reblin 2010). In the lower estuary, the Kennebec is also connected to the Sheepscot River in two places by the Sasanoa River (just north of the action area, east of Bath, ME) and the Back River (within the action area, near Georgetown, ME).

The Kennebec River is a complex estuarine system draining Sagadahoc County below Merrymeeting Bay. Landward of the beaches and ebb deltas near at the estuary's mouth, lower-energy intertidal communities are represented by saltmarshes and mudflats that fringe the Kennebec channel. The area has extensive salt marshes and is abutted by sand flats with productive shellfish habitat. The habitat adjacent to the dredge and disposal sites can be characterized as undeveloped marshland with silty sand sediments, rocky intertidal areas or sandy beaches. Moving north in the estuary, as salinities decline, freshwater and brackish tidal marshes become more common at about 10 rm (16 rkm) from the river's mouth, supplanting saltmarshes as the dominant inter-tidal community (Moore 2010).

The U.S. Fish and Wildlife Service characterizes the Kennebec River north of Merrymeeting Bay as "tidal riverine" and the area below Merrymeeting Bay as an estuarine subsystem. Depending on the river flows and the strength of the tide, marine waters typically penetrate up the estuary between 5 and 35 km (3–22 mi) from the Kennebec's mouth (Kistner and Pettigrew 2001).

The Kennebec River estuary is an elongate, rock-bound estuary where the lower estuary (approximately 16.8 mi (27 km) from the mouth) is characterized by salt-water intrusion. Semidiurnal tides have a mean range of 8 ft and a maximum spring range of 11.5 ft. The Kennebec River estuary has a strong ebb-current dominance that is produced primarily through spring snowmelt floods (freshets) ((Fenster and FitzGerald 1996); Fenster et al. 2001). The unique geology, extreme discharge seasonality, and large tidal ranges create transport of coarse-grained sediment from the lower 17 mi of the river to the nearshore and coastal region of south-central Maine ((Fenster and FitzGerald 1996); Fenster et al. 2005; Fenster et al. 2001; FitzGerald et al. 2005). The Kennebec Estuary is one of the primary sources of freshwater to the Gulf of Maine with a discharge that ranges between 131 cy per second and 5,232 cy per second (annual mean = 556 cy per second) (Kistner and Pettigrew 2001). Freshwater annual discharge averages approximately 341 cy per second at the Kennebec River estuary mouth, but varies seasonally from summer and mid-winter low flows to early winter and late spring high flows (Fenster and FitzGerald 1996). Spring flood freshwater discharge can exceed average daily flows by an order of magnitude in the lower estuary (Stumpf and Goldschmidt 1992).

In the lower estuary, main channel depths occur naturally from 58 ft (17 m) near the mouth to less than 33 ft (10 m) in the Kennebec River above Merrymeeting Bay (Moore and Reblin 2010); however, sediment transport creates shoals and sand waves in several areas of the channel, with varying elevations at the ranging from -18.4 ft (-5.6 m) to -26.5 ft (-8.1 m) MLLW. The natural width of the river in the action area ranges from approximately 919-2,625 ft (280-800 m). Substrate in the lower estuary consists mainly of sand, with some outcrops of bedrock; however, portions of the river that experience lower energy flows (e.g., coves, margins along the banks) are composed of some finer materials ((Fenster and FitzGerald 1996); Moore and Reblin 2010). At Bath, the tidal range averages 6.9 ft (2.1 m), greatly influencing the salinity throughout the action area, from approximately 5-25 parts per thousand (ppt) just downstream of Bath (Moore and Reblin 2010).

Dredge Sites

All of the proposed dredging sites are sub-tidal and have been dredged multiple times in the past. The dry dock landing grid is at the southern end of their facility and was last dredged in March 2020 (Grid #1 of the landing grids). The ship berths lie along the eastern face of their facility's piers and have been dredged at different schedules, Pier Berth #2 most recently in the fall of 2019. The dry dock sinking basin was last dredged in March 2017. The river bottom throughout the project area is composed of sand and silt with limited epifauna. The upland on the Bath side is dominated by the applicant's ship building facility that extends upstream to the Route 1 bridge.

The upland on the Woolwich side of the river, where dredged material is typically off-loaded for upland disposal, is lightly developed residentially and is primarily wooded. A 27 ft deep, 150 ft wide federal channel (FNP) is located in the Kennebec River just east of BIW's dry dock sinking basin. With the exception of the large naval vessels built at the applicant's facility and transiting to the open ocean, the bulk of the boating traffic in the river consists of small to moderate sized recreational and commercial/sport fishing vessels.

Bluff Head (In-River) Disposal Site

The disposal of material dredged from the channel near Doubling Point will occur at an in-river site 2,500 ft north of Bluff Head. The disposal site is located at a deep portion of the channel, with waters up to approximately 30-100 ft deep with an average depth of 76.5 ft and is 500 ft wide by 500 ft long located within the Federal channel. The site is about two mi downriver of the proposed dredge site. The shoreline is rocky intertidal or marsh and with much of the upland areas forested.

At Bath, the tidal range averages 6.8 ft (2.1 m) (NOAA 2019a). Tidal currents between the Kennebec River entrance and Bath have average velocities at strength of 2 to 3 knots (NOAA 2019b). Ebb velocities up to 6 knots have been observed, and considerably larger velocities may be expected during freshets (NOAA 2019b). The disposal area is estuarine with salinities varying (10–20 psu) with river runoff (Mayer et al. 1996; Wong and Townsend 1999).

Sediments from the river bed in this area of the Kennebec can be carried upstream by flood currents that are stronger than ebb currents or downstream in the mouth of the river when freshwater discharge exceeds 294–425 cy/s (FitzGerald et al. 2005). In 1981, USACE conducted several hydrographic surveys, before disposal, one-month post-disposal and 10 months post-disposal. The average depth for the disposal area and surveyed regions up to approximately 1000 ft downstream were all slightly shallower (5–10 ft) one month after disposal, but all surveyed areas even the site 300 ft upstream of the disposal area had eroded some (2–7 ft) 10 months post-disposal (Hubbard 1982). Only one grain size sample was collected from the Bluff Head disposal area in 1986 and the material consisted medium grained sand. Fenster and FitzGerald (1996) describe the particularly narrow regions of the channel (i.e., 820 ft in Fiddler Reach) as absent of all semi-consolidated and unconsolidated sediment units and the bedrock basement forming the channel bottom. The Bluff Head disposal area is an erosional area with sand moving through the area but not expected to stay in the area over the long-term.

4.0 STATUS OF LISTED SPECIES AND CRITICAL HABITAT IN THE ACTION AREA

We have determined that the action considered in this biological opinion may affect the following endangered or threatened species and critical habitat under our jurisdiction (Table 2):

Table 2: ESA-listed species and critical habitat in the action area

ESA-Listed Species	**Latin Name**	**Distinct Population Segment (DPS)**	**Federal Register (FR) Citation**	**Recovery Plan**
Atlantic Salmon	*Salmo salar*	Gulf of Maine	74 FR 29344	NMFS & USFWS 2019
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	Gulf of Maine; New York Bight	77 FR 5880	N/A
Shortnose Sturgeon	*Acipenser brevirostrum*	Range-wide	32 FR 4001	NMFS 1998
Designated Critical Habitat (species)	**Latin Name**	**Distinct Population Segment (DPS)**	**Federal Register (FR) Citation**	**Recovery or River Unit**
Atlantic Salmon	*Salmo salar*	Gulf of Maine	74 FR 29300	Merrymeeting Bay Salmon Habitat Recovery Unit
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	Gulf of Maine	82 FR 39160	Kennebec River Unit

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

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

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

4.1.1 Atlantic Salmon (Gulf of Maine DPS) and Critical Habitat Designated for the Gulf of Maine DPS of Atlantic Salmon

The GOM DPS of anadromous Atlantic salmon was initially listed by USFWS and us (collectively, the Services) as an endangered species on November 17, 2000 (65 FR 69459). A subsequent rule issued by the Services (74 FR 29344, June 19, 2009) expanded the geographic range for the GOM DPS of Atlantic salmon. The GOM DPS of Atlantic salmon is defined as all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, and wherever these fish occur in the estuarine and marine environment. The marine range of the GOM DPS extends from the Gulf of Maine, throughout the Northwest Atlantic Ocean, to the coast of Greenland. Included in the GOM DPS are all associated conservation hatchery populations used to supplement these natural populations; currently, such conservation hatchery populations are maintained at Green Lake National Fish Hatchery (GLNFH) and Craig Brook National Fish Hatcheries (CBNFH), both operated by the USFWS, as well as private watershed-based facilities (Downeast Salmon Federation's East Machias and Pleasant River facilities). Excluded from the GOM DPS are landlocked Atlantic salmon and those salmon raised in commercial hatcheries for the aquaculture industry (74 FR 29344, June 19, 2009).

Atlantic salmon adult and smolt life stages move through the action area during their spawning and outmigration periods. Although spawning does not occur until late fall, the majority of Atlantic salmon in Maine enter freshwater between May and mid-July (Baum 1997, Meister 1958), but may enter at any time between early spring and late summer. Peak upstream migration movements in the Kennebec River occur in the month of June (Fay *et al.* 2006). The number of Atlantic salmon returning to the Kennebec River annually has been low; ranging between 5 and 64 between 2009 and 2018, with an average of approximately 25 salmon per year (USASAC 2019). These salmon would be migrating through the mainstem of the Kennebec River between April and November. Between 2014 and 2017, 125 pre-spawn Atlantic salmon were trapped at the Lockwood Dam fish trap, approximately 103 km upstream of the action area (Brookfield 2015, 2016, 2017, 2018).

After spawning, male and female Atlantic salmon (kelts) either return to sea immediately or remain in fresh water until the following spring before returning to the sea (Fay *et al.* 2006). No kelt outmigration data exists for the Androscoggin River; however, Baum (1997) reported that 20% of kelts outmigrated to the ocean in the fall, with the remaining 80% migrating to the ocean in the spring.

After hatching, salmon fry remain in their natal river for three years. Once smoltification occurs, smolts begin their downstream migration between April and June. In 2015, smolt trapping studies on the Sheepscot River in the Merrymeeting Bay Salmon Habitat Recovery Unit (SHRU) indicated a median migration date of May 12 with a migration duration of 33 days (USASAC 2016). While the annual abundance of smolts in the Kennebec River is presently unknown, MDMR estimates the current egg and fry stocking in the Sandy River could be producing approximately 9,000 to 14,000 smolts annually based on life-stage survival estimates. Since 2011, 2,000 fry have been released annually to the Sandy River (USASAC 2015). Typically, over 500,000 eggs are also planted annually in the Sandy River. Redd counts and juvenile surveys confirmed that adult salmon trucked to the Sandy River successfully spawned (MDMR 2010). In addition, some amount of natural reproduction is likely occurring in the Sandy River. We do expect the seasonal presence of downstream migrating kelts and smolts in the spring of each year; while we only expect a few kelts each year, we anticipate thousands of smolts to migrate through the action area annually.

Table 3: Timing of Atlantic salmon lifestages and behaviors in the action area

Lifestage	**Time of Year Present in Action Area**	**Behavior in Action Area**
Adults	April 1-November 30	Migration of spawning adults in the spring-fall; outmigration of kelts in the fall and spring.
Smolts	April 1-June 30	Outmigration to marine waters

4.1.1.1 Effects of the Proposed Action on the Gulf of Maine DPS of Atlantic Salmon

As noted, above, when possible, dredge events will occur from November 1 to April 1, an in-water work window designed to protect diadromous fish; however, as many as three dredge events may occur from April 2 to October 31 between 2020 and 2029.

Dredge Capture

There are no known incidences of Atlantic salmon being captured in a mechanical dredge. As Atlantic salmon are highly mobile and not likely to be concentrated in the action area there is little risk of individuals being captured. The risk of capture is further reduced by the distribution of Atlantic salmon in the upper water column, not near the bottom where mechanical buckets are actively dredging. Though a dredge bucket may be open (depending on the type of bucket used) as it travels through the water column, the low number and sparse spatial concentration of Atlantic salmon in the action area make effects of dredge bucket capture extremely unlikely. Furthermore, you are proposing to dredge from November 1 to April 1 whenever possible. This window provides minimal overlap with the times of year we expect Atlantic salmon to be the action area (Table 3). As such, it is extremely unlikely that any Atlantic salmon will be captured during dredging operations. Therefore, the effects of dredge capture on Atlantic salmon are discountable.

Turbidity and Suspended Sediments

Suspended sediments can have lethal and sub-lethal effects on Atlantic salmon. Sub-lethal effects of suspended sediments can include impairment of swimming activity, respiration, and predator avoidance.

Turbidity and TSS effects to Atlantic salmon worsen with increased levels of turbidity (Newcombe 1994). Juvenile and adult salmonids show minor physiological stress and sub-lethal effects at suspended sediment concentrations of 7 mg/L for a six-day exposure and at 55 mg/L for a seven-hour exposure (Newcombe and Jensen 1996). MaineDOT’s Programmatic Biological Assessment (Maine DOT 2016) outlined biological responses for Atlantic salmon and classified them into three major categories. The three categories are behavioral responses, sub-lethal effects, and potential mortality, as defined below.

Behavioral response - The range of turbidity releases expected to result in behavioral reactions ranging from a startle response to avoidance. These responses are anticipated after exposure to turbidity/suspended sediment levels of:

- 1-20 mg/L for one hour; or,
- 1 mg/L for 24 hours

Sub-lethal effects – The ranges of turbidity releases expected to result in sub-lethal effects including stress, reduction in feeding rates, and increased respiration rates. These responses are anticipated after exposure to turbidity/suspended sediment levels of:

- 20-22,026 mg/L for one hour; or,
- 1 mg/L for six days

Potential mortality - A higher range of releases has the potential to result in fish mortality. These responses are anticipated after exposure to turbidity/suspended sediment levels of:

- >22,026 mg/L for one hour; or,
- 7 mg/L for 30 months.

We expect that migrating adults, outmigrating kelts, and smolts will be present in the action area for less than one day as movement through the estuary is direct and rapid. During this migration, salmon may encounter increased levels of turbidity and suspended sediments from dredging activities and disposal of dredged material.

As discussed in the Effects of the Action section below, we expect that near-bottom plumes caused by mechanical dredges may extend approximately 2,400 ft (732 m) down-current from the dredge with TSS concentrations ranging from 105-445 mg/L (USACE 2001, 2015). During the discharge of sediment at the in-river disposal site, we expect TSS levels as high as 500.0 mg/L within 250 ft (76 m) of the disposal vessel and decreasing to background levels (i.e., 15.0-100.0 mg/L depending on location and sea conditions) within 4,000 ft (1,219 m) (USACE 1983). As the substrate in the action area is predominantly sand with little fine material (i.e., silt), which generates very little turbidity when disturbed and settles through the water column quickly (likely in a matter of minutes), these are likely very conservative estimates (both the distance of the turbidity plume and the TSS levels). We expect disposal events to last for approximately 5 minutes. In any given year, dredging and disposal lasts for approximately 20-30 days, and requires 8-10 trips to the Bluff Head in-river disposal site for every 30,000 cy of dredging. As we expect an average annual dredge total of approximately 17,300 cy, with some seasons requiring up to 70,000 cy if the sinking basin requires dredging, we expect a range of 6-23 annual vessel trips to Bluff Head.

Consistent with the categories above, salmon may encounter TSS levels reaching approximately 500 mg/L in the action area. While this TSS level falls within a range that can result in sub-lethal effects, the highest TSS levels were measured very close to the draghead (i.e., at the riverbed) and in close proximity to the point of disposal. Because we expect salmon adults, kelts, and smolts to quickly move through the estuary using the upper portion of the water column, we do not expect that the action will have any effects on salmon beyond a brief avoidance response, as they may avoid quickly settling sand. Furthermore, you have conditioned your permit to require BIW to develop and implement a TSS management/monitoring plan in order to insure that Atlantic salmon are not exposed to TSS levels greater than 50 mg/L above background if dredging occurs from April 2 through October 31. Therefore, given the short period of time we expect salmon to spend in action area, along with the ephemeral nature of the stressor and the TSS monitoring plan, we expect any effects to salmon migration (i.e., migratory delay due to avoidance of the portion of the river with elevated TSS) to be so small that they cannot be meaningfully measured, detected or evaluated, and therefore, insignificant.

Habitat Modification

The action may create temporary disturbances within Atlantic salmon migratory habitat from the presence of an active mechanical dredge, scow movement to disposal areas, and increases in turbidity from dredging and disposal activities. Given the short period of time that in-water work is anticipated to occur in an event (approximately 20-30 days), if salmon adults, kelts, or smolts enter the action area while in-water work is occurring (or indirect effects were still present), we expect they will be able to continue their migration through the habitat without delay by making minor evasive movements. Any effects to water quality from increasing the depth of the channel and increases in TSS and turbidity (i.e., water temperature, salinity, dissolved oxygen) are also either temporary or too small to be meaningfully measured or detected (i.e., dredging will only occur in a small portion of the channel, which is itself only a small portion of the lower Kennebec estuary).

Therefore, any modifications to salmon habitat in the action area are minor and temporary, and their effects on salmon use of the habitat are too small to be meaningfully measured or detected, and are insignificant.

4.1.1.2 Physical and Biological Features of Atlantic Salmon Critical Habitat in the Action Area

Coincident with the June 19, 2009 endangered listing, we designated critical habitat for the GOM DPS of Atlantic salmon (74 FR 29300; June 19, 2009)(Figure 3). The final rule was revised on August 10, 2009. In this revision, designated critical habitat for the expanded GOM DPS of Atlantic salmon was reduced to exclude trust and fee holdings of the Penobscot Indian Nation and a table was corrected (74 FR 39003; August 10, 2009).

As part of the 2009 GOM DPS listing and designation of critical habitat, we defined three Salmon Habitat Recovery Units (SHRU): the Merrymeeting Bay SHRU, the Penobscot Bay SHRU, and the Downeast Coastal SHRU (Figure 3). As defined in the Endangered Species Consultation Handbook, a Recovery Unit is a “management subset of the listed species that is created to establish recovery goals or carry out management actions.” The NMFS Interim Recovery Plan Guidance goes on to state that recovery units are frequently managed as management units, though makes the distinction that recovery units are deemed necessary to both the survival and recovery of the species, whereas management units are defined as not always being “necessary” to both the survival and recovery[2].

The action area occurs within the Merrymeeting Bay SHRU. Outside of marine survival, dams are the greatest impediment to the recovery of salmon in the Penobscot, Kennebec, and Androscoggin river basins ((Fay *et al.* 2006)). Hydropower dams in the Merrymeeting Bay SHRU significantly impede the migration of Atlantic salmon and other diadromous fish and either reduce or eliminate access to roughly 352,000 units of historically accessible spawning and rearing habitat. Also, agriculture and urban development largely affect the lower third of the Merrymeeting Bay SHRU by reducing substrate and cover, reducing water quality, and elevating water temperatures. Additionally, smallmouth bass and brown trout introductions, along with

[2] https://www.fisheries.noaa.gov/national/endangered-species-conservation/endangered-species-act-guidance-policies-and-regulations

other non-indigenous species, significantly degrade habitat quality throughout the Merrymeeting Bay SHRU by altering natural predator/prey relationships.

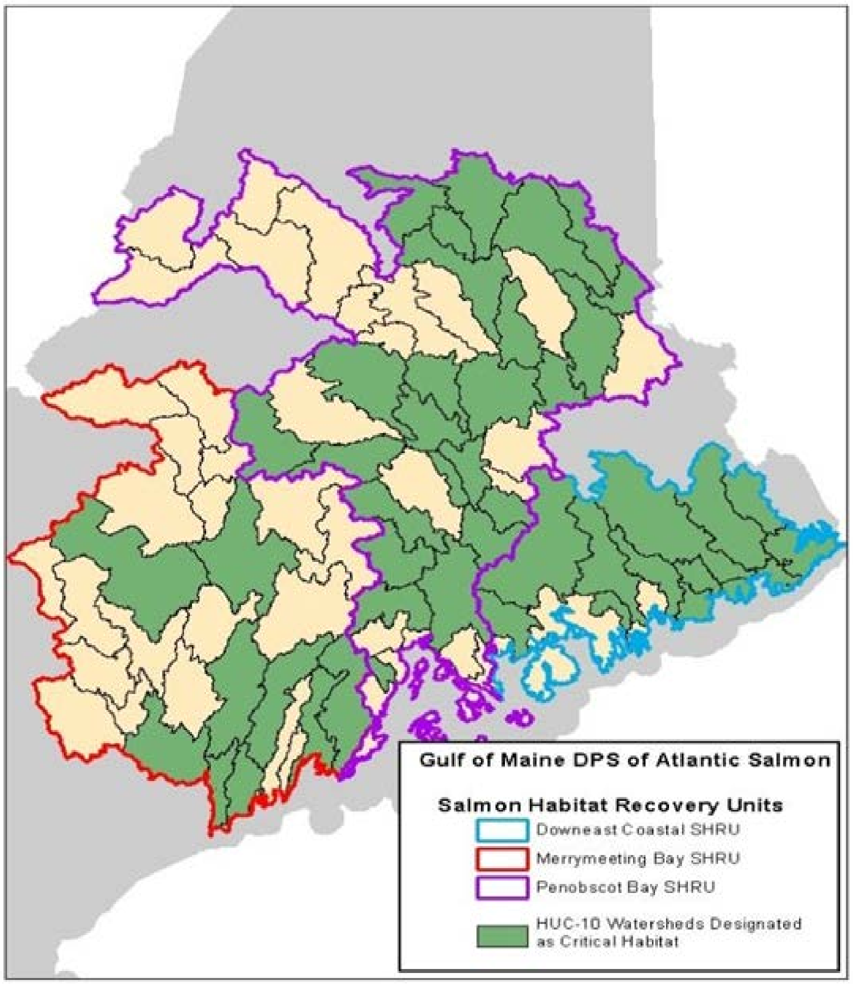

Figure 3: HUC-10 Watersheds Designated as Atlantic Salmon Critical Habitat and Salmon Habitat Recovery Units within the GOM DPS

Designation of critical habitat is based on the known physical and biological features within the occupied areas of a listed species that are deemed essential to the conservation of the species. For the GOM DPS, the physical and biological features (PBFs) essential for the conservation of Atlantic salmon are: 1) sites for spawning and rearing, and, 2) sites for migration (excluding marine migration[3]). We chose not to separate spawning and rearing habitat into distinct PBFs, although each habitat does have distinct features, because of the GIS-based habitat prediction model approach that was used to designate critical habitat (74 FR 29300; June 19, 2009). This model cannot consistently distinguish between spawning and rearing habitat across the entire range of the GOM DPS.

3 Although successful marine migration is essential to Atlantic salmon, we were not able to identify the essential features of marine migration and feeding habitat or their specific locations at the time critical habitat was designated.

The physical and biological features for Atlantic salmon critical habitat are as follows:

Physical and Biological Features of Spawning and Rearing Habitat

1. Deep, oxygenated pools and cover (*e.g.*, boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall.
2. Freshwater spawning sites that contain clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support spawning activity, egg incubation, and larval development.
3. Freshwater spawning and rearing sites with clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support emergence, territorial development, and feeding activities of Atlantic salmon fry.
4. Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.
5. Freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate parr's ability to occupy many niches and maximize parr production.
6. Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.
7. Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.

Physical and Biological Features of Migratory Habitat

1. Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations.
2. Freshwater and estuary migration sites with pool, lake, and instream habitat that provide cool, oxygenated water and cover items (*e.g.*, boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon.
3. Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.
4. Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.
5. Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration.
6. Freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

Habitat areas designated as critical habitat must contain one or more physical and biological features within the acceptable range of values required to support the biological processes for which the species uses that habitat. Critical habitat includes all perennial rivers, streams, and estuaries and lakes connected to the marine environment within the range of the GOM DPS, except for those areas that have been specifically excluded as critical habitat. Critical habitat has only been designated in areas (HUC-10 watersheds) considered currently occupied by the species. Critical habitat includes the stream channels within the designated stream reach and includes a lateral extent as defined by the ordinary high-water line or the bankfull elevation in the absence of a defined high-water line. In estuaries, critical habitat is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

To facilitate and standardize determinations of effect for section 7 consultations involving Atlantic salmon critical habitat, we developed the "Matrix of Essential Features for Designated Atlantic Salmon Critical Habitat in the GOM DPS" (Table 4). The matrix lists the physical and biological features (essential features) of Atlantic salmon habitat, and the potential conservation status of critical habitat within an action area. Two essential features in the matrix (spawning and rearing, and migration) are described in regards to five distinct Atlantic salmon life stages: 1) adult spawning; 2) embryo and fry development; 3) parr development; 4) adult migration; and, 5) smolt migration. The conservation status of the essential features may exist in varying degrees of functional capacity within the action area. The three degrees of functional capacity used in the matrix are described in ascending order: 1) fully functioning; 2) limited function; and 3) not properly functioning.

Table 4: Matrix of essential features for assessing the functioning of critical habitat in the action area

	Conservation Status Baseline		
Essential Features	**Fully Functioning**	**Limited Function**	**Not Properly Functioning**
A) Adult Spawning (October 1 – December 14)			
Substrate	highly permeable coarse gravel and cobble between 1.2 to 10 cm in diameter	40- 60% cobble (22.5-256 mm dia.) 40-50% gravel (2.2 – 22.2 mm dia.); 10-15% coarse sand (0.5 -2.2 mm dia.), and <3% fine sand (0.06-0.05mm dia.)	more than 20% sand (particle size 0.06 to 2.2 mm), no gravel or cobble
Depth	17-30 cm	30 - 76 cm	< 17 cm or > 76 cm
Velocity	31 to 46 cm/sec.	8 to 31cm/sec. or 46 to 83 cm/sec.	< 5-8 cm/sec. or > 83cm/sec.
Temperature	7º to 10ºC	often between 7º to 10ºC	always < 7º or > 10ºC
pH	> 5.5	between 5.0 and 5.5	< 5.0
Cover	Abundance of pools 1.8-3.6 meters deep (McLaughlin and Knight 1987). Large boulders or rocks, over hanging trees, logs, woody debris, submerged vegetation or undercut banks	Limited availability of pools 1.8-3.6 meters deep (McLaughlin and Knight 1987). Large boulders or rocks, over hanging trees, logs, woody debris, submerged vegetation or undercut banks	Absence of pools 1.8-3.6 meters deep (McLaughlin and Knight 1987). Large boulders or rocks, over hanging trees, logs, woody debris, submerged vegetation or undercut banks

	Conservation Status Baseline		
Essential Features	**Fully Functioning**	**Limited Function**	**Not Properly Functioning**
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
B) Embryo and Fry Development: (October 1 – April 14)			
Temperature	0.5ºC and 7.2ºC, averages nearly 6oC from fertilization to eye pigmentation	averages < 4 ºC, or 8 to 10ºC from fertilization to eye pigmentation	>10ºC from fertilization to eye pigmentation
D.O.	at saturation	7-8 mg/L	< 7 mg/L
pH	> 6.0	6 - 4.5	< 4.5
Depth	5.3-15cm	NA	<5.3 or >15cm
Velocity	4 – 15cm/sec.	NA	<4 or > 15cm/sec.
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
C) Parr Development (All year)			
Substrate	gravel between 1.6 and 6.4 cm in diameter and boulders between 30 and 51.2 cm in diameter. May contain rooted aquatic macrophytes	gravel < 1.2cm and/or boulders > 51.2. May contain rooted aquatic macrophytes	no gravel, boulders, or rooted aquatic macrophytes present
Depth	10cm to 30cm	NA	<10cm or >30cm
Velocity	7 to 20 cm/sec.	< 7cm/sec. or > 20 cm/sec.	velocity exceeds 120 cm/sec.
Temperature	15º to 19ºC	generally between 7- 22.5 ºC, but does not exceed ºC at any time	stream temperatures are continuously < ºC or known to exceed 29 ºC
D.O.	> 6 mg/L	2.9 - 6 mg/L	< 2.9 mg/L
Food	Abundance of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows	Presence of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows	Absence of larvae of mayflies, stoneflies, chironomids, caddisflies, blackflies, aquatic annelids, and mollusks as well as numerous terrestrial invertebrates and small fish such as alewives, dace or minnows
Passage	No anthropogenic causes that inhibit or delay movement	Presence of anthropogenic causes that result in limited inhibition of movement	barriers to migration known to cause direct inhibition of movement

Essential Features	Conservation Status Baseline Fully Functioning	Limited Function	Not Properly Functioning
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
D) Adult Migration (April 15 – December 14)			
Velocity	30 cm/sec to 125 cm/sec	In areas where water velocity exceeds 125 cm/sec adult salmon require resting areas with a velocity of < 61 cm/s	sustained speeds > 61 cm/sec and maximum speed > 667 cm/sec
D.O.	> 5mg/L	4.5-5.0 mg/L	< 4.5mg/L
Temperature	14 – 20ºC	temperatures sometimes exceed 20 ºC but remain below 23ºC.	> 23ºC
Passage	No anthropogenic causes that delay migration	Presence of anthropogenic causes that result in limited delays in migration	Presence of anthropogenic barriers to migration known to cause significant delay, injury, or mortality of adults
Fisheries Interactions	Abundant diverse populations of indigenous fish species	Abundant diverse populations of indigenous fish species, low quantities of non-native species present	Limited abundance and diversity of indigenous fish species, abundant populations of non-native species
E) Juvenile Migration (April 15 – June 14)			
Temperature	8 - 11oC	5 - 11ºC.	< 5 ºC or > 11 ºC
pH	> 6	5.5 - 6.0	< 5.5
Essential Features	Fully Functioning	Limited Function	Not Properly Functioning
Passage	No anthropogenic causes that delay migration	Presence of anthropogenic causes that result in limited delays in migration	barriers to migration known to cause direct or indirect mortality of smolts

Within the action area, several PBFs for Atlantic salmon migration for the juvenile (smolt) and adult life stages are present. These PBFs are:

Migration PBF M1. *Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations.*
Migration PBF M3. *Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.*
Migration PBF M4. *Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.*

There is no freshwater within the action area, so none of the seven PBFs of spawning and rearing habitat are present. The action area primarily consists of the main river channel and a nearshore disposal area with a swift current and mostly sandy bottom. As such, we have determined that Migration PBF M2 (i.e., freshwater and estuary migration sites with pool, lake, and in-stream habitat that provide cool, oxygenated water and cover items (e.g., boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon) does not occur in the action area. Any smolts entering the action area have already experienced the water temperature, flows, and diurnal cues to stimulate their migration, because once in the action area, their downstream migration to the lower estuary and ocean is nearly complete. Therefore, we do not expect any further smolt migration stimulation to occur or be needed, and Migration PBF 5 does not occur in the action area (i.e., freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration). Similarly, we expect freshwater migration sites with the water chemistry to support sea water adaption of smolts (PBF 6) to occur upstream of the action area, because once they enter the action area they will have been in a mostly saline environment for approximately 10 rkm (where Merrymeeting Bay meets the lower Kennebec estuary). Therefore, we do not expect Migration PBF 6 to occur in the action area.

4.1.1.3 Effects of the Proposed Action on Critical Habitat Designated for the Gulf of Maine DPS of Atlantic Salmon

As detailed in section 4.1.1.2, the action area occurs within the Merrymeeting Bay SHRU, and we have determined that several critical habitat Migration PBFs are present (PBFs M1, M3, and M4). In this analysis, we consider the effects of the action on the identified PBFs. For each feature that may be affected by the action, we then determine whether any effects to the feature are insignificant, discountable, or entirely beneficial. In making this determination, we consider the action's potential to affect how each PBF supports the conservation needs of Atlantic salmon in the action area. Part of this analysis is consideration of whether the action will have effects on the ability of Atlantic salmon to access the feature, temporarily or permanently, and consideration of the effect of the action on the action area's ability to develop the feature over time.

<u>Migratory PBF 1:</u>
Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations.

The proposed action may have temporary negative effects on PBF M1 by creating in water stressors from dredging and disposal activities; however, as described above, none of the proposed activities will be barriers to the movement of adult Atlantic salmon. Based on our assessment, these impediments to movement are extremely unlikely to affect the function of PBF M1 to the conservation of the species in the action area; that is, it is extremely unlikely that the habitat alterations in the action area will impede the movement of adults to and from spawning sites; therefore, the effects are discountable.

Migratory PBF 3:
Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.

Several diadromous species, including adult alewives, blueback herring and American shad (three unlisted anadromous clupeid species), move through the project area during their upstream migration period. Alewives generally move upstream in the Kennebec River during May. American shad and blueback herring tend to run during the latter part of the spring (i.e., late May and June).

When possible, dredging will occur from November 1 to April 1, avoiding much of the spawning migration of the most important native fish communities that serve as a protective buffer against Atlantic salmon predation (i.e., alewife, blueback herring, and American shad). Up to three events may occur from April 2 to October 31; however, we do not expect the temporary effects from dredging or disposal activities to impede or delay the upstream or downstream passage of these species. Therefore, we do not expect the proposed project to affect diverse native fish communities' ability to serve as a protective buffer against salmon predation.

Migratory PBF 4:
Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.

When possible, dredging will occur from November 1 to April 1, almost entirely avoiding (with the exception of one day) the time of year when we expect outmigrating smolts to be in the action area (April 1 – June 30). Up to three events may occur from April 2 to October 31. Therefore, the proposed action may have temporary negative effects on PBF M3 by creating in water stressors from dredging and disposal activities; however, as described above, none of the proposed activities will be barriers to the movement of Atlantic salmon smolts. Based on our assessment, these impediments to movement are extremely unlikely to affect the function of PBF M3 to the conservation of the species in the action area; that is, it is extremely unlikely that the habitat alterations in the action area will impede the movement of adults to and from spawning sites; therefore, the effects are discountable.

Summary of Effects of Proposed Activities on Atlantic Salmon Critical Habitat
We have determined that all of the effects of the proposed maintenance dredging and disposal on critical habitat designated for the GOM DPS of Atlantic salmon, including PBFs M1, M3, and M4, are insignificant or discountable.

4.1.2 Critical Habitat Designated for the Gulf of Maine DPS of Atlantic Sturgeon

4.1.2.1 Physical and Biological Features of Atlantic Sturgeon Critical Habitat in the Action Area
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 New York 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 Kennebec River critical habitat unit designated for the Gulf of Maine 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 five critical habitat units to achieve this objective for the Gulf of Maine DPS: (1) Penobscot River main stem from the Milford Dam downstream for 33 mi (53 rkm) to where the main stem river discharges at its mouth into Penobscot Bay; (2) Kennebec River main stem from the Ticonic Falls/Lockwood Dam downstream for 64 mi (103 rkm) to where the main stem river discharges at its mouth into the Atlantic Ocean; (3) Androscoggin River main stem from the Brunswick Dam downstream for 10 rkm to where the main stem river discharges at its mouth into Merrymeeting Bay; (4) Piscataqua River from its confluence with the Salmon Falls and Cocheco rivers downstream for 11.8 mi (19 rkm) to where the main stem river discharges at its mouth into the Atlantic Ocean as well as the waters of the Cocheco River from its confluence with the Piscataqua River and upstream 3.1 mi (5 rkm) to the Cocheco Falls Dam, and waters of the Salmon Falls River from its confluence with the Piscataqua River and upstream 3.7 mi (6 rkm) to the Route 4 Dam; and, (5) Merrimack River from the Essex Dam (also known as the Lawrence Dam) downstream for 29.8 mi (48 rkm) to where the main stem river discharges at its mouth into the Atlantic Ocean. In total, these designations encompass approximately 152 mi (244 rkm) 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 parts per thousand (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 action area for the proposed work considered in this Opinion extends across a 4.5 mi (7.2 rkm) stretch of the saline reaches of the lower Kennebec River, and is entirely within the Kennebec River critical habitat unit (which is bank-to-bank within the Kennebec River). The action area covers approximately 1,007 acres. It contains three of the four PBFs; it does not contain PBF 1, hard bottom substrate (*e.g.,* rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (*i.e.,* 0.0 to 0.5 parts per thousand (ppt) range) for settlement of fertilized eggs, refuge, growth, and development of early life stages. Information on the PBFs within the action area is contained in the section below.

4.1.2.2 Status of Atlantic Sturgeon Critical Habitat in the Action Area

As noted above in the description of the proposed action, the action area considered in this Opinion extends from rm 8.8 to 13.2 (rkm 14.1 to 21.3). The Kennebec River critical habitat unit extends from Ticonic Falls/Lockwood Dam (approximately rm 64; rkm 103) downstream to where the main stem river discharges at its mouth into the Atlantic Ocean.

<u>PBF 2</u>
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.

Salinities in the action area (approximately 5-25 ppt), from rm 8.8 to 13.2 (rkm 14.1 to 21.3), meet the salinity range as defined in PBF 2. Substrate in the lower Kennebec estuary consists mainly of sand, with some outcrops of bedrock; however, portions of the river that experience lower energy flows (e.g., coves, margins along the banks) are composed of some finer materials (Fenster and FitzGerald 1996)(Moore and Reblin 2010). As noted above, sediment sampling results from the Doubling Point dredge area show the material to be primarily sand (medium or medium to fine grained; sometimes with traces of silt and/or gravel). Moving downstream approximately 1.9 mi (3 rkm), the Bluff Head disposal site is located at a deep portion of the channel, with waters up to approximately 30-100 ft (9.1-30.5 m) deep with an average depth of 76.5 ft (23.3 m) and is 500 ft wide by 500 ft (152.4 m by 152.4 m) long located within the Federal channel. The only sediment sampling done at the site in 1986 returned medium grained sand. Given the flow dynamics in this narrow region of the channel which create the scour and depths of this habitat, semi-consolidated and unconsolidated sediment units are expected to be widely absent, with transitional sand moving through the area over a bedrock basement (channel bottom).

While some bedrock outcrops may exist, based on the best available information on the benthic habitat in the action area, we believe the vast majority of the critical habitat within the action area meets the defined criteria of PBF 2. You have estimated that the area of critical habitat within the action area (including the footprint of the dredge sites and the in-river disposal site, the vessel transit routes, and the areas experiencing increased levels of turbidity from dredging and disposal) to be 1,007 acres.

As defined, PBF 2 focuses on soft substrates for juvenile foraging and physiological development. Based on extensive sampling, tagging, tracking, over the past several decades (see Section 5.6.1), we are confident that the action area is heavily utilized by juvenile Atlantic sturgeon from the GOM DPS. Juvenile foraging in the lower Kennebec estuary occurs primarily from April through November, with juveniles moving upstream into Merrymeeting Bay in the late fall and winter months; however, we expect that on rare occasions individuals may pass through the action area from December through March.

Activities that have impacted and will continue to impact PBF 2 include those that impact salinity and those that result in the loss or disturbance of soft sediment within the transitional salinity zone. These include activities that result in sediment disturbance and subsequent sediment deposition that buries prey species (e.g., disturbance of soft substrate by deep draft vessels such as Naval ships traveling to or from BIW), direct removal or displacement of soft bottom substrate (e.g., dredging, construction), activities that result in the contamination or degradation of habitat reducing or eliminating populations of benthic invertebrates, and activities that influence the salinity gradient (e.g., climate change, deepening of the river channel). Very few deep draft vessels with the capacity to disturb benthic sediments pass through the Kennebec River FNP to and from BIW. Beyond minor projects at marinas and piers, dredging in the action area is limited to the proposed dredging that is the subject of this Opinion (occurring approximately every one to two years at different piers, landing grids, and the sinking basin).

As described in Section 5.5, water pollution and contamination have historically been, and continue to be, an issue in the Kennebec River, despite significant progress in limiting pollution and improving water quality in the past few decades. Point source discharges (e.g.., municipal wastewater, industrial cooling water or waste water) and compounds associated with discharges (e.g., metals, dioxins, dissolved solids, phenols, and hydrocarbons) contribute to poor water quality and may also impact the health benthic fauna consumed by foraging juvenile sturgeon in the transitional salinity zone. We consider the impacts of climate change in Section 6.0.

PBF 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.

Following these criteria, PBF 3 is present throughout the portion of the action area that overlaps with critical habitat (i.e., rm 8.8 to 13.2 (rkm 14.1 to 21.3)).

Both historically and today, the location of the Lockwood Dam (Ticonic Falls) is the upstream limit for Atlantic sturgeon in the Kennebec River. Within the action area, while there are bankside developments (piers) and potentially some exposed boulders, there are no physical obstructions preventing passage of sturgeon. In addition to navigating around existing structures, sturgeon movements can also be 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.). We are not aware of any ongoing construction projects in the action area.

The Kennebec River estuary experiences semidiurnal tides with mean range of 8 ft (2.4 m) and a maximum spring range of 11.5 ft (3.5 m). The natural width of the river in the action area ranges from approximately 656-5,003 ft (200-1,525 m). Depths within the action area vary; however, the authorized FNP, which extends through the action area, consists of a channel 27 ft (8.2 m) deep at MLLW. The Bluff Head disposal site is one of the deepest natural points, reaching depths of approximately 100 ft (32m).

The action area currently supports the unimpeded movement of juvenile, subadult, and adult Atlantic sturgeon, and in addition to forage habitat, may also support staging, resting, or holding of subadults or spawning condition adults.

<u>PBF 4</u>

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).*

Adhering to these criteria, PBF 4 is present throughout the action area (rm 8.8 to 13.2 (rkm 14.1 to 21.3)); however, based on an exceedance of salinity tolerance, we do not expect spawning or the development of early life stages to occur the action area.

Water quality factors of temperature, salinity and dissolved oxygen are interrelated environmental variables, and are constantly changing from influences of the tide, weather, season, etc. Dissolved oxygen 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). This means that, for example, the dissolved oxygen levels that support growth and development will be different at different combinations of water temperature and salinity. Similarly, the dissolved oxygen levels that we would expect Atlantic sturgeon to avoid would also vary depending on the particular water temperature, salinity, and life stage. As dissolved oxygen tolerance changes with age, the conditions that support growth and development and likewise, the dissolved oxygen levels that would be avoided, change (82 FR 39160; NMFS 2017).

Before the Clean Water Act of 1972, textile, pulp and paper, and municipalities discharged directly into the Kennebec River causing it to be one of the most heavily polluted rivers in the United States. Pollution caused reductions in fish and other aquatic organisms due to anoxic conditions during the summer months. However, even with this pollution, dissolved oxygen levels in the Androscoggin River just above the Brunswick Dam were measured at ~6 mg/L in the 1930s (Brennan et al. 1931 in Moore and Reblin 2010). With the implementation of legal mandates on pollution discharge, dissolved oxygen levels have continued to improve in the Kennebec and Androscoggin Rivers (Moore and Reblin 2010). Surveys conducted in 2004 in the Kennebec estuary from approximately Popham Beach to Merrymeeting Bay returned surface and bottom DO levels ranging from 7.2-9.1 mg/L (Souther 2005 in Moore and Reblin 2010).

In the lower Kennebec River water quality can be negatively affected by both point and non-point pollution sources in the watersheds of the Kennebec and Androscoggin rivers, located north and/or upstream of Merrymeeting Bay. These pollution sources include 8 municipal waste water treatment plants (with 6 containing combined sewer overflows), multiple agricultural farms, and multiple acres of impervious surfaces located in urban and suburban areas of the watersheds. Following rain events, pollution from these sources can be transported into the Kennebec and Androscoggin rivers as either overland runoff, or discharged directly into the river via combined sewer overflows and wastewater treatment plant bypasses. These pollutants (from both rivers) could eventually transported downstream to the lower Kennebec River, and can negatively affect the water quality and its designated uses (such as shellfish harvesting).

The State of Maine classifies all estuarine and marine waters lying within the boundaries of Sagadahoc County (county encompassing the action area), that are not otherwise classified, as Class SB waters.

Per the states regulations (§465-B)(Maine Legislature 2019):

1) Class SB waters. Class SB waters shall be the 2nd highest classification.
    A. Class SB waters must be of such quality that they are suitable for the designated uses of recreation in and on the water, fishing, aquaculture, propagation and harvesting of shellfish, industrial process and cooling water supply, hydroelectric power generation, navigation and as habitat for fish and other estuarine and marine life. The habitat must be characterized as unimpaired.

Based on known water quality parameters of the action area, as well as past sampling, tagging, and tracking of Atlantic sturgeon in the action area, water quality in the action area is adequate to support Atlantic sturgeon annual and interannual adult, subadult, and juvenile survival; and juvenile and subadult growth, development, and recruitment.

4.1.2.3 Effects of the Proposed Action on Critical Habitat

In this analysis, we consider the direct and indirect effects of the action on the critical habitat PBFs we determined to be in the action area (section 4.1.3.1). For each PBF, we identify those activities that may affect the PBF. For each feature that may be affected by the action, we then determine whether any negative effects to the feature are insignificant, discountable, or entirely beneficial and if not, consider the consequences of those adverse effects. In making this determination, we consider the action's potential to affect how each PBF supports Atlantic sturgeon's conservation needs in the action area. Part of this analysis is consideration of the conservation value of the habitat and whether the action will have effects on the ability of Atlantic sturgeon to use the feature, temporarily or permanently, and consideration of the effect of the action on the action area's ability to develop the feature over time.

As described above, the action area extends from rm 8.8 to 13.2 (rkm 14.1 to 21.3) (Figure 3). The Kennebec River critical habitat unit extends from Ticonic Falls/Lockwood Dam (approximately rm 64; rkm 103) downstream to where the main stem river discharges at its mouth into the Atlantic Ocean. As salinities in the action area range from approximately 5-25 ppt, the action area does not support Atlantic sturgeon spawning habitat and early life stages are not expected to be present. Therefore, PBF 1 is not present in the action area, and will not be analyzed below.

PBF 2

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; therefore, we consider effects of the action on soft substrate and salinity and any change in 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. We also consider the effect 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 increased salinity increases with age. PBF 2 occurs throughout the action area, including effects from disposal of dredged material at Bluff Head (rm 8.8; rkm 14.1) to the upstream limit of effects of dredging (rm 13.2; rkm 21.3). Using the best available information, we estimate the area of PBF 2 critical habitat within the action area (including the footprint of the dredge sites and the disposal site, the vessel transit routes, and the areas experiencing increased levels of turbidity from dredging and disposal) to be 1,007 acres. Based on extensive sampling, tagging, tracking, over the past several decades (see Section 5.8.1), we are confident that the action area is heavily utilized by juvenile Atlantic sturgeon from the GOM DPS.

The proposed action has the potential to affect (e.g., remove or bury) the substrate that supports juvenile foraging, and result in temporary reduction in the availability of benthic habitat. However, the portion of this habitat that may be affected by the proposed action would be very small relative to the total amount of aquatic juvenile habitat available for juvenile foraging and physiological development within the action area. Specifically, the estimated area of PBF 2 to be removed or buried (17.9 acres for the cumulative total area of the dredge sites and 5.7 acres for the Bluff Head disposal site) is compared to the 1,007 acres of PBF 2 habitat within the action area. In total, these 23.6 acres of non-contiguous PBF 2 habitat that may be affected equate to 2.3% of the PBF 2 within the action area.

As described in Section 7.4, we expect dredged areas and the disposal site to regain their full conservation function in one to two years. Dredging and disposal in the action area may occur every one to two years (10 events); however, based on our analysis of prior dredging events, we have determined that those events infrequently occur in the same dredge area in consecutive years (Table 1). Bluff Head disposal site is a dynamic areas where we expect dredged material to be transported downstream relatively quickly, potentially lessening the effects of prey item burial. Therefore, we expect juvenile Atlantic sturgeon to have access to fully reestablished forage grounds for at least one year prior to subsequent dredging events.

Dredging 17.9 acres and disposing of dredged material over 5.7 acres will negatively affect PBF 2, and will contribute to the feature's inability to improve in value in the future. The repeated removal of substrates to maintain the channel depth will interrupt the establishment and succession of benthic invertebrates in these areas on which juvenile Atlantic sturgeon would otherwise feed. However, the areas to be dredged combined with the impacted disposal area represent a small (approximately 2.3% of the area potentially supporting PBF 2 in the action area) and non-contiguous amount of the available soft bottom substrate within the action area. As described in the environmental baseline, an additional 45 acres of PBF 2 within the action area will be dredged approximately every two to three years to maintain the Kennebec River FNP (see Section 5.2). Therefore, when added to the baseline, we estimate that 93.2% (938.4 acres) of the unaffected, contiguous habitat in the action area supporting PBF 2 remains available to support juvenile foraging and development. Considering these factors, the effects of dredging this small amount of habitat on juvenile foraging or physiological development will be so small that they cannot be meaningfully measured, evaluated, or detected. Therefore, any effects to the value of PBF 2 to the conservation of the species are insignificant.

<u>PBF 3</u>

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, as if water is too shallow it can be a barrier to sturgeon movements, and an alteration in water flow could similarly impact 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 effect of the action on the action area's ability to develop the feature over time.

By definition, PBF 3 is present throughout the portion of the action area that overlaps with critical habitat (i.e., rm 8.8 to 13.2 (rkm 14.1 to 21.3)). Areas subject to dredging and disposal will experience localized and temporary effects (i.e., turbidity plumes, presence of vessels) that do not extend across the entire width of the river at any time. These activities overlap with juvenile, subadult, and adult Atlantic sturgeon life stages where PBF 3 occurs in the action area. However, Atlantic sturgeon (less those injured or killed by capture in the dredges) will still have room to maneuver within the river while avoiding adverse effects from potential barrier-causing stressors related to project activities. Proposed activities will not prevent adults from migrating to and from spawning sites, nor will they prevent juvenile sturgeon from reaching appropriate salinity zones necessary for foraging and development.

In sum, the proposed action may have temporary negative effects on PBF 3 by creating in water stressors from dredging and disposal activities; however, none of the effects of proposed activities serve as long-term barriers to the movement of juvenile, subadult, or adult Atlantic sturgeon. Based on our assessment, these impediments to movement are extremely unlikely to affect the value of PBF 3 to the conservation of the species in the action area; that is, it is extremely unlikely that the habitat alterations that will affect the movement of Atlantic sturgeon in the action area will impede the movement of adults to and from spawning sites or the seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary or impede the staging, resting, or holding of subadults or spawning condition adults; therefore, the effects are discountable.

PBF 4

In considering effects to PBF 4, we consider whether the proposed action will have any effect on water quality, 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; annual and interannual adult, subadult, larval, and juvenile survival; and larval, juvenile, and subadult growth, development, and recruitment. Therefore, we 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 dissolved oxygen saturation for a particular area. We also consider whether the action will have effects to 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.

By definition, PBF 4 is present throughout the action area (rm 8.8 to 13.2 (rkm 14.1 to 21.3)); however, based on an exceedance of salinity tolerance, we do not expect spawning or the development of early life stages to occur the action area.

Proposed dredging and disposal can affect DO through increases in suspended sediments and turbidity. Increases in turbidity decrease levels of light and impact temperature. Additionally, dredging can potentially affect DO levels. Depending on the scale of the dredging effort, effects can be either short-term or long-term, and involve physical changes to river morphology and hydrology because of alterations to water depth and circulation (Kaur et al. 2007; May 1973). Increased water depth can result in decreased water temperatures (i.e., deeper water receives less light, keeping them cooler), thereby increasing the capacity for DO saturation, particularly during summer months when aquatic animals require more oxygen to support higher metabolisms and DO levels are generally at the lowest. Conversely, these changes can also decrease DO concentrations when a deeper depth results in slowing of river velocities and reduced vertical mixing, leading to thermal stratification and potential changes of flow that introduce oxygen rich waters into the system (Kaur et al. 2007; May 1973). However, long-term changes are not anticipated from the proposed action, as the river naturally fluctuates in depth, with some areas significantly deeper than the proposed dredge depths. In some years, spring runoff events flush enough sediment out of the action area to diminish the need for dredging in that season (depending on the timing of ship movements).

Short-term changes in DO that may occur during dredging are also a function of the amount of resuspended sediment in the water column, the oxygen demand of the sediment, and the duration of resuspension (Pithakpol 2007; LaSalle et al. 1991). Studies have indicated wide variations in DO levels associated with dredging from minimal (Lunz et al. 1988), or no measurable reduction, to large reductions in DO levels. Some literature suggests that the effects are negligible (Herbich 2000; Lewis et al. 2001; Ohimain et al. 2008; Pithakpol 2007). We expect that any elevated suspended solids concentrations, and subsequent impacts on DO levels, from the Proposed Action would be confined to the immediate proximity of the dredge or disposal area and dissipate rapidly at the completion of the operation.

As noted above, temperatures required to support juvenile rearing habitat must not exceed 30 °C. We do not expect temporary increases in turbidity or minor increases in the river depth to have a measurable effect on temperature once the work is complete. Increases in turbidity will return to background levels within a couple of hours once dredging ceases and dredging depths are largely within the natural variation of depths within the action area. Therefore, the work will not affect how juvenile, subadult, or adult Atlantic sturgeon use those respective portions of the action area for migration, rearing, or development.

Changes in salinity can affect the distribution and habitat use of Atlantic sturgeon; however, temporary effects from the proposed dredging and disposal activities will not alter the river-wide hydrodynamics (e.g., saltwater intrusion, freshwater runoff, stratification of salinity and temperature in the water column) at a large enough scale to create measureable changes to salinity levels in the action area. Rising sea levels resulting from climate change may have significant effects on salinity (see section 6.0).

The proposed action will not cause any permanent effects to temperature, salinity, and oxygen values in the action area. Dredging will only occur over a short period each year (~20-30 days) in a small portion of the action area, all of which supports PBF 4. Therefore, the effects of the action on the value of PBF 4 to the conservation of the species (i.e., the current and future development of this feature to provide the temperature, salinity, and oxygen values that, combined, support: annual and interannual adult, subadult, and juvenile survival; and juvenile, and subadult growth, development, and recruitment) to be too small to be meaningfully measured or detected, and are therefore, insignificant.

4.1.2.4 Summary of Effects of Proposed Activities on Atlantic sturgeon Critical Habitat

We have determined that effects of the proposed action on PBF 2 and 4 will be so small that they are not able to be meaningfully measured, detected or evaluated and are therefore insignificant. We have determined that effects to PBF 3 are extremely unlikely to occur and are therefore, discountable.

4.2 Species Likely to be Adversely Affected by the Action

4.2.1 Shortnose Sturgeon

Shortnose sturgeon are fish that occur in rivers and estuaries along the East Coast of the U.S. and Canada (SSSRT 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 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's Biological Assessment (2010). Information on the population that occurs in the action area is provided in section 5.7 (Environmental Baseline).

4.2.1.1 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 5.

Table 5: Shortnose sturgeon general life history for the species throughout its range

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 Larvae	15 - 57	12-40 days post hatch	Free swimming; feeding; Silt bottom, 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 saltwedge
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	450-1100 average; (max recorded 1400)	Post-maturation	Freshwater to estuary with some individuals making nearshore coastal migrations

Shortnose sturgeon live on average for 30-40 years (Dadswell *et al.* 1984). Males mature at approximately 5-10 years and females mature between age 7 and 13, with later maturation occurring in more northern populations (Dadswell *et al.* 1984). Females typically spawn for the first time 5 years post-maturation (age 12-18) and then spawn every 3-5 years (Dadswell 1979, Dadswell *et al.* 1984). Males spawn for the first time approximately 1-2 years after maturity with spawning typically occurring every 1-2 years (Dadswell *et al.* 1984, Kieffer and Kynard 1996);(NMFS 1998). 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.* 2012). Shortnose sturgeon spawn in freshwater reaches of their natal rivers when water temperatures reach 9–15°C in the spring (Dadswell 1979, Kynard 1997, Taubert 1980a, Taubert 1980b). Spawning occurs over gravel, rubble, and/or cobble substrate (Buckley and Kynard 1985b, Dadswell 1979, Kynard 1997, Taubert 1980a, Taubert 1980b) 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 (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 1979, Dadswell *et al.* 1984). Salinity tolerance increases with age; while young of the year must remain in freshwater, adults have been documented in the ocean with salinities of up to 30 parts-per-thousand (ppt)(Holland and Yelverton 1973). Dissolved oxygen affects distribution, with preference for DO levels at or above 5mg/L and adverse effects anticipated for prolonged exposure to DO less than 3.2 mg/L.

Shortnose sturgeon feed on benthic insects, crustaceans, mollusks, and polychaetes (Dadswell *et al.* 1984). Both juvenile and adult shortnose sturgeon primarily forage over sandy-mud bottoms, which support benthic invertebrates (Carlson and Simpson 1987, Kynard 1997). 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 (Buckley and Kynard 1985a, b, Dadswell *et al.* 1984, O'Herron *et al.* 1993).

In northern rivers, shortnose aggregate during the winter months in discrete, deep (3-10m) freshwater areas with minimal movement and foraging (Kynard *et al.* 2012; Buckley and Kynard 1985a; Dadswell 1979, Li *et al.* 2007; Dovel *et al.* 1992; Bain *et al.* 1998a and b). 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 (Rogers and Weber 1995). Older juveniles typically occur in the same overwintering areas as adults while young of the year remain in freshwater (Jenkins *et al.* 1993, Jarvis *et al.* 2001).

4.2.1.2 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 (see Catesby 1734; McDonald 1887; Smith and Clugston 1997). 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.

4.2.1.3 Current Status

There is no current total population estimate for shortnose sturgeon rangewide. 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 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 1996).

Population Structure

There are 19 documented populations of shortnose sturgeon ranging from the St. Johns River, Florida (possibly extirpated from this system) to the Minas Basin in Nova Scotia, 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. Currently, there are significantly more shortnose sturgeon in the northern portion of the range.

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; Grunwald *et al.* 2002; King *et al.* 2001; Waldman *et al.* 2002b; Walsh *et al.* 2001; Wirgin *et al.* 2009; Wirgin *et al.* 2002; SSSRT 2010). 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 metapopulations.[4] 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

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[4] 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.

populations (see Walsh *et al.* 2001; Grunwald *et al.* 2002; Waldman *et al.* 2002; Wirgin *et al.* 2005). 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 our Greater Atlantic Region, shortnose sturgeon are known to spawn in the Kennebec, Androscoggin, Merrimack, Connecticut, Hudson and Delaware Rivers. Shortnose sturgeon are also known to 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 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. Robust design analysis with closed periods in the summer and late fall 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% CI = 5,000 - 10,800; Squiers *et al.* 1982). A population study conducted 1998-2000 estimated population size at 9,488 (95% CI = 6,942 -13,358; 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.

Merrimack River

The historic range in the Merrimack extended to Amoskeag Falls (Manchester, NH, rm 72; rkm 116; Piotrowski 2002); currently shortnose sturgeon cannot move past the Essex Dam in Lawrence, MA (rm 29; 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. To date, genetic analysis has not been completed and we do not yet know the river of origin of this fish.

<u>Connecticut River Population</u>
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, Wirgin *et al.* 2005, Kynard *et al.* 2012). 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, unpublished data in SSSRT 2010); this compares to a previous Peterson mark-recapture estimate of 370–714 adults (Taubert 1980a). Using four mark-recapture methodologies, the longterm 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%. 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; however, in 2017, a shortnose sturgeon was confirmed above the Turners Falls Dam, and future research will investigate whether there is a larger population in that location. 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.* 2012). 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).

<u>Hudson River Population</u>
The Hudson River population of shortnose sturgeon is the largest in the United States. Studies indicated an extensive increase in abundance from the late 1970s (13,844 adults (Dovel *et al.* 1992), to the late 1990s (56,708 adults (95% 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 examined environmental conditions throughout this 20-year period and determined that years when water temperatures drop quickly 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 (rm 139; 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 (Hastings *et al.* 1987 and ERC 2006b). 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 (Spells 1998; Litwiler 2001; Kynard et al. 2007, 2009; SSSRT 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 are no shortnose sturgeon between the 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 thought to be 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% 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 is thought to result 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 Pinoplis 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%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% CI = 104-249). While the more recent estimate is lower, it is not significantly different than 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. They are thought to be 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.

4.2.1.4 Threats

Because sturgeon are long-lived and slow growing, their stock productivity is relatively low, making 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 also 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; Wirgin *et al.* 2000) 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 reductions in the number of adult spawners (Anders *et al.* 2002; 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 YOY and juveniles as compared to adults (Gross *et al.* 2002); that is, increasing the number of YOY 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 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. Climate change, particularly shifts in seasonal temperature regimes and changes in the location of the salt wedge, may impact shortnose sturgeon in the future (more information on Climate Change is presented in section 6.0). More information on threats experienced in the action area is presented in the Environmental Baseline section of this Opinion.

4.2.1.5 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.

4.2.1.6 Summary of Status

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

4.2.2 Atlantic sturgeon

The section below describes the Atlantic sturgeon listing, provides life history information that is relevant to all DPSs of Atlantic sturgeon and then provides information specific to the status of each DPS of Atlantic sturgeon we expect to be present in the action area. Below, we also provide information on the use of the action area by Atlantic sturgeon (see Environmental Baseline).

Species description

Atlantic sturgeon occupy ocean waters and associated bays, estuaries, and coastal river systems from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (Stein *et al.* 2004) (Figure 4). Atlantic sturgeon are listed as five DPSs under the ESA.

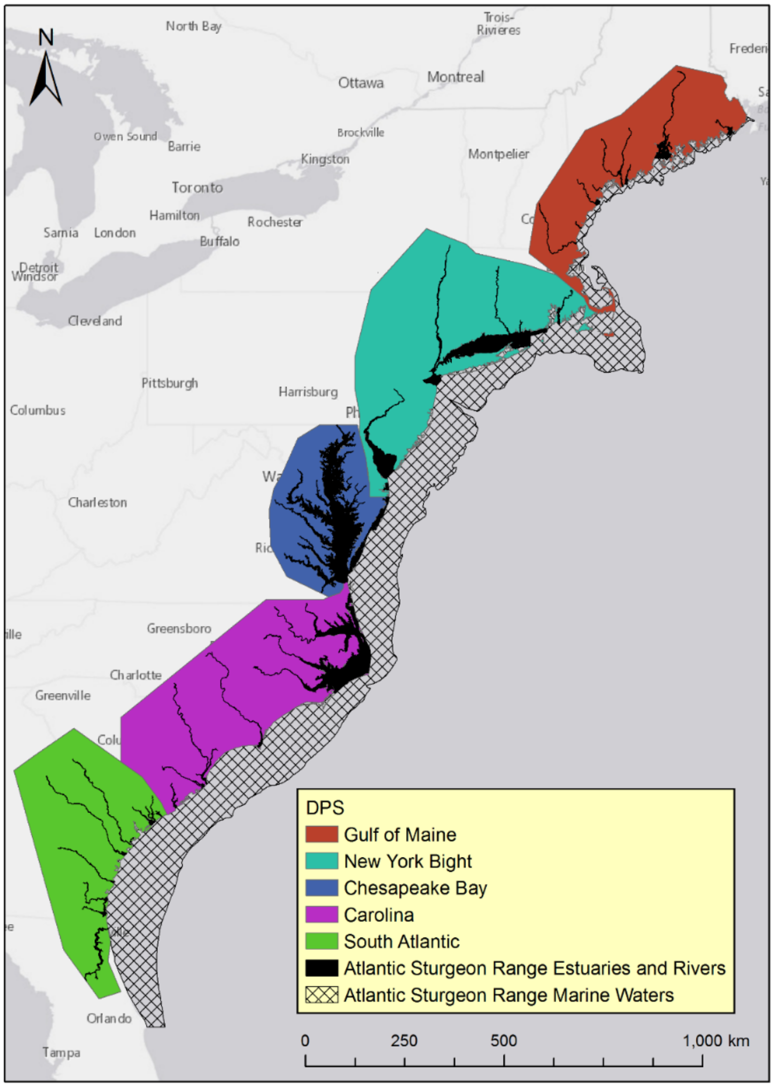

Figure 4. Map Depicting the 5 Atlantic Sturgeon DPSs

The Atlantic sturgeon is a long-lived, late maturing, anadromous species. Atlantic sturgeon attain lengths of up to approximately 14 ft, and weights of more than 800 pounds (Figure 10). They are bluish black or olive brown dorsally with paler sides and a white ventral surface and have five major rows of dermal scutes (Colette and Klein-MacPhee 2002). Five DPSs were listed under the ESA on February 6, 2012. The Gulf of Maine DPS was listed as threatened, and the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered (Table 6).

Table 6. Information on Atlantic sturgeon review, listing, recovery plans, and critical habitat

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	Gulf of Maine (GOM)	Threatened	2007	77 FR 5880	No	82 FR 39160

Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	New York Bight (NYB)	Endangered	2007	77 FR 5880	No	82 FR 39160
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	Chesapeake Bay (CB)	Endangered	2007	77 FR 5880	No	82 FR 39160
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	Carolina	Endangered	2007	77 FR 5914	No	82 FR 39160
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	South Atlantic (SA)	Endangered	2007	77 FR 5914	No	82 FR 39160

Life history

Atlantic sturgeon size at sexual maturity varies with latitude with individuals reaching maturity in the Saint Lawrence River at 22 to 34 years (Scott and Crossman 1973). Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Spawning adults generally migrate upriver in May through July in Canadian systems (Bain 1997, Caron *et al.* 2002, Murawski and Pacheco 1977, Smith 1985, Smith and Clugston 1997). Atlantic sturgeon spawning is believed to occur in flowing water between the salt front and fall line of large rivers at depths of three to 27 m (Bain *et al.* 2000, Borodin 1925, Crance 1987, Leland 1968, Scott and Crossman 1973). Atlantic sturgeon likely do not spawn every year; spawning intervals range from one to five years for males (Caron *et al.* 2002, Collins *et al.* 2000, Smith 1985) and two to five years for females (Stevenson and Secor 2000, Van Eenennaam *et al.* 1996, Vladykov and Greeley 1963).

Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (Gilbert 1989, Smith and Clugston 1997) between the salt front and fall line of large rivers (Bain *et al.* 2000, Borodin 1925, Crance 1987, Scott and Crossman 1973). Following spawning in northern rivers, males may remain in the river or lower estuary until the fall; females typically exit the rivers within four to six weeks (Savoy and Pacileo 2003). Hatching occurs approximately 94 to 140 hours after egg deposition at temperatures of 20 and 18 degrees Celsius, respectively (Smith *et al.* 1980). The yolk sac larval stage is completed in about eight to 12 days, during which time larvae move downstream to rearing grounds over a six to 12 day period (Kynard and Horgan 2002). Juvenile sturgeon continue to move further downstream into waters ranging from zero to up to ten parts per thousand salinity. Older juveniles are more tolerant of higher salinities as juveniles typically spend two to five years in freshwater before eventually becoming coastal residents as sub-adults (Boreman 1997, Schueller and Peterson 2010, Smith 1985).

Upon reaching the subadult phase, individuals may move to coastal and estuarine habitats (Dovel and Berggren 1983, Murawski and Pacheco 1977, Smith 1985, Stevenson 1997). Tagging and genetic data indicate that subadult and adult Atlantic sturgeon may travel widely once they emigrate from rivers. Despite extensive mixing in coastal waters, Atlantic sturgeon exhibit high fidelity to their natal rivers (Grunwald *et al.* 2008, King *et al.* 2001, Waldman *et al.* 2002).

Because of high natal river fidelity, it appears that most rivers support independent populations (Waldman and Wirgin 1998; Wirgin *et al.* 2000, 2002; King *et al.* 2001; Grunwald *et al.* 2008). Atlantic sturgeon feed primarily on polychaetes, isopods, American sand lances and amphipods in the marine environment, while in fresh water they feed on oligochaetes, gammarids, mollusks, insects, and chironomids (Guilbard *et al.* 2007a, Johnson *et al.* 1997, Moser and Ross 1995, Novak *et al.* 2017, Savoy 2007a).

Population dynamics

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

Abundance

Historically, the Gulf of Maine DPS likely supported more than 10,000 spawning adults. The current abundance is estimated to be one to two orders of magnitude smaller than historical levels (Secor *et al.* 2002; ASSRT 2007).

The New York Bight, ranging from the Delmarva Peninsula to Cape Cod, historically supported four or more spawning populations. Currently, this DPS only supports two spawning populations, the Delaware and Hudson River, although new information demonstrates that the Connecticut River may support spawning as well. Numbers of Atlantic sturgeon in the New York Bight DPS are extremely low compared to historical levels and have remained so for the past 100 years. The spawning populations of this DPS are thought to be one to two orders of magnitude below historical levels.

Historically the Delaware River is believed to have supported around 180,000 individuals (Secor 2002). In 2007, NMFS status review estimated that the population had declined to fewer than 300 individuals. In 2014, Hale *et al.* (2016) estimated that 3,656 (95% CI = 1,935-33,041) early juveniles (age zero to one) utilized the Delaware River estuary as a nursery. Based on commercial fishery landings from the mid-1980s to the mid-1990s, the total abundance of adult Hudson River Atlantic sturgeon was estimated to be 870 individuals (Kahnle 2007). Based on the juvenile assessments from (Peterson 2000), the Hudson River suffered a series of recruitment failures, which triggered the ASMFC fishing moratorium in 1998 to allow the populations to recover.

There are no current abundance estimates for the Chesapeake Bay DPS. Historically, Atlantic sturgeon were common throughout the Chesapeake Bay and its tributaries (Bushnoe 2005, Kahnle 1998). At the time of listing, the James River was the only known spawning river for the Chesapeake Bay DPS (ASSRT 2007; Balazik *et al.* 2012). Since the listing, spawning has been confirmed to occur in the Pamunkey River, a tributary of the York River (Hager *et al.* 2014, Kahn *et al.* 2014) and is suspected to be occurring in Marshyhope Creek, a tributary of the Nanticoke River. The historical and contemporary accounts of Atlantic sturgeon in the York, Rappahannock, Susquehanna, and Potomac Rivers (ASSRT 2007a), as well as the presence of the features necessary to support reproduction and recruitment in this river indicate that there is the potential for spawning to occur.

The Carolina DPS spawning populations are estimated to be at less than 3% of their historic levels. Prior to 1890, there were estimated to be 7,000 to 10,500 adult female Atlantic sturgeon in North Carolina and approximately 8,000 adult females in South Carolina. Currently, the existing spawning populations in each of the rivers in the Carolina DPS are thought to have less than 300 adults spawning each year.

The South Atlantic DPS historically supported eight spawning populations ranging from the St. Johns River, Florida to the Ashepoo, Combahee, and Edisto Rivers Basin in South Carolina. Currently, this DPS supports five extant spawning populations. Of these populations, the Altamaha is believed to support the largest number of spawning adults. The current abundance of the Altamaha population is suspected to be less than 6% of historical abundance, extrapolated from the 1890s commercial landings (Secor 2002). Few captures have been documented in other populations within this DPS and are suspected to be less than 1% of their historic abundance (less than 300 spawning adults).

Stock Assessments

The ASMFC released a new benchmark stock assessment for Atlantic sturgeon in October 2017 (ASMFC 2017). The assessment used both fishery-dependent and fishery-independent data, as well as biological and life history information. Fishery-dependent data came from commercial fisheries that formerly targeted Atlantic sturgeon (before the moratorium), as well as fisheries that catch sturgeon incidentally. Fishery-independent data were collected from scientific research and survey programs.

At the coastwide and DPS levels, the stock assessment concluded that Atlantic sturgeon are depleted relative to historical levels. The low abundance of Atlantic sturgeon is not due solely to effects of historic commercial fishing, so the ‘depleted’ status was used instead of ‘overfished.’ This status reflects the array of variables preventing Atlantic sturgeon recovery (e.g., bycatch, habitat loss, and ship strikes).

As described in the Assessment Overview, Table 7 shows “the stock status determination for the coastwide stock and DPSs based on mortality estimates and biomass/abundance status relative to historic levels, and the terminal year (i.e., the last year of available data) of indices relative to the start of the moratorium as determined by the ARIMA[5] analysis.”

[5] “The ARIMA (Auto-Regressive Integrated Moving Average) model uses fishery-independent indices of abundance to estimate how likely an index value is above or below a reference value” (ASMFC 2017a).

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

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

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

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

Distribution

The Gulf of Maine DPS includes 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, Massachusetts (Figure 5). The geomorphology of most small coastal rivers in Maine is not sufficient to support Atlantic sturgeon spawning populations, except for the Penobscot and the estuarial complex of the Kennebec, Androscoggin, and Sheepscot rivers. Spawning still occurs in the Kennebec and Androscoggin Rivers, and may occur in the Penobscot River. Atlantic sturgeon have more recently been observed in the Saco, Presumpscot, and Charles rivers.

The natal river systems of the New York Bight DPS span from the Connecticut River south to the Delaware River (Figure 4). The Connecticut River has long been known as a seasonal aggregation area for subadult Atlantic sturgeon, and both historical and contemporary records document presence of Atlantic sturgeon in the river as far upstream as Hadley, Massachusetts (Pacileo 2003, Savoy 1992). The upstream limit for Atlantic sturgeon on the Hudson River is the Federal Dam at the fall line, approximately rm 153 (rkm 246) (Dovel 1983, Kahnle 1998). In the Delaware River, there is evidence of Atlantic sturgeon presence from the mouth of the Delaware

Bay to the head-of-tide at the fall line near Trenton on the New Jersey side and Morrisville on the Pennsylvania side of the River, a distance of 137 mi (220 rkm) (Breece *et al.* 2013).

The natal river systems of the Chesapeake Bay DPS span from the Susquehanna River south to the James River (Figure 5).

The natal river systems of the Carolina DPS span from the Roanoke River, North Carolina south to the Santee-Cooper system in South Carolina (Figure 5). The Carolina DPS ranges from the Santee-Cooper River to the Albemarle Sound and consists of seven extant populations; one population (the Sampit River) is believed to be extirpated.

The natal river systems of the South Atlantic DPS span from Edisto south to the St. Mary's River (Figure 5). Seventy-six Atlantic sturgeon were tagged in the Edisto River during a 2011 to 2014 telemetry study (Post *et al.* 2014). Fish entered the river between April and June and were detected in the saltwater tidal zone until water temperature decreased below 25 degrees Celcius. They then moved into the freshwater tidal area, and some fish made presumed spawning migrations in the fall around September to October. Atlantic sturgeon in the Savannah River were documented displaying similar behavior three years in a row—migrating upstream during the fall and then being absent from the system during spring and summer. Forty three Atlantic sturgeon larvae were collected in upstream locations (rm 70-176; rkm 113-283) near presumed spawning locations (Collins 1997).

Status

Atlantic sturgeon were once present in 38 river systems and, of these, spawned in 35 of them. Individuals are currently present in 36 rivers, and spawning occurs in at least 20 of these (ASSRT 2007a). The decline in abundance of Atlantic sturgeon has been attributed primarily to the large U.S. commercial fishery which existed for the Atlantic sturgeon from the 1870s through the mid 1990s. The fishery collapsed in 1901 and landings remained at between 1%-5% of the pre-collapse peak until ASMFC placed a two generation moratorium on the fishery in 1998 (ASMFC 1998a, 1998b). The majority of the populations show no signs of recovery, and new information suggests that stressors such as bycatch, ship strikes, and low DO can and do have substantial impacts on populations (ASSRT 2007). Additional threats to Atlantic sturgeon include habitat degradation from dredging, damming, and poor water quality (ASSRT 2007). Climate change related impacts on water quality (e.g., temperature, salinity, dissolved oxygen, contaminants) have the potential to impact Atlantic sturgeon populations using impacted river systems. These effects are expected to be more severe for southern portions of the U.S. range of Atlantic sturgeon (Carolina and South Atlantic DPSs). None of the spawning populations are currently large or stable enough to provide any level of certainty for continued existence of any of the DPSs.

Recovery Goals

Recovery Plans have not yet been drafted for any of the Atlantic sturgeon DPSs.

4.2.2.1 Determination of DPS Composition in the Action Area

As explained above, the range of all five DPSs overlaps and extends from Canada through Cape Canaveral, Florida. The distribution of Atlantic sturgeon is influenced by geography, with

Atlantic sturgeon from a particular DPS becoming less common the further from the river of origin one moves. Areas that are geographically close are expected to have a similar composition of individuals. We have considered the best available information to determine from which DPSs individuals in the action area are likely to have originated.

There is currently no mixed stock analysis for the Androscoggin River or Kennebec Rivers. Mixed stock analysis is available for the Bay of Fundy. Given the geographic proximity of the Bay of Fundy to the action area, it is reasonable to anticipate similar distribution in these two areas (93% Gulf of Maine DPS (60% St. John, 40% Kennebec) and 7% New York Bight DPS). However, in the action area we would expect a higher frequency of Androscoggin and Kennebec River origin individuals than St. John River individuals. As such, in the Kennebec River System (including the Androscoggin River) we expect Atlantic sturgeon to occur at the following frequencies: Gulf of Maine 93% (60-100% Androscoggin and Kennebec and up to 40% St. John (Canada)) and 7% New York Bight. These occurrences are supported by preliminary genetic analyses of fish caught in the Gulf of Maine (see Damon-Randall *et al*. 2013). The genetic assignments have a plus/minus 5% confidence interval; however, for purposes of section 7 consultation we have selected the reported values above, which approximate the mid-point of the range, as a reasonable indication of the likely genetic makeup of Atlantic sturgeon in the action area. These assignments and the data from which they are derived are described in detail by Damon-Randall *et al.* (2013).

4.2.2.2 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, Atlantic sturgeon historically spawned in at least the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT 2007). Spawning habitat is available and accessible in the Penobscot, Androscoggin, Kennebec, Merrimack, and Piscataqua (inclusive of the Cocheco and Salmon Falls rivers) rivers. Spawning has been documented in the Kennebec River. In the Androscoggin River, captures of adult Atlantic sturgeon, including a ripe male, over suitable spawning grounds during the spawning season confirm likely spawning; however Atlantic sturgeon eggs and larvae have not yet been recovered in the Androscoggin (Wippelhauser pers. comm. 2018). Despite the availability of suitable habitat and the presence of Atlantic sturgeon in the remaining rivers, there is currently no evidence spawning activity in these rivers.

Studies are on-going to determine whether Atlantic sturgeon are spawning in these rivers. Atlantic sturgeons that are spawned elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT 2007). The movement of subadult and adult sturgeon between rivers, including to and from the Kennebec River and the Penobscot River, demonstrates that coastal and marine migrations are key elements of Atlantic sturgeon life history for the Gulf of Maine DPS as well as likely throughout the entire range (ASSRT 2007; Fernandes *et al.* 2010).

Bigelow and Schroeder (1953) surmised that Atlantic sturgeon likely spawned in Gulf of Maine

Rivers in May-July. More recent captures of Atlantic sturgeon in spawning condition within the Kennebec River suggest that spawning more likely occurs in June-July (Squiers *et al.* 1981; ASMFC 1998; NMFS and USFWS 1998). Evidence for the timing and location of Atlantic sturgeon spawning in the Kennebec River includes: (1) the capture of five adult male Atlantic sturgeon in spawning condition (i.e., expressing milt) in July 1994 below the (former) Edwards Dam; (2) capture of 31 adult Atlantic sturgeon from June 15, 1980, through July 26, 1980, in a small commercial fishery directed at Atlantic sturgeon from the South Gardiner area (above Merrymeeting Bay) that included at least 4 ripe males and 1 ripe female captured on July 26,1980; and, (3) capture of nine adults during a gillnet survey conducted from 1977-1981, the majority of which were captured in July in the area from Merrymeeting Bay and upriver as far as Gardiner, ME (NMFS and USFWS 1998; ASMFC 2007). The low salinity values for waters above Merrymeeting Bay are consistent with values found in other rivers where successful Atlantic sturgeon spawning is known to occur.

Several threats play a role in shaping the current status of Gulf of Maine DPS Atlantic sturgeon. Historical records provide evidence of commercial fisheries for Atlantic sturgeon in the Kennebec and Androscoggin Rivers dating back to the 17th century (Squiers *et al.* 1979). In 1849, 160 tons of sturgeon was caught in the Kennebec River by local fishermen (Squiers *et al.* 1979). Following the 1880s, the sturgeon fishery was almost non-existent due to a collapse of the sturgeon stocks. All directed Atlantic sturgeon fishing as well as retention of Atlantic sturgeon by-catch has been prohibited since 1998. Nevertheless, mortalities associated with bycatch in fisheries occurring in state and federal waters still occurs. In the marine range, Gulf of Maine DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.* 2004; ASMFC 2007). 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.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Many rivers in the Gulf of Maine DPS have navigation channels that are maintained by dredging. Dredging outside of Federal channels and in-water construction occurs throughout the Gulf of Maine DPS. While some dredging projects operate with observers present to document fish mortalities, many do not. To date we have not received any reports of Atlantic sturgeon killed during dredging projects in the Gulf of Maine region; however, as noted above, not all projects are monitored for interactions with fish. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects. We are also not able to quantify any effects to habitat.

Connectivity is disrupted by the presence of dams on several rivers in the Gulf of Maine region, including the Penobscot and Merrimack Rivers. While there are also dams on the Kennebec, Androscoggin and Saco Rivers, these dams are near the site of natural falls and likely represent the maximum upstream extent of sturgeon occurrence even if the dams were not present. Because no Atlantic sturgeon are known to occur upstream of any hydroelectric projects in the

Gulf of Maine region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. While not expected to be killed or injured during passage at a dam, the extent that Atlantic sturgeon are affected by the existence of dams and their operations in the Gulf of Maine region is currently unknown. The tracking of spawning condition Atlantic sturgeon downstream of the Brunswick Dam in the Androscoggin River suggests however, that Atlantic sturgeon spawning may be occurring in the vicinity of at least that project and therefore, may be affected by project operations. Until it was breached in July 2013, the range of Atlantic sturgeon in the Penobscot River was limited by the presence of the Veazie Dam. Since the removal of the Veazie Dam and the Great Works Dam, sturgeon can now travel as far upstream as the Milford Dam. While Atlantic sturgeon are known to occur in the Penobscot River, there is no evidence of spawning currently occurring. The Essex Dam on the Merrimack River blocks access to approximately 58% of historically accessible habitat in this river. Atlantic sturgeon occur in the Merrimack River but spawning has not been documented. Like the Penobscot, it is unknown how the Essex Dam affects the likelihood of spawning occurring in this river.

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

There are no empirical abundance estimates for the Gulf of Maine DPS. The Atlantic sturgeon SRT (2007) presumed that the Gulf of Maine DPS was comprised of less than 300 spawning adults per year, based on abundance estimates for the Hudson and Altamaha River riverine populations of Atlantic sturgeon. Surveys of the Kennebec River over two time periods, 1977-1981 and 1998-2000, resulted in the capture of nine adult Atlantic sturgeon (Squiers 2004). However, since the surveys were primarily directed at capture of shortnose sturgeon, the capture gear used may not have been selective for the larger-sized, adult Atlantic sturgeon; several hundred subadult Atlantic sturgeon were caught in the Kennebec River during these studies.

<u>Summary of the Gulf of Maine DPS</u>

Spawning for the Gulf of Maine DPS is known to occur in two rivers (Kennebec and Androscoggin). Spawning may be occurring in other rivers, such as the Penobscot, but has not been confirmed. There are indications of increasing abundance of Atlantic sturgeon belonging to the Gulf of Maine DPS. Atlantic sturgeon continue to be present in the Kennebec River; in addition, they are captured in directed research projects in the Penobscot River, and are observed in rivers where they were unknown to occur or had not been observed to occur for many years (e.g., the Saco, Presumpscot, and Charles rivers). These observations suggest that abundance of the Gulf of Maine DPS of Atlantic sturgeon is sufficient such that recolonization to rivers historically suitable for spawning may be occurring. However, despite some positive signs, there is not enough information to establish a trend for this DPS.

Some of the impacts from the threats that contributed to the decline of the Gulf of Maine DPS have been removed (e.g., directed fishing), or reduced as a result of improvements in water quality and removal of dams (e.g., the Edwards Dam on the Kennebec River in 1999). There are strict regulations on the use of fishing gear in Maine state waters that incidentally catch sturgeon. In addition, there have been reductions in fishing effort in state and federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear (ASMFC 2007). Atlantic sturgeon from the 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.* in draft).

As noted previously, studies have shown that in order to rebuild, Atlantic sturgeon can only sustain low levels of bycatch and other anthropogenic mortality (Boreman 1997; ASMFC 2007; Kahnle *et al.* 2007; Brown and Murphy 2010). We have determined that the Gulf of Maine DPS is at risk of becoming endangered in the foreseeable future throughout all of its range (i.e., is a threatened species) based on the following: (1) significant declines in population sizes and the protracted period during which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect recovery.

4.2.2.3 New York Bight DPS of Atlantic sturgeon

The New York Bight DPS includes the following: all anadromous Atlantic sturgeon spawned in the watersheds that drain into coastal waters from Chatham, MA to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (Murawski and Pacheco 1977; Secor 2002; ASSRT 2007). Spawning still occurs in the Delaware and Hudson Rivers, but there is no recent evidence (within the last 15 years) of spawning in the Taunton River (ASSRT 2007). However, there is recent evidence that spawning may be occurring in the Connecticut River. 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).

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). 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. Given the significant annual fluctuation, it is difficult to discern any trend. Despite the CPUEs from 2000-2007 being generally higher than those from 1990-1999, they are low compared to the late 1980s. Standardized mean catch per net set from the NYSDEC juvenile Atlantic sturgeon survey have had a general increasing trend from 2006 – 2015, with the exception of a dip in 2013.

In addition to capture in fisheries operating in Federal waters, bycatch and mortality also occur in state fisheries; however, the primary fishery that impacted juvenile sturgeon (shad) in the Hudson River, has now been closed and there is no indication that it will reopen soon. In the Hudson River, sources of potential mortality include vessel strikes and entrainment in dredges. Individuals are also exposed to effects of bridge construction (including the replacement of the Tappan Zee Bridge). Impingement at water intakes, including the Danskammer, Roseton and Indian Point power plants also occurs. Recent information from surveys of juveniles (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 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- the year (YOY) Atlantic sturgeon in the Delaware River (i.e., natal sturgeon) resulted in the capture of 34 YOY, ranging in size from 178 to 349 mm TL (Fisher 2009) and the collection of 32 YOY 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 YOY indicates that at least 3 females successfully contributed to the 2009 year class (Fisher 2011). Therefore, while the capture of YOY 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.

Several threats play a role in shaping the current status and trends observed in the Delaware River and Estuary. In-river threats include habitat disturbance from dredging, and impacts from historical pollution and impaired water quality. A dredged navigation channel extends from Trenton seaward through the tidal river (Brundage and O'Herron 2009), and the river receives significant shipping traffic. Vessel strikes have been identified as a threat in the Delaware River; however, at this time we do not have information to quantify this threat or its impact to the population or the New York Bight DPS. Similar to the Hudson River, there is currently not enough information to determine a trend for the Delaware River population.

Summary of the New York Bight DPS

Atlantic sturgeon originating from the New York Bight DPS spawn in the Hudson and Delaware rivers. While genetic testing can differentiate between individuals originating from the Hudson or Delaware river the available information suggests that the straying rate is high between these rivers. There are no indications of increasing abundance for the New York Bight DPS (ASMFC 2009; 2010). Some of the impact from the threats that contributed to the decline of the New York Bight DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the 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, and vessel strikes 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). As explained above, currently available estimates indicate that at least 4% of adults may be killed as a result of bycatch in fisheries authorized under Northeast FMPs. Based on mixed stock analysis results presented by Wirgin and King (2011), over 40 percent of the Atlantic sturgeon bycatch interactions in the Mid Atlantic Bight region were sturgeon from the New York Bight DPS. Individual-based assignment and mixed stock analysis of samples collected from sturgeon captured in Canadian fisheries in the Bay of Fundy indicated that approximately 1-2% were from the New York Bight DPS. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats.

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

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

New York Bight DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Hudson and Delaware over the past decades (Lichter *et al.* 2006; EPA 2008). Both the Hudson and Delaware rivers, as well as other rivers in the New York Bight region, were heavily polluted in the past from industrial and sanitary sewer discharges. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds as developing eggs and larvae are particularly susceptible to exposure to contaminants.

Vessel strikes occur in the Delaware River. Twenty-nine mortalities believed to be the result of vessel strikes were documented in the Delaware River from 2004 to 2008, and at least 13 of these fish were large adults. Additionally, 138 sturgeon carcasses were observed on the Hudson River and reported to the NYSDEC between 2007 and 2015. Of these, 69 are suspected of having been killed by vessel strike. Genetic analysis has not been completed on any of these individuals to date, given that the majority of Atlantic sturgeon in the Hudson River belong to the New York Bight DPS, we assume that the majority of the dead sturgeon reported to NYSDEC belonged to the New York Bight DPS. Given the time of year in which the fish were observed (predominantly May through July), it is likely that many of the adults were migrating through the river to the spawning grounds.

Studies have shown that to rebuild, Atlantic sturgeon can only sustain low levels of anthropogenic mortality (Boreman 1997; ASMFC 2007; Kahnle *et al.* 2007; Brown and Murphy 2010). There are no empirical abundance estimates of the number of Atlantic sturgeon in the New York Bight DPS. We determined that the New York Bight DPS is currently at risk of extinction due to: (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and (3) the impacts and threats that have and will continue to affect population recovery.

5.0 ENVIRONMENTAL BASELINE

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

The environmental baseline for this Opinion includes the effects of several activities that may affect the survival and recovery of the listed species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: dredging operations (including those outlined in Table 1), actions that impact water quality, scientific research, shipping and other vessel traffic, and fisheries.

5.1 Upstream Dams in the Kennebec River System

On July 19, 2013, we issued an Opinion to FERC on the impacts to listed species from operations of the Lockwood, Shawmut, and Weston Projects on the Kennebec River; as well as the Brunswick, and Lewiston Falls Projects on the Androscoggin River; in order to incorporate the provisions of an interim Species Protection Plan (ISPP). In our July 19, 2013 biological opinion, we concluded that the proposed action was likely to adversely affect, but not likely to jeopardize the continued existence of the Gulf of Maine distinct population segment (DPS) of Atlantic salmon, shortnose sturgeon, or any of the five DPSs of Atlantic sturgeon. We also concluded that the action was not likely to destroy or adversely modify critical habitat designated for Atlantic salmon. The purpose of the ISPP is to collect information on passage efficiency and survival of Atlantic salmon adults and smolts attempting to migrate past the Projects. Lewiston Falls does not have fishways, so passage efficiency studies were not proposed at that project. The ITS of the Opinion authorized take for the proposed studies, as well as for the effects of ongoing operations at the Project. The ISPP, and the Opinion, have a seven-year term (2013-2019), after which the Opinion and ITS will no longer be valid. At that point (2019), FPL Energy will put together a final SPP that contains additional protection measures for listed fish, and FERC will reinitiate formal consultation in order to obtain take authorization for the remainder of the projects' license terms.

The ITS accompanying the Opinion exempted incidental take for upstream and downstream fish passage studies, as well as for the operation of the Project over the term of the ISPP. The ITS also exempted incidental take of four trapped shortnose sturgeon and Atlantic sturgeon (four in the fishway and four stranded) at the Lockwood Project (license expires in 2036), and another four trapped of each species (four in the fishway and four stranded) at the Brunswick Project (license expires in 2029). Neither mortality nor major injuries of any sturgeon is anticipated or exempted.

On March 31, 2017, Brookfield filed their ISPP Annual Report. In that report, Brookfield indicated that the average mortality of Atlantic salmon smolts is below what was anticipated at the Lockwood and Weston Projects but is in excess of what was expected at the Brunswick and Shawmut Projects. The amount of take at the Brunswick and Shawmut Projects exceeded the annual amount of take exempted for those two projects. However, in a 2017 letter to FERC, we concluded that the take exceedance was minor and of short duration, and measures will be implemented to reduce take levels below or in compliance with the amount of exempted take (i.e., the proposed measures are expected to improve smolt survival for the remainder of the ISPP), the information does not alter the conclusions in the 2013 Opinion.

5.2 Kennebec River FNP

In October 25, 2019, we issued a Biological Opinion to the U.S. Navy for planned maintenance dredging of the Federal Navigation Project (FNP) in the lower Kennebec River, Maine from 2019-2029. Dredging is necessary to provide access for naval warships to navigate from the BIW shipyard to the open ocean. Based on previous dredging requirements, the U.S. Navy anticipates maintenance dredging to be needed every three years; however, future Navy ship movements from the BIW shipyard to the open ocean or shoaling conditions could increase the need for dredging to possibly five times over the next ten years. When possible, dredge events will occur from December 1 to March 1, an in-water work window designed to protect diadromous fish, including sturgeon; however, given the unpredictability of environmental conditions (e.g., sediment transport) and Navy activities, along with past instances where circumstances have required dredging outside this window, U.S. Navy proposed that as many as two dredge events may occur from March 2 to November 30 between 2019 and 2029.

The authorized FNP in the lower Kennebec River consists of a channel 27 feet (ft) deep at Mean Lower Low Water (MLLW) and 500 ft wide extending about 13 miles (mi) upstream from the river mouth at Popham Beach to the city of Bath. About 8 mi upstream of Bath, the FNP provides for a navigation channel 17 ft deep MLLW and 150 ft wide along the east side of Swan Island for 14 mi to the city of Gardiner. An 18-foot deep MLLW and 150 ft wide channel extends through the ledge at Lovejoy Narrows opposite the upper end of Swan Island. A training wall was built along the Beef Rock Shoal opposite the lower end of Swan Island and another training wall was built opposite South Gardiner. A secondary channel 12 ft deep and 100 ft wide was provided along the west-side of Swan Island to Richmond, with the navigation channel deepening to 15 ft MLLW near the upper end of Swan Island. A 16-ft deep MLW channel was provided at Gardiner. A channel 11 ft deep MLLW and 150 ft wide extends 7 mi to the upper limit of the FNP in Augusta.

Since the FNP for the lower Kennebec River was deepened to 27 ft deep in the early 1940's, maintenance dredging has been performed at the Doubling Point and Popham Beach reaches at approximately three-year intervals. These sites have been dredged a total of approximately 20 times since 1950. Dredging has been performed using a hopper dredge and the amount of material removed has ranged from 4,707 cubic yards (cy) to 108,830 cy. Disposal sites have historically been located in the river north of Bluff Head for the material removed from the channel near Doubling Point and at a nearshore disposal site located approximately 0.4 nautical miles (nm) south of Jackknife Ledge for the material dredged from the channel at the river mouth near Popham Beach. In recent years, dredging occurred in 1991, 1997, 2000, 2002, 2003, 2011, 2017, and 2020 (Table 8).

Table 8: Dredging of the Kennebec River FNP (1991-Present)

Location	Dates	Volume Removed (cy)	Observer Present?	Interactions with ESA-listed species
Doubling Point	October 1991	69,000	No	2 shortnose sturgeon (lethal)
Doubling Point	November 1997	21,660	Yes	0
Doubling Point	December 2000	19,900	Yes	0
Doubling Point	April 2002	21,582	Yes	0
Doubling Point	October 2003	22,310	Yes	3 shortnose sturgeon (lethal); 2 shortnose sturgeon (injured but alive upon release)
Doubling Point & Popham	August 2011	58,000	Yes	0

Beach				
Doubling Point & Popham Beach	April 2017	62,353	Yes	1 Atlantic sturgeon (lethal)
Doubling Point & Popham Beach	January 2020	36,987	Yes	0

From 2019-2029, we estimated that the U.S. Navy action has the potential to result in the mortality of shortnose sturgeon and individuals from the GOM DPS of Atlantic sturgeon due to entrainment in hopper dredges or capture in a mechanical dredge. Specifically, through 2029, the ITS exempts the lethal take of 29 shortnose sturgeon (juveniles or adults) and 5 GOM DPS Atlantic sturgeon (juveniles, subadults, or adults).

5.3 EPA Fish Assemblage Study

On January 12, 2015, we issued a Biological Opinion on the effects of the U.S. Environmental Protection Agency's (EPA) continued funding of a multi-year bio-assessment study on the Kennebec and Sebasticook Rivers (2014-2019). The purpose of the survey was to document changes to fish assemblages in the rivers following the removal of the Edwards Dam in 2001 and the Ft. Halifax dam in 2009. The ITS in the 2015 Opinion allowed for the annual non-lethal take (through 2019) of up to four shortnose sturgeon, four Atlantic sturgeon (GOM or NYB DPS), and four Atlantic salmon (GOM DPS). Since the 2015 Opinion was issued, the following non-lethal harassment has been observed during electrofishing:

Table 9: EPA Fish Assemblage Study Recorded Take (2015-2019)

Year	Atlantic salmon (GOM DPS)	Atlantic sturgeon (GOM or NYB DPS)	Shortnose Sturgeon
2015	1	0	0
2016	0	0	2
2017	0	0	2
2018	0	1	1
2019	2	1	5

The EPA Fish Assemblage Study was completed in 2019; however, the principal investigators are currently pursuing a Section 10 incidental take permit to continue the research.

5.4 Scientific Studies

Maine DMR is authorized under the USFWS' endangered species blanket permit (No. 697823) to conduct monitoring, assessment, and habitat restoration activities for listed Atlantic salmon populations in Maine. The extent of take from Maine DMR activities during any given year is not expected to exceed 2% of any life stage being impacted; for adults, it would be less than 1%. Maine DMR will continue to conduct Atlantic salmon research and management activities in the GOM DPS while the proposed action is carried out. The information gained from these activities will be used to further salmon conservation actions.

USFWS is also authorized under an ESA section 10 endangered species blanket permit to conduct the conservation hatchery program at the Craig Brook and Green Lake National Fish Hatcheries. The mission of the hatcheries is to raise Atlantic salmon parr and smolts for stocking into selected Atlantic salmon rivers in Maine. Over 90% of adult returns to the GOM DPS are currently provided through production at the hatcheries. The hatcheries provide a significant buffer from extinction for the species.

The University of Maine holds a scientific research permit (No. 20347) to capture, tag, and sample genetic material from shortnose sturgeon and Atlantic sturgeon from 2017-2027. The University proposes to:

1. Combine acoustic telemetry, blood analysis, genetics and scute spine analysis to determine spawning periodicity for each sex and species and river of origin;
2. Compare aging of fin spines/rays and scute spines to determine if scute spines are an alternate means of ageing fish ; and
3. Use mark-recapture and acoustic telemetry to identify critical habitat for juveniles, estimate annual juvenile recruitment, and movement within and between river systems.

Across Gulf of Maine rivers and coastal marine habitat, their objectives for Atlantic sturgeon include capturing a maximum of 845 adults/subadults, 138 juveniles, and 200 early life stages (ELS; eggs and larvae). All adults, subadults, and juveniles will be weighed, measured, examined for tags, examined with a borescope when appropriate, marked with PIT tags and T-bar or Floy tags, photographed, and sampled for genetic material (i.e. a fin clip) and blood prior to being released. Their objectives for shortnose sturgeon include capturing a maximum of 1,535 adults, 189 juveniles, and 210 ELS. All adults, sub-adults, and juveniles will be weighed, measured, examined for tags, examined with a borescope when appropriate, marked with PIT tags and T-bar or Floy tags, photographed, and sampled for genetic material (i.e. a fin clip) and blood prior to being released (hereafter "basic processing").

Specific to the Kennebec River System (including the Androscoggin River and the action area), they propose to capture and handle as many as 200 Atlantic sturgeon (all DPSs) and 400 shortnose sturgeon. They also propose to capture 100 Atlantic sturgeon eggs/larvae from the GOM DPS and 50 shortnose sturgeon eggs/larvae, resulting in mortality. Over the lifetime of the permit, they also expect the unintentional mortality of one Atlantic sturgeon adult/subadult (all DPSs), one Atlantic sturgeon juvenile (all DPSs), two shortnose sturgeon adults, and two shortnose sturgeon juveniles.

5.5 Contaminants and Water Quality

Contaminants including heavy metals, polychlorinated aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs), can have serious, deleterious effects on aquatic life and are associated with the production of acute lesions, growth retardation, and reproductive impairment (Ruelle and Keenlyne 1993). Contaminants introduced into the water column or through the food chain, eventually become associated with the benthos where bottom dwelling species like sturgeon are particularly vulnerable.

Several characteristics of sturgeon life history including long life span, extended residence in estuarine habitats, and being a benthic omnivore, predispose this species to long term, repeated exposure to environmental contaminants and bioaccumulation of toxicants (Dadswell 1979). Contaminant analysis of tissues from a shortnose sturgeon from the Kennebec River revealed the presence of fourteen metals, one semivolatile compound, one PCB Aroclor, Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in one or more of the tissue samples. Of these chemicals, cadmium and zinc were detected at concentrations above an adverse effect concentration reported for fish in the literature (ERC 2003). Thomas and Khan (1997) demonstrated that exposure to cadmium at concentrations well below the concentration detected in the shortnose sturgeon significantly increased ovarian production of estradiol and testosterone which can adversely affect reproductive function. The concentration of zinc detected in the shortnose sturgeon liver tissue was slightly less than the effect concentration for reduced egg hatchability reported by Holcombe et al. (1979) and exceeded the effect concentration for reduced survival cited in Flos et al. (1979).

Ruelle and Henry (1994) determined that heavy metals and organochlorine compounds (i.e., PCBs) accumulate in fat tissues. Although the long term effects of the accumulation of contaminants in fat tissues is not yet known, some speculate that lipophilic toxins could be transferred to eggs and potentially inhibit egg viability. PCBs may also contribute to a decreased immunity to fin rot. In other fish species, reproductive impairment, reduced egg viability, and reduced survival of larval fish are associated with elevated levels of environmental contaminants including chlorinated hydrocarbons. A strong correlation that has been made between fish weight, fish fork length, and DDE concentration in pallid sturgeon livers indicates that DDE increase proportionally with fish size (NMFS 1998).

Contaminant analysis conducted in 2003 of tissues from a shortnose sturgeon from the Kennebec River revealed the presence of fourteen metals, one semivolatile compound, one PCB Aroclor, Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in one or more of the tissue samples. Of these chemicals, cadmium and zinc were detected at concentrations above an adverse effect concentration reported for fish in the literature (ERC 2003).

Point source discharges (i.e., municipal wastewater, paper mill effluent, industrial or power plant cooling water or waste water) and compounds associated with discharges (i.e., metals, dioxins, dissolved solids, phenols, and hydrocarbons) contribute to poor water quality and may also impact the health of sturgeon and salmon populations. The compounds associated with discharges can alter the pH or receiving waters, which may lead to mortality, changes in fish behavior, deformations, and reduced egg production and survival.

5.6 State or Private Activities in the Action Area

5.6.1 Private Recreational Boating

The action area, encompassing a portion of the lower Kennebec River estuary, contains numerous private and public boat launches, as well as private and public piers and marinas. Recreational vessel traffic is common throughout the action area from the spring (especially during diadromous fish runs), through the summer and into the fall. We do not expect recreational vessels in the action area during the winter months. Recreational vessels include small inboard and outboard motorized vessels, as well as non-motorized vessels (e.g., canoes, kayaks, etc.).

Although smaller motorized vessels have a shallower draft and entrain less water, they often operate at higher speeds. There is evidence to suggest that small fast vessels with shallow draft are a source of vessel strike mortality on Atlantic and shortnose sturgeon. On November 5, 2008, in the Kennebec River, Maine, Maine Department of Marine Resources (Maine DMR) staff observed a small (<20 foot) boat transiting a known shortnose sturgeon overwintering area at high speeds. When Maine DMR approached the area after the vessel had passed, a fresh dead shortnose sturgeon was discovered. The fish was collected for necropsy, which later confirmed that the mortality was the result of a propeller wound to the right side of the mouth and gills.

5.6.2 State Authorized Fisheries

Shortnose and Atlantic sturgeon are taken incidentally in anadromous fisheries along the East Coast and may be targeted by poachers (ASSRT 2007b, NMFS 1998). The Kennebec River is an important corridor for migratory movements of various species including alewife (*Alosa pseudohernegus*), American eel (*Anguilla rostrata*), blueback herring (*Alosa aestivalis*), American shad (*Alosa sapidissima*), rainbow smelt (*Osmerus mordax*), striped bass (*Morone saxatilis*) and lobster (*Homarus americanus*). Historically, the river and its tributaries supported the largest commercial fishery for shad in the State of Maine. However, pollution and the construction of dams decimated the shad runs in the late 1920s and early 1930s. Shortnose sturgeon in the Kennebec River may have been taken as bycatch in the shad fishery or other fisheries active in the action area. It has been estimated that approximately 20 shortnose sturgeon are killed each year in the commercial shad fishery and an additional number are also likely taken in recreational fisheries (T. Savoy pers. comm. in NMFS 1998). However, the incidental take of shortnose sturgeon in the river has not been well documented due to confusion over distinguishing between Atlantic sturgeon and shortnose sturgeon. Due to a lack of reporting, no information on the number of shortnose or Atlantic sturgeon caught and released or killed in commercial or recreational fisheries on the Kennebec River is available.

5.7 Status of Shortnose Sturgeon in the Action Area

5.7.1 Shortnose Sturgeon in the Kennebec River System

The Kennebec system includes the Kennebec, Androscoggin and Sheepscot Rivers. Shortnose sturgeon occur in the estuarine complex formed by the Sheepscot, Kennebec, and Androscoggin rivers. Atkins (1887) documented the presence of sturgeon in Maine rivers, though they were identified as common sturgeon (*Acipenser sturio*). Fried (1973) discovered shortnose sturgeon within Montsweag Bay in the Sheepscot River in 1971 and 1972. This was the first reported occurrence of shortnose sturgeon in Maine. Shortnose were subsequently found in the Kennebec River by Maine DMR in 1977 and 1978 (Squires *et al.* 1979). Historically, the upstream extent of shortnose sturgeon in the Kennebec is thought to have been Ticonic Falls (rm 64; rkm 103)(NMFS 1998).

Sturgeon were tagged with Carlin tags from 1977 to 1981, with recaptures in each of the following years. A Schnabel estimate of 7,222 (95% CI, 5,046 to 10,765) adults for the combined estuarine complex was computed from the tagging and recapture data from 1977 through 1981 (Squires *et al.* 1982). A Schnabel estimate using tagging and recapture data from 1998 - 2000 indicates a population estimate of 9,488 (95% CI, 6,942 to 13,358) for the estuarine complex (Squiers 2003). The average density of adult shortnose sturgeon/hectare of habitat in the estuarine complex of the Kennebec River was the second highest of any population studied through 1983 (Dadswell *et al.* 1984). The Schnabel estimate from 1998-2000 is the most recent population estimate for the Kennebec River System shortnose sturgeon population; however, does not include an estimate of the size of the juvenile population. A comparison of the population estimate for the estuarine complex from 1982 (Squires *et al.* 1982) to 2000 (Squiers 2003) suggests that the adult population has grown by approximately 30% in that twenty year period. Assuming that this trend continued past 2000, we would expect the shortnose sturgeon population in the Kennebec River system to be increasing; however, without more information on the status of more recent year classes it is not possible to determine if this trend has been sustained.

5.7.1.1 Spawning in the Kennebec

In 1999, the Edward's Dam (rm 46; rkm 74), which represented the first significant impediment to the northward migration of shortnose sturgeon in the Kennebec River, was removed. The Lockwood Dam continues to operate, though it is not thought to impede shortnose access to historic habitat given its location at Ticonic Falls (rm 64; rkm 103), the presumed historic upstream extent of shortnose in the Kennebec River. Thus, with the removal of the Edwards dam almost 100% of historic habitat is now accessible. Since the removal of the Edwards Dam, shortnose sturgeon have been documented just downstream of the Lockwood Dam (rm 64; rkm 103) indicating this habitat is being utilized (Wippelhauser *et al.* 2015).

Wippelhauser and Squiers (2015) summarized field studies on shortnose and Atlantic sturgeon from 1977-2001 in the Kennebec River system that sought to produce population estimates and documentation of spawning, overwintering, and foraging habitat. Based on the capture of 172 adult shortnose sturgeon between May 1-31 over a period of 22 years (including two ripe males releasing sperm during handling) from rkm 47.5-74 in the Kennebec River, they identified spawning run timing and potential spawning habitat. Maine DMR conducted ichthyoplankton surveys from 1996 through 2001. Sampling sites were located both above and below the dam and were surveyed using surface tows with plankton nets and stationary sets with D-shaped plankton nets. Through these efforts, researchers captured 54 eggs and 10 larvae at two sampling locations (rm 40.3 and 45.2; rkm 65 and 72.7), confirming that spawning occurs in that 5.6 mi (9 rkm) stretch below the former Edwards Dam (Wippelhauser and Squiers 2015).

Between 2007 and 2013, Wippelhauser *et al.* (2015) tagged 134 adult shortnose sturgeon throughout the Gulf of Maine (Penobscot, Kennebec, Saco, Merrimack). Twenty-one (20%) of 104 shortnose sturgeon tagged in the Penobscot River, two (50%) of four tagged in the Kennebec system, one (50%) of two tagged in the Saco River, and 16 (37%) of 43 tagged in the Merrimack River moved into the Kennebec system and made suspected spawning runs. These adults displayed two distinct pre-spawning behaviors. Some (~35%) emigrated to the Kennebec system in the summer or fall and overwintered one to two seasons before participating in a spring spawning run, while the majority (~65%) migrated to the Kennebec system in the early spring and participated in a spawning run that same year. Tagged shortnose were detected in spawning areas from April 7 through June 6 as water temperatures increased and discharge decreased. During this time, bottom temperatures in the Kennebec River ranged from 5.8-17.6°C and fish spent an average of 9.9-12.5 days in the spawning sites (varied by Kennebec location). Discharge when shortnose sturgeon were at the spawning areas was typically ≤558 m^3/s; however, flows reached as high as 1,487 m^3/s in some years. Spawning was documented for the first time in the restored portion of the Kennebec (above the former Edwards Dam (rm 46; rkm 74)) between May 17-19, 2010, as two larvae were captured below the Lockwood Dam at rm 63.4 (rkm 102) using D-nets. Spawning was again confirmed below the former Edwards Dam with the capture of 23 larvae between rm 40-45 (rkm 64-72) in a sampling period from May 19-June 15, 2009, as well as the capture of seven larvae between rm 42-45 (rkm 67-73) in a sampling period from May 3-June 6, 2011 (Wippelhauser *et al.* 2015).

5.7.1.2 Spawning in the Androscoggin River

In the Androscoggin River, shortnose sturgeon migration, and thus spawning location, was likely limited historically by the natural falls located at the Brunswick Dam (rkm 8.4). From 1979-1982, MDMR conducted gillnet studies to identify spawning areas. During this period large numbers of shortnose sturgeon were captured between Brunswick and Topsham. Water temperatures during this time ranged between 8.5 and 14.5°C (late April until the end of May), many of the males captured were freely expressing milt and several females were ripe (Squires *et al.* 1982). Tracking studies to delineate spawning habitat were performed on the Androscoggin River during 1993 (Squiers *et al.* 1993). Gill nets were used to capture study animals and catch rates were recorded. Gill net catch-per-unit-effort during this study was the highest recorded in this area, suggesting that the population in the Androscoggin has increased since last surveyed. Using cement blocks fitted with plastic mesh, this study also confirmed spawning by collecting eggs at two different discrete spawning areas (May 13 and 19) at approximately rm 4.8 (rkm 7.7). One larval shortnose sturgeon was also captured in the same general area (May 28) using a plankton net. This study indicated that spawning was concentrated in the reach of river between approximately rm 4.8 and 5.2 (rkm 7.7 and 8.4) (the Brunswick Dam).

Adding to this research, Wippelhauser *et al.* (2015) (discussed above) used telemetry data to record 14 spawning events (presence of late-stage females in known spawning grounds during the spawning season) from early April to early June. In data provided to MaineDOT for their BA, Wippelhauser (2016) stated that shortnose spawning below the Brunswick Dam (rm 4.8 and 5.2; rkm 7.7-8.4) occurs from April 7 – June 11. During spawning, bottom temperatures in the spawning area ranged from 8.8-16.4°C, and spawning adults spent an average of 4 days at the spawning site (range 0.1-7.8 days)(Wippelhauser *et al.* 2015).

5.7.1.3 Foraging

Foraging areas have been identified in the Sasanoa River entrance[6] and in the mainstem of the Kennebec River below Bath, from mid-April through November or early December (Squires *et al.* 1982)(Normandeau 1999). Between June and September, shortnose sturgeon forage in shallow waters on mud flats that are covered with rooted aquatic plants. In the summer months, concentrations of shortnose sturgeon have also been known to move up into the freshwater reaches of the Kennebec River and foraging shortnose sturgeon have also been seen in Montsweag and Hockomock Bays in the Sheepscot River, which is located near the eastern end

[6] The Sasanoa River entrance is located directly across the Kennebec River from the Bath Iron Works facility. The river is less than ½ mile wide at this point.

of the Sasanoa River (NMFS 1996). McCleave (1977) examined several stomachs from shortnose sturgeon captured in Montsweag Bay and found crangon shrimp (*Crangon septemspinosous*); clams (*Mya arenaria*); and small winter flounder (*Pseudopleuronectes americanus*) were common prey items.

In the late summer (August 10 to September 2, 1993), Squiers *et al.* (1993) looked between rm 4.3 and 5.2 (rkm 7.0 and 8.4) for foraging young of the year and juvenile shortnose sturgeon. No young of the year or juvenile shortnose sturgeon were captured in sampling with an otter trawl. The authors concluded that it was likely that the larval shortnose sturgeon would have emigrated further downstream prior to August and that the juveniles would be associated with deep channel areas with rugged substrate and not in the area surveyed (including the action area).

5.7.1.4 Overwintering

Studies indicate that at least a portion of the shortnose sturgeon population in the Kennebec River overwinters in Merrymeeting Bay (Squiers and Robillard 1997). The seasonal migrations of shortnose sturgeon are believed to be correlated with changes in water temperature. In 1999, when a tracking study was performed by Normandeau Associates, the water temperature near Bath Iron Works (BIW) reached the 8-9ºC threshold (believed to be the trigger prompting spawning fish to migrate to the spawning area) in mid-April. Also during the tracking study, several fish presumed to be non-spawning sturgeon, were documented in the Chops Point and Swan Island areas (north of Doubling Point) in late March and then were found to have migrated south to the BIW region (e.g., north and south of the BIW Pier and Museum Point) early in April.

Until a study aimed at specifically determining overwintering locations was conducted by the MDMR in 1996 for the MaineDOT, the sites thought to be the most likely overwintering sites were deep pools below Bluff Head, and possibly in adjacent estuaries such as the Sheepscot (Squiers and Robillard 1997). The 1996 study of overwintering activity suggests that at least one overwintering site is located above Bath. This is based on tracking 15 shortnose sturgeon collected and released in the vicinity of the Sasanoa River (Pleasant Cove), Winnegance Cove (near the Doubling Point reach), and Merrymeeting Bay (north of Bath and the Sasanoa River entrance). Tracking was done from October through January. Eleven of these fish were relocated in Merrymeeting Bay. Two of the fish from Pleasant Cove were never found in Merrymeeting Bay; one Pleasant Cove fish moved to Winnegance Cove and back to Pleasant Cove and another moved to Days Ferry (half way between Bath and Merrymeeting Bay). All of the fish that continued to transmit after November were only found in upper Merrymeeting Bay on the east-side of Swan Island (~rm 24.9-26.1; rkm 40-42). Fish departed the wintering site between April 7-25, with most moving downstream toward the lower Kennebec estuary (Wippelhauser and Squiers 2015). This is consistent with the trends for movement of shortnose sturgeon in the Delaware River (O'Herron *et al.* 1993). Overwintering sturgeon in the Delaware River are found in the area of Newbold Island, in the Trenton to Kinkora river reach, in an area geographically similar to the area around Swan Island.

5.7.1.5 Expected Seasonal Distribution of Shortnose Sturgeon in the Action Area

The discussion below summarizes the expected seasonal distribution of shortnose sturgeon in the action area.

Wippelhauser (unpublished data, used with permission) described shortnose sturgeon migration (from 2007–2017) in the lower Kennebec River, at rm 2.8 (rkm 4.5) (from April to November), rm 9.9 (rkm 16) (from March to November), and rm 11.2 (rkm 18) (in September of 2011 only) for shortnose sturgeon tagged in the Kennebec, Penobscot, Saco, and Merrimack Rivers (Table 9). While rm 2.8 is not within the action area, the data are included here to help demonstrate movement in and out of the estuarine system. The receivers were, on average, deployed for the full month for each month from May to October. Receivers were not deployed from January to February (only in March on one occasion); therefore, no data were collected during this period.

Table 10: Average number of days per month individual shortnose sturgeon were detected by acoustic tagging study (Wippelhauser (2019) unpublished data, used with permission)

Species	***Receiver Location (at rm)***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec[1]***
Shortnose sturgeon	2.8		2.2	5.4	6.2	3.8	4.7	4.2	1.8	1.4	
Shortnose sturgeon	9.9	2.7[2]	2.1	3.6	4.3	3.3	2.1	1.6	2.0	2.0	
Shortnose sturgeon	11.2							2.0[3]			

[1] Zero shortnose sturgeon were detected in December at rm 2.8, rm 9.9, and rm 11.2.
[2] Only 3 shortnose sturgeon were detected in March at rm 9.9 for the 8 days data was collected.
[3] One shortnose sturgeon was detected in September at rm 11.2 for the 2 days; 5 at rm 2.8 for the 21 days; and 9 at rm 9.9 for the 14 days data was collected.

Wippelhauser's unpublished data (2019) was further summarized to describe monthly individual detections (2007–2017) in the lower Kennebec River, at rm 2.8, rm 9.9, and rm 11.2 (Table 9, Figure 6). The number of shortnose sturgeon that were acoustically tagged in the Kennebec River include 4 in 2011, 17 in 2012, and 5 in 2013. Other detections came from fish tagged in the Penobscot, Saco, and Merrimack Rivers. Across all years and all river mile markers, the first detection of a shortnose sturgeon occurred in March at rm 9.9 and was intermittent through November with detections at rm 2.8 and rm 9.9. Receiver stations were not deployed past the second day of December for any year. According to Wippelhauser (pers. comm. (2019)), shortnose sturgeon primarily migrate through the lower Kennebec River and exclusively spawn and overwinter in the upper Kennebec River. Based on the trend in these data (Figure 6), shortnose sturgeon are only rarely expected to be in the proposed action area in the late fall and winter months (November to March) as they would be likely be in overwintering habitat further upriver.

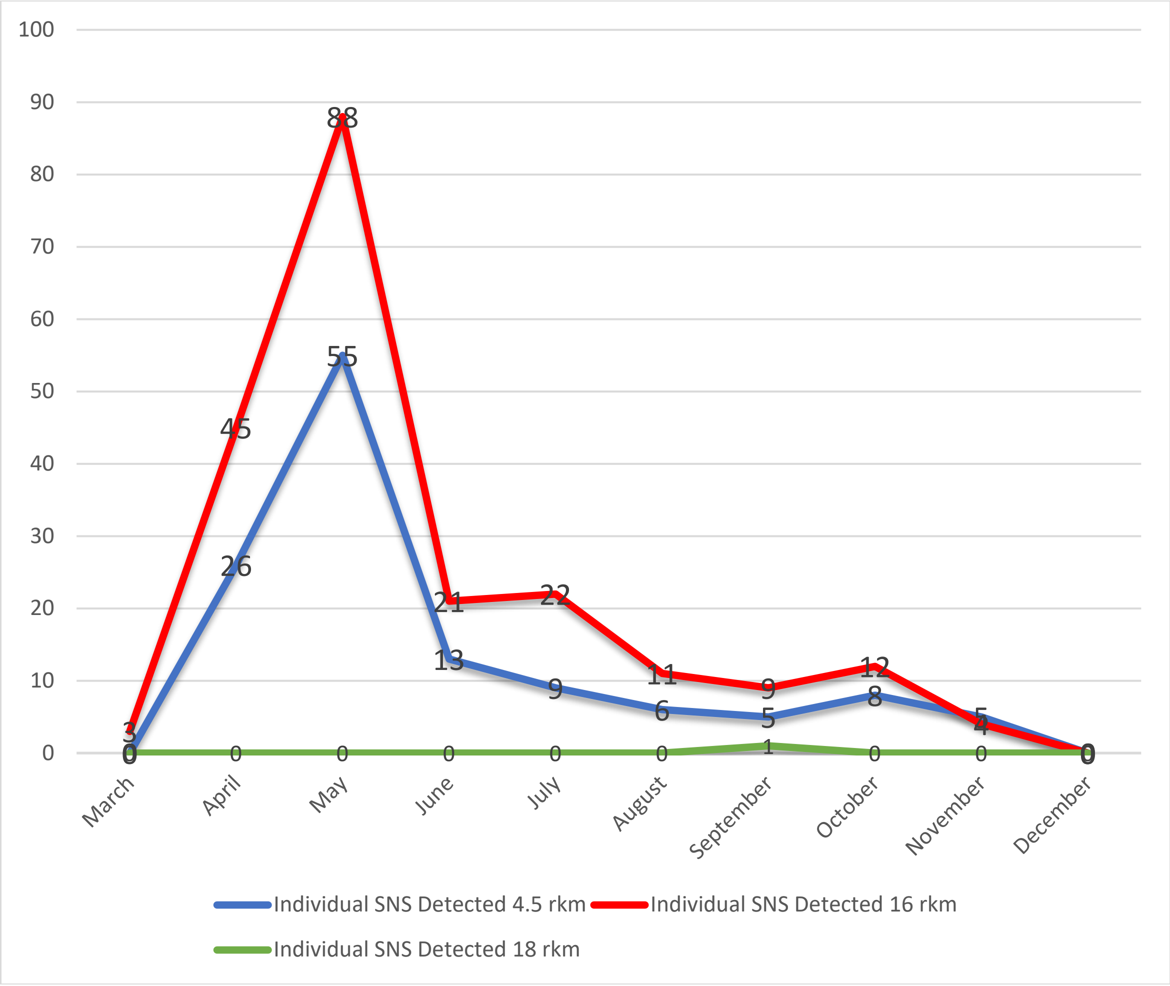

Figure 5: Number of individual shortnose sturgeon detected in the Kennebec River from 2007–2017 at rm 2.8, 9.9, and 11.2 (rkm 4.5, 16, and 18) (Wippelhauser (2019) unpublished data, used with permission)

Juvenile shortnose sturgeon were not captured from December 1997 through February 1998. However, the researchers were able to track tagged fish around BIW until ice impeded the researchers' navigation, providing evidence that shortnose sturgeon are potentially present year-round.

Table 11: Timing of shortnose sturgeon lifestages and behaviors in the action area

Lifestage	Time of Year Present in Action Area	Behavior in Action Area
Adults	Year-round	Adults are expected to be present and actively foraging from April through October with presence increasing in rarity in November (Figure 5). Shortnose sturgeon from other river systems (e.g., Merrimack, Penobscot), are likely to migrate through the action area in the early spring, and those that

		overwinter outside of the Kennebec River system, will emigrate in the fall. Presence in the action area from November through March is expected to be rare and limited to a few individuals.
Juveniles	Year-round	Juveniles are expected to be present and actively foraging from April through October with presence increasing in rarity in November (Figure 5). Presence in the action area from November through March is expected to be rare and limited to a few individuals.

5.8 Status of Atlantic Sturgeon in the Action Area

5.8.1 Atlantic Sturgeon in the Kennebec River System

As noted above, historical records provide evidence of commercial fisheries for Atlantic sturgeon in the Kennebec and Androscoggin Rivers dating back to the 17^{th} century (Squiers *et al.* 1979). Following the 1880s, the sturgeon fishery was almost non-existent due to a collapse of the sturgeon stocks. While directed fishing and retention as by-catch has been prohibited since 1998, the GOM DPS of Atlantic sturgeon remains threatened. Based on the NEAMAP survey data, we estimate an ocean population of 7,455 adult and subadult GOM DPS Atlantic sturgeon. In the marine range, GOM DPS Atlantic sturgeon are still incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.* 2004; ASMFC 2007). Habitat disturbance and direct mortality from anthropogenic sources are primary concerns. Due to the lack of recaptures, to date, we do not have a population estimate for adult Atlantic sturgeon in the Kennebec River system (Wippelhauser and Squiers 2015). For a summary of threats faced by the GOM DPS of Atlantic sturgeon, see section 4.2.2.

5.8.1.1 Coastal Movements

As part of a study to assess coastal movements of Atlantic sturgeon in the Gulf of Maine, Wippelhauser *et al.* 2017 captured 681 sub-adult and adult Atlantic sturgeon within four study rivers (Merrimack, Saco, Kennebec, Penobscot). Approximately 25% (169) were tagged with acoustic transmitters for tracking using a series of acoustic receiver arrays in each of the rivers, as well as compatible arrays in the marine coastal environment. Of the 169 tagged sturgeon, 20 were captured and tagged in the Merrimack, 51 in the Saco, 55 in the Kennebec, and 43 in the Penobscot. Fifty-nine (59) individuals tagged elsewhere were detected in the Kennebec system. Nonspawning Atlantic sturgeon entered the Kennebec system in late May (median date of May 30) and departed early in the late summer or early fall (median date of August 25).

5.8.1.2 Foraging

While in the Kennebec system, adult and subadult Atlantic sturgeon that did not enter spawning grounds spent the majority of their time between rm 0 and 28 (rkm 0 and 45), likely foraging (Wippelhauser *et al.* 2017). From 1977-2001, between May and the end of November, Wippelhauser and Squiers (2015) also captured 304 juvenile Atlantic sturgeon (described as "early, intermediate, and late stage") in the upper Kennebec estuary, Merrymeeting Bay, lower Kennebec estuary, and the Sasanoa River. Over half of the juveniles (146) were caught in October and September (67), and the majority were captured in the lower Kennebec estuary (212) and Merrymeeting Bay (67), indicating the likely presence of foraging grounds.

5.8.1.3 Spawning in the Kennebec River System

To date, despite captures of sturgeon in the Merrimack, Penobscot and Piscataqua/Salmon Falls/Cocheco rivers, as well as the necessary physical and biological features to support spawning in each of those rivers, the only confirmed spawning locations for the GOM DPS of Atlantic sturgeon are in the Kennebec River system (upper Kennebec River estuary and the Androscoggin River).

As reported in Wippelhauser *et al.* 2017, between 2010 and 2014, most tagged Atlantic sturgeon entered the Kennebec system during April and May (May 6 on average, with a range of April 11-June 17). They then moved to the spawning grounds mostly in June (average of June 14, range May 8-July 20), and remained at the spawning grounds through July (average of July 13, range of June 12-August 20). Water temperatures were typically over 16°C when Atlantic sturgeon occupied spawning areas, and freshwater discharge was usually less than 522 cy per second. After spawning, some tagged individuals from the 2009-2011 study remained in Merrymeeting Bay or the lower Kennebec estuary for approximately 60 days before departing the system in October (Wippelhauser *et al.* 2017).

5.8.1.4 Spawning in the Kennebec River

As described above in section 4, from 1977-2001, Atlantic sturgeon in spawning condition were caught between rm 32.8 and rm 46 (rkm 52.8 and rkm 74) of the Kennebec River during the months of June and July, the likely spawning season. The removal of the Edwards Dam (rkm 74) in 1999 allowed Atlantic sturgeon to access 13 mi of historic spawning habitat, up to Ticonic Falls/Lockwood Dam (rkm 103). From 2009 to 2011, 31 Atlantic sturgeon, including 6 ripe males, were caught in the Kennebec River between rm 43.5 and rm 46.6 (rkm 70 and rkm 75) (Wippelhauser 2012; Wippelhauser and Squiers 2015). Spawning was confirmed in the restored Kennebec River habitat (above the former Edwards Dam) when two larvae were captured (July 11-12, 2011) in the Upper Kennebec Estuary, 0.6 to 1 mi (1 to 1.6 rkm) upstream of the former Edwards Dam site (rm 46; rkm 74). One larvae was also captured at rm 44.7 (rkm 72) during the same time span (Wippelhauser 2012; Wippelhauser *et al.* 2017).

5.8.1.5 Spawning in the Androscoggin River

From 2009-2017, 11 adult Atlantic sturgeon have been captured and/or detected in the Androscoggin River near rm 4.8 (rkm 7.7). One of the sturgeon (captured on June 21, 2011) was a spawning condition (i.e., ripe) male (74.2 in TL). Two of the sturgeon, including the ripe male, had been caught and PIT tagged in the Saco River the previous year (Wippelhauser *et al.* 2017; Wippelhauser pers. comm. 2018). With one exception, all of the sturgeon had left the spawning area by the end of July (one left on August 7). While these captures confirm likely spawning, Atlantic sturgeon eggs and larvae have not yet been recovered in the Androscoggin (Wippelhauser pers. comm. 2018).

5.8.1.6 Expected Seasonal Distribution of Atlantic Sturgeon in the Action Area

Unpublished data provided by Wippelhauser (2019) describes acoustic telemetry detections (from 2007–2017) in the lower Kennebec River, where receivers were deployed at rm 2.8 (rkm 4.5) (from April to December 2012–2017), rm 9.9 (rkm 16) (from March to November 2007–2017), and at rm 11.2 (rkm 18) (from August to October in 2011 only) for Atlantic sturgeon tagged in the Kennebec, Penobscot, Saco, and Merrimack Rivers (Table 11). As noted above, while rm 2.8 is not within the action area, the data are included here to help demonstrate movement in and out of the estuarine system. The receiver was, on average, deployed for the full duration for the months of May through October. Receivers were not deployed from January to February (only in March on one occasion); therefore, no data on Atlantic sturgeon in the Kennebec River were collected during these months.

Table 12: Average number of days per month acoustic receivers were deployed at rm 2.8 and rm 9.9 from 2007–2017 (Wippelhauser (2019) unpublished data, used with permission)

Receiver Location (at rm)	***Years Deployed***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
2.8	2012-2017	0	8	24	25	29	31	30	31	20	2
9.9	2007-2017[1]	7[1,2]	13	30	30	31	29	30	31	20	2

[1] There was a gap in data collection at station rm 9.9 during a portion of March–July 2010 due to a lost receiver.
[2] 2010 is the only year that data is available for the month of March.
Note: No data are available from stations during the months of January or February.

Wippelhauser (2019) was further summarized to describe to the average number of days per month Atlantic sturgeon were detected and also the number of monthly individual Atlantic sturgeon detections (2007–2017) in the lower Kennebec River at rm 2.8, rm 9.9, and rm 11.2 (Table 12, Figure 7). The number of Atlantic sturgeon that were acoustically tagged in the Kennebec include 5 in 2009, 8 in 2010, 11 in 2011, 16 in 2012, and 15 in 2013. Other detections came from fish tagged in the Penobscot, Saco, and Merrimack Rivers. Across all years and all river mile markers, the first detection of an Atlantic sturgeon occurred in March at rkm 16 and was intermittent through the end of November. Receiver stations were not deployed past the second day of December for any year. Based on the trend in these data (Figure 7), Atlantic sturgeon are not likely to occur in the proposed action area in the late fall and winter months as they would be likely to move out to sea by December of each year.

Table 13: Average number of days per month individual Atlantic sturgeon were detected by acoustic tagging study (Wippelhauser (2019) unpublished data, used with permission)

Species	***Receiver Location (at rm)***	***# Years Deployed***	***Mar[1]***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec[2]***
Atlantic sturgeon	2.8	6		3.3	4.0	4.7	2.4	2.6	3.0	3.7	4.2	3.0
Atlantic sturgeon	9.9	11	5.5	5.6	7.9	5.7	3.4	2.8	2.6	2.3	1.6	

Atlantic sturgeon	11.2	1						1.9	4.4	2.8		

[1] Only two individual fish detected in March at rm 9.9 for the 3 days data was collected.
[2] Only one individual fish detected in December at rm 2.8 for the 11 days data was collected.

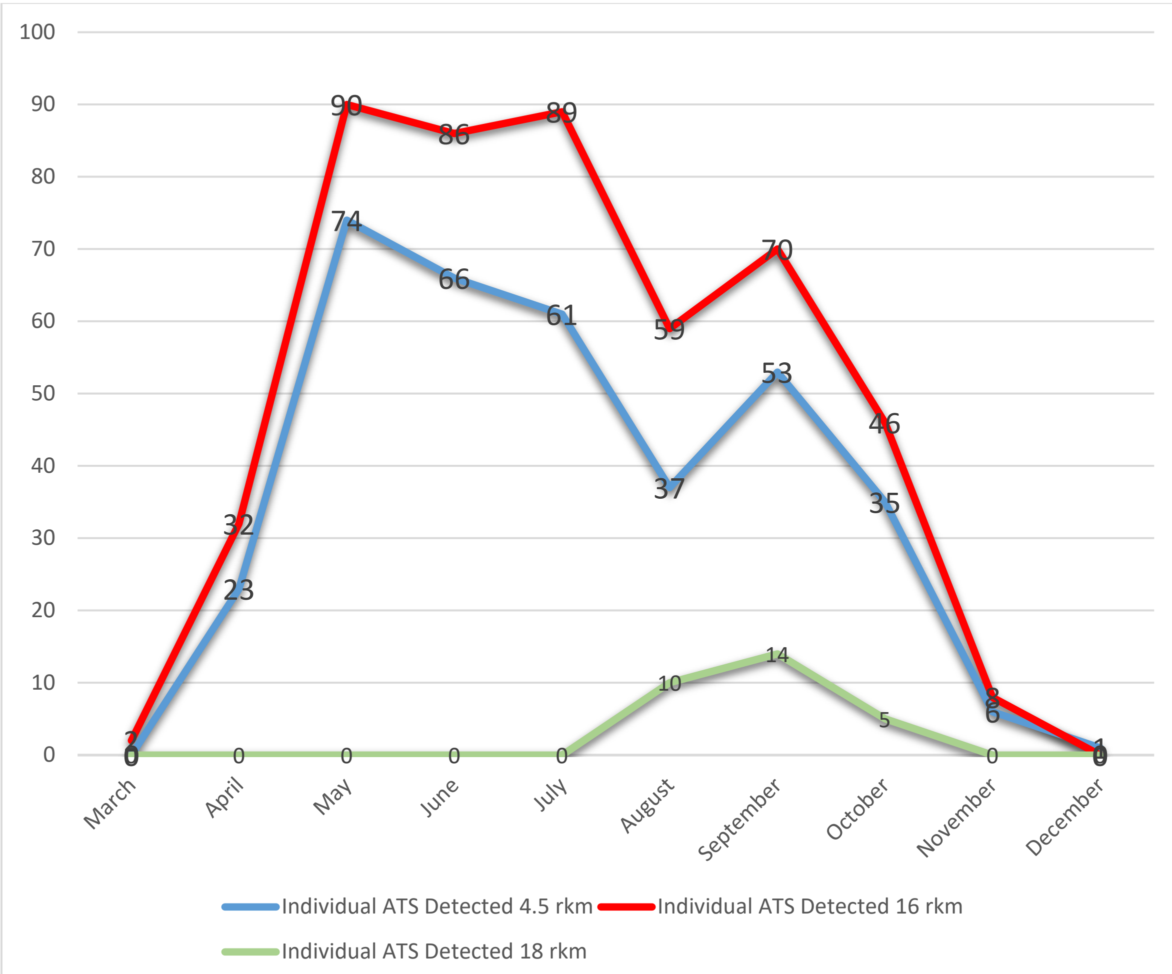

Figure 6: Number of individual Atlantic sturgeon detected in the Kennebec River from 2007–2017 at rm 2.8, 9.9, and 11.2 (rkm 4.5, 16, and 18) (Wippelhauser (2019) unpublished data, used with permission)

Additional data from a trawl survey in the Kennebec River in the late 1990s near the BIW shipyard shows captures of subadult Atlantic sturgeon from April 17 through November 17 (Atlantic Sturgeon Status Review Team 2007). Atlantic sturgeon were not captured from December 1997 through February 1998. However, the researchers were able to track tagged fish around BIW until ice impeded the researchers' navigation, providing evidence that Atlantic sturgeon are likely present year-round. Atlantic sturgeon were also tracked in the Bath region of the river (near rm 12.4) in 1998 and 1999. Two Atlantic sturgeon were tracked in October and November 1998, and one was present in December 1998 in Merrymeeting Bay (presumably overwintering with shortnose sturgeon). An overwintering site has not been identified for the Atlantic sturgeon in the Kennebec River; therefore, it is thought adults and subadults would mostly move out to sea by December of each year (Wippelhauser and Squiers Jr 2015). Atlantic sturgeon were tracked again from April through November 1999. They were observed to move in and out of BIW, up to Swan Island (in the mouth of the Penobscot River) and Chops Point, and down to Hospital Point (near the Doubling Point dredge site in the lower Kennebec River) (Atlantic Sturgeon Status Review Team 2007).

Table 14: Timing of Atlantic sturgeon lifestages and behaviors in the action area

Lifestage	Time of Year Present in Action Area	Behavior in Action Area
Adults	April 1 – November 30	Adults are expected to be present and actively foraging from April through November; however, the number of recorded detections in November is extremely low (Figure 6). Spawning adults will migrate upstream in the spring and downstream in the fall. Adults are not known to overwinter in the action area.
Subadults	April 1 – November 30	Subadults are expected to be present and actively foraging from April through November; however, the number of recorded detections in November is extremely low (Figure 6). Subadults are not known to overwinter in the action area.
Juveniles	Year-round	Juveniles are expected to be present and actively foraging from April through November; however, the number of recorded detections in November is extremely low (Figure 6). Presence in the action area from November through March is expected to be rare and limited to a few individuals.

6.0 CLIMATE CHANGE

The discussion below presents background information on global climate change and information on past and predicted future effects of global climate change throughout the range of the listed species considered here. Additionally, we present the available information on predicted effects of climate change on listed species and critical habitat in the action area over the lifespan of the proposed project (2020-2029). Climate change is relevant to the Status of the Species, Environmental Baseline and Cumulative Effects sections of this Opinion; rather than include partial discussion in several sections of this Opinion, we are synthesizing this information into one discussion, below.

6.1 Background Information on Global climate change

In its Fifth Assessment Report (AR5) from 2014, the Intergovernmental Panel on Climate Change (IPCC) stated that the globally averaged combined land and ocean surface temperature data has shown a warming of 0.85°C (likely range: 0.65° to 1.06°C) over the period of 1880-2012. Similarly, the total increase between the average of the 1850-1900 period and the 2003-2012 period is 0.78°C (likely range: 0.72° to 0.85°C). On a global scale, ocean warming has been largest near the surface, with the upper 75 m of the world's oceans having warmed by 0.11°C (likely range: 0.09° to 0.13°C) per decade over the period of 1971-2010 (IPCC 2014). In regards to resultant sea level rise, it is very likely that the mean rate of global averaged sea level rise was 1.7 millimeters/year (likely range: 1.5 to 1.9 millimeters/year) between 1901 and 2010, 2.0 millimeters/year (likely range: 1.7 to 2.3 millimeters/year) between 1971 and 2010, and 3.2 millimeters/year (likely range: 2.8 to 3.6 millimeters/year) between 1993 and 2010.

Climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next several decades. The global mean surface temperature change for the period 2016-2035 relative to 1986-2005 will likely be in the range of 0.3° to 0.7°C (medium confidence). This assessment is based on multiple lines of evidence and assumes there will be no major volcanic eruptions or secular changes in total solar irradiance. Relative to natural internal variability, near-term increases in seasonal mean and annual mean temperatures are expected to be larger in the tropics and subtropics than in mid- and high latitudes (high confidence). This temperature increase will very likely be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Climate warming has also resulted in increased river discharge and glacial and sea-ice melting (Greene *et al.* 2008). The strongest ocean warming is projected for the surface in tropical and Northern Hemisphere subtropical regions. At greater depths, the warming will be most pronounced in the Southern Ocean (high confidence). Best estimates of ocean warming in the top 100 m are about 0.6° to 2.0°C, and about 0.3° to 0.6°C at a depth of about 1,000 m by the end of the 21st century (IPCC 2014).

Under Representative Concentration Pathway (RCP) 8.5, the projected change in global mean surface air temperature and global mean sea level rise for the mid- and late 21st century relative to the reference period of 1986-2005 is as follows. Global average surface temperatures are likely to be 2.0°C higher (likely range: 1.4° to 2.6°C) from 2046-2065 and 3.7°C higher (likely range: 2.6° to 4.8°C) from 2081-2100. Global mean sea levels are likely to be 0.30 m higher (likely range: 0.22 to 0.38 m) from 2046-2065 and 0.63 m higher (likely range: 0.45 to 0.82 m) from 2081-2100, with a rate of sea level rise during 2081-2100 of 8 to 16 millimeters/year (medium confidence).

The past three decades have witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene *et al.* 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and the export of freshwater to the North Atlantic (IPCC 2007; Greene *et al.* 2008). With respect specifically to the North Atlantic Oscillation (NAO), changes in salinity and temperature are thought to be the result of changes in the Earth's atmosphere caused by anthropogenic forces (IPCC 2007). The NAO impacts climate variability throughout the Northern Hemisphere (IPCC 2007). Data from the 1960s through the 2000s showed that the NAO index increased from minimum values in the 1960s to strongly positive index values in the 1990s and somewhat declined since (IPCC 2007).

This warming extends over 1,000 m deep and is deeper than anywhere in the world's oceans and is particularly evident under the Gulf Stream/North Atlantic Current system (IPCC 2007). On a global scale, large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (IPCC 2007; Greene *et al.* 2008). There is evidence that the NADW has already freshened significantly (IPCC 2007). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the entire world (Greene *et al.* 2008).

There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Ocean acidification resulting from massive amounts of carbon dioxide and pollutants released into the air can have major adverse impacts on the calcium balance in the oceans. Changes to the marine ecosystem due to climate change include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007). These trends have been most apparent over the past few decades, although this may also be due to increased research. Information on future impacts of climate change in the action area is discussed below.

While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change over the next few decades on coastal and marine resources on smaller geographic scales, such as the action area, especially as climate variability is a dominant factor in shaping coastal and marine systems. The effects of future change will vary greatly in diverse coastal regions for the U.S. Additional information on potential effects of climate change specific to the action area is discussed below. Warming and sea level rise is very likely to continue in the U.S. over this century, particularly through this middle of this century, regardless of reductions in greenhouse gases, due to emissions that have already occurred (USGCRP 2018). It is very likely that the magnitude and frequency of ecosystem changes will continue to increase in the next 50 years, and it is possible that they will accelerate. Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. Water temperatures in streams and rivers are likely to increase as the climate warms and are very likely to have both direct and indirect effects on aquatic ecosystems. Changes in temperature will be most evident during low flow periods when they are of greatest concern (USGCRP 2018). In some marine and freshwater systems, shifts in geographic ranges and changes in algal, plankton, and fish abundance are associated with high confidence with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation (IPCC 2007).

Expected consequences of climate change for river systems could be 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). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). A warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants currently degrade water quality (Murdoch *et al.* 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources along the U.S. Atlantic coast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. A global analysis of the potential effects of climate change on river basins indicates that due to changes in discharge and water stress, the area of large river basins in need of reactive or proactive management interventions in response to climate change will be much higher for basins impacted by dams than for basins with free-flowing rivers (Palmer *et al.* 2008). Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to adapt so that systems that might ordinarily be capable of responding to variability and change are less able to do so. Because stresses on water quality are associated with many activities, the impacts of the existing stresses are likely to be exacerbated by climate change. Within 50 years, river basins that are impacted by dams or by extensive development will experience greater changes in discharge and water stress than unimpacted, free-flowing rivers (Palmer *et al.* 2008).

While debated, researchers anticipate: 1) the frequency and intensity of droughts and floods will change across the nation; 2) a warming of about 1.2^{o}C over the next few decades; and 3) continued sea level rise; annual median sea level along the U.S. coast has increased about 22.9 cm since the early 20th century (USGCRP 2018). It is also important to note that ocean temperature in the U.S. Northeast Shelf and surrounding Northwest Atlantic waters have warmed faster than the global average over the last decade (Pershing *et al.* 2015). New projections for the U.S. Northeast Shelf and Northwest Atlantic Ocean suggest that this region will warm two to three times faster than the global average and thus existing projections from the IPCC may be too conservative (Saba *et al.* 2015).

6.2 Anticipated Effects of Climate Change in the Action Area to Atlantic and shortnose sturgeon and the Kennebec River Critical Habitat Unit

Information on how climate change will impact the action area is extremely limited. According to Fernandez *et al.* (2015), the Intergovernmental Panel on Climate Change (IPCC) models predict that Maine's annual temperature will increase another 3.0–5.0 °F (1.7–2.8 °C) by 2050. The IPCC models predict that precipitation will continue to increase across the Northeast by 5–10% by 2050, although the distribution of this increase is likely to vary across the climate zones (Fernandez *et al.* 2015); model predictions show greater increases in precipitation in interior Maine. Total accumulated snow is predicted to decline in Maine especially along the coast where total winter snow loss could exceed 40% relative to recent climate (Fernandez *et al.* 2015). Since 2004, sea surface temperatures in the Gulf of Maine have accelerated to 0.41 °F (0.23 °C) per year; a rate that is faster than 99% of the world's oceans (Fernandez *et al.* 2015).

According to the most recent National Climate Assessment (Melillo *et al.* 2014), a global sea level is projected to rise an additional 0.5 to 2.0 ft (0.2 to 0.6 m) or more by 2050. Rising sea levels would likely shift the salt wedge in the Kennebec River and other rivers in the GOM DPS; however the action area is relatively far from the current upper limits of the salt wedge where Merrymeeting Bay empties into the lower Kennebec River estuary (at least 9.3 rm), and is buffered to some extent by Merrymeeting Bay. As there is significant uncertainty in the rate and timing of change as well as the effect of any changes that may be experienced in the action area due to climate change, it is difficult to predict the impact of these changes on Atlantic salmon.

Water availability, either too much or too little, as a result of global climate change is expected to have an effect on the features essential to successful sturgeon spawning and recruitment of the offspring to the marine environment (for Atlantic sturgeon). The increased rainfall predicted by some models in some areas may increase runoff, scour spawning areas, and create flooding events that dislodge early life stages from the substrate where they refuge in the first weeks of life. High freshwater inputs during juvenile development can influence juveniles to move further downriver and, conversely, lower than normal freshwater inputs can influence juveniles to move further upriver potentially exposing the fish to threats they would not typically encounter. Increased number or duration of drought events (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spawning season(s) may also expose eggs and larvae in rearing habitats. If a river becomes too shallow or flows become intermittent, all sturgeon life stages, including adults, may become susceptible to stranding or habitat restriction. Low flow and drought conditions are also expected to cause additional water quality issues including effects to the combined interactions of dissolved oxygen, water temperature, and salinity. Elevated air temperatures can also impact dissolved oxygen levels in the water, particularly in areas of low water depth, low flow, and elevated water temperature. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems affecting dissolved oxygen and temperature.

The action area encompasses an estuarine, mesohaline portion of the Kennebec River. The relatively short timeframe of the proposed action (2020-2029) makes any prediction of large scale and long-term climate change effects difficult. That said, over the next ten years, we do not expect the salinity of the action area to change in any way that would meaningfully alter the use of the habitat for sturgeon foraging or resting.

In the action area, it is possible that changing seasonal temperature regimes could result in shifts in the timing of seasonal migrations through the area as sturgeon move throughout the river. Atlantic sturgeon prefer water temperatures up to approximately 28 °C (82.4 °F); these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise and temperatures above 28 °C are experienced in larger areas, Atlantic sturgeon may be excluded from some habitats. Additionally, temperature cues for spawning migration and spawning could occur earlier in the season causing a mismatch in prey that are currently available to developing sturgeon in rearing habitat. Any of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey.

Spawning and overwintering behaviors are not triggered solely by water temperature, but also by day length (which would not be affected by climate change) and river flow (which could be affected by climate change). It is difficult to predict how any change in water temperature or river flow will affect the seasonal movements of sturgeon through the action area. However, it seems most likely that spawning would shift to earlier in the year, and that overwintering may begin later and end earlier.

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

Limited information on the thermal tolerances of Atlantic and shortnose sturgeon is available. Atlantic sturgeon have been observed in water temperatures above 30°C in the south (see Damon-Randall *et al.* 2010); in the wild, shortnose sturgeon are typically found in waters less than 28°C. In the laboratory, juvenile Atlantic sturgeon showed negative behavioral and bioenergetics responses (related to food consumption and metabolism) after prolonged exposure to temperatures greater than 28°C (82.4°F) (Niklitschek 2001). Tolerance to temperatures is thought to increase with age and body size (Jenkins *et al.* 1993, Ziegeweid *et al.* 2008), however, no information on the lethal thermal maximum or stressful temperatures for subadult or adult Atlantic sturgeon is available. Shortnose sturgeon, 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. For purposes of considering thermal tolerances, we consider Atlantic sturgeon to be a reasonable surrogate for shortnose sturgeon given similar geographic distribution and known biological similarities. Rising temperatures could meet or exceed the preferred temperature of shortnose and Atlantic sturgeon (28°C) on more days and/or in larger areas. This could result in shifts in the distribution of sturgeon out of certain areas during the warmer months. Information from southern river systems suggests that during peak summer heat, sturgeon are most likely to be found in deep water areas where temperatures are coolest. Thus, we could expect that over time, sturgeon would shift out of shallow habitats on the warmest days. This could result in reduced foraging opportunities if sturgeon were foraging in shallow waters.

As described above, over the long term, global climate change may affect shortnose and Atlantic sturgeon by affecting the location of the salt wedge, distribution of prey, water temperature and water quality. However, there is significant uncertainty, due to a lack of scientific data, on the degree to which these effects may be experienced and the degree to which shortnose or Atlantic sturgeon will be able to successfully adapt to any such changes. Any activities occurring within and outside the action area that contribute to global climate change are also expected to affect shortnose and Atlantic sturgeon in the action area. While we can make some predictions on the likely effects of climate change on these species, without modeling and additional scientific data these predictions remain speculative. Additionally, these predictions do not take into account the adaptive capacity of these species which may allow them to deal with change better than predicted.

Additional modeling for climate change impacts, particularly salt water intrusion, are needed for the action area, to better assess the potential effects on shortnose and Atlantic sturgeon, as well as Atlantic sturgeon critical habitat.

7.0 EFFECTS OF THE ACTION

This section of an Opinion assesses 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 (Sec § 402.17).

This Opinion examines the likely consequences of the proposed action on the shortnose sturgeon, Atlantic sturgeon (GOM DPS), and the Kennebec River Unit of critical habitat designated for Atlantic sturgeon (GOM DPS). We consider these effects on the species and their habitat within the context of the species status now and projected over the course of the action, the environmental baseline, and cumulative effects.

As explained in the "Description of the Proposed Action" section (3.0), the action under consideration in this Opinion is ten years of maintenance dredging (2020-2029) of the various piers, landing grids, and sinking basin at BIW, with open water disposal at the Bluff Head disposal site. You anticipate maintenance dredging to be needed every one to two years; however, given the unpredictability of future Navy ship movements from the BIW shipyard to the open ocean and shoaling conditions, we will assume that dredging may occur on an annual basis. When possible, dredge events will occur from November 1 to April 1; however, you are proposing that as many as three dredge events may occur from April 2 to October 31 between 2020 and 2029.

We have divided the following sections by the project related stressors we have identified that may have an effect on listed species or critical habitat.

7.1 Dredging Entrapment

The scope of the Proposed Action includes ten years of maintenance dredging. Based on previous dredging requirements, you anticipate maintenance dredging to be needed every one to two years; however, future Navy ship movements from the BIW shipyard to the open ocean, or shoaling conditions could require annual dredging. Based on past dredge events since 2000 (Table 1), we estimate that average annual dredging will remove approximately 17,300 cubic yards (cy) of clean sand will be removed from BIW over an area of approximately 17.9 acres. This average annual estimate accounts for the fact that approximately every 4 years, 50,000-70,000 cy of clean sand are also removed from the sinking basin. Therefore, over 10 years, we anticipate that approximately 173,000 cy of material will be dredged from BIW. You have proposed to complete all dredging with a mechanical dredge.

7.1.1 Mechanical Dredging

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

7.1.2 Mechanical Dredging Effects on Sturgeon

Sturgeon may be injured or killed from entrapment in the bucket or burial in sediment during dredging and/or when sediment is deposited into the dredge scow. Sturgeon captured and emptied out of the bucket could suffer severe stress or injury, which could also lead to mortality.

In 2012, you (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 capture in dredge buckets, of which four are considered credible. 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 (NMFS 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 BIW in 2001 (Maine DMR 2002). On April 30, 2003, a shortnose sturgeon was captured in a clam-shell bucket dredge operating in the BIW sinking basin; the fish was nearly cut in half. This fish was killed during the last hour of a 24-hour a day dredging operation that had been ongoing for approximately six weeks. One shortnose sturgeon was captured in a clamshell bucket and detected in the dredge scow on June 1, 2009 during dredging operations at BIW. Observer coverage at dredging operations at the BIW facility has been 100 percent for approximately 20 years, with dredging occurring every one to two years.

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

You are proposing as many as ten dredge events from 2020-2029, with three of the ten events potentially occurring from April 2 to October 31, and the others occurring from November 1 to April 1. Based on the occurrence of sturgeon in the action area, and the documented vulnerability of this species to capture with mechanical dredges at BIW, it is likely that a small number of sturgeon will be captured by a mechanical dredge operating to remove sediment.

Since 1997 when endangered species observers began staffing dredging projects at BIW, two shortnose sturgeon (April 2003; June 2009) and one Atlantic sturgeon (June 2001) have been documented to be captured with a mechanical dredge. Based on the best available information, the risk that a shortnose or Atlantic sturgeon would be captured in the slow moving dredge bucket is relatively low. This is evidenced by the small number of sturgeon captured during dredging operations at BIW since 1997, despite the occurrence of approximately 20 dredge events since this time.

Based on the Maine DMR CPUE data (see Table 16; Table 17), the greatest risk for interactions between mechanical dredges and individual sturgeon at BIW is likely in June, July, and October for shortnose sturgeon, and July and September for Atlantic sturgeon, when fish are present in larger numbers. We expect the majority of both sturgeon species to have left the action area between November 1 and April 1. The likelihood of a dropping dredge bucket interacting with an individual sturgeon is low due to the slow speed at which the bucket moves and the relatively small area of the bottom it interacts with at any one time. Therefore, it is extremely unlikely that a sturgeon would be captured during mechanical dredging activities between November 1 and April 1, and effects are discountable.

Based on the dredging history at BIW, and the consistently documented presence of sturgeon throughout most of the spring, summer, and fall, we expect that one sturgeon (Atlantic or shortnose) may be captured during each of the three potential dredge events that occur from April 2 through October 31. Thus, a total of no more than three shortnose sturgeon or three Atlantic sturgeon are likely to be captured by a mechanical dredge operating to conduct maintenance dredging over the 10 years of proposed maintenance dredging (2020-2029).

Sturgeon captured in a dredge bucket could be injured or killed. Sources of mortality include injuries suffered during contact with the dredge bucket or burial in the dredge scow. Of the three captures of sturgeon with mechanical dredges at BIW (two shortnose, one Atlantic), one of the shortnose sturgeon was killed. This fish suffered from a large laceration, likely experienced due to contact with the dredge bucket. The Atlantic sturgeon reportedly captured in Wilmington Harbor (1998) was also killed. As the risk of mortality once captured is high, it is reasonable to expect that any of the sturgeon likely to be captured in the dredge bucket could suffer injury or mortality due to contact with the dredge bucket or through suffocation due to burial in the scow. Furthermore, we do not know if the two other sturgeon captured during prior BIW dredging events survived after being released. Therefore, it is reasonable to expect that any captured sturgeon will suffer mortality.

As noted in the Status and Environmental Baseline sections, we expect 93% of adult and subadult Atlantic sturgeon in the action area to be from the Gulf of Maine DPS, and 7% from the New York Bight DPS. Given the low numbers of New York Bight DPS fish in the action area and the low number of mortalities anticipated over 10 years, it is unlikely that there will be any mortality of New York Bight DPS Atlantic sturgeon adults or subadults. Therefore, the three anticipated takes of Atlantic sturgeon, whether they be adults, subadults, or juveniles, would be from the Gulf of Maine DPS.

7.2 Sedimentation and Turbidity

7.2.1 Proposed activities that may produce sedimentation and turbidity

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

7.2.3 Mechanical Dredge

Mechanical dredges include many different bucket designs (e.g., clamshell, closed versus open bucket, level-cut bucket) and backhoe dredges, representing a wide range of bucket sizes. TSS concentrations associated with mechanical clamshell bucket dredging operations have been shown to range from 105 mg/L in the middle of the water column to 445 mg/L near the bottom (210 mg/L, depth-averaged)(USACE 2001). Furthermore, a study by Burton (1993) measured TSS concentrations at distances of 500, 1,000, 2,000 and 3,300 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 New York/New Jersey Harbor Deepening Project, USACE conducted extensive monitoring of mechanical dredge plumes (USACE 2015). The dredge sites included Arthur Kill, Kill Van Kull, Newark Bay, and Upper New York Bay. Although briefly addressed in the report, the effect of currents and tides on the dispersal of suspended sediment were not thoroughly examined or documented. Independent of bucket type or size, plumes dissipated to background levels within 600 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 suspended sediment concentrations at several hundreds of mg/L above background may be present in the immediate vicinity of the bucket, but would settle rapidly within a 2,400 ft (732 m) radius of the dredge location.

7.2.4 In-River Open Water Disposal

During the discharge of sediment at offshore disposal sites, suspended sediment concentrations have been reported as high as 500 mg/L within 250 ft (76 m) of the disposal vessel and decreasing to background levels (i.e., 15.0–100.0 mg/L depending on location and sea conditions within 1,000-6,500 ft (305–1,981 m)(USACE 1983). Plume concentrations are generally less likely to exceed baseline levels of suspended sediments in excess of 4,000 ft (1,219 m). Additionally, at disposal sites, the TSS near the center of the sediment plume body have been observed to return to near background levels in 35 to 45 minutes (Battelle 1994 in USACE and EPA 2010). At Bluff's Head, deposited sediment may be carried upstream or downstream by flood currents and return to background conditions in short duration. Additionally, the dredged material is considered mostly medium grain sand with very low silt content, limiting the potential for dispersion estimate. Given this information, the potential area of effect at the disposal site could be conservatively characterized as 4,000 ft (1,219 m) from the disposal location.

7.2.5 Effects of Turbidity and Suspended Sediments on Sturgeon

Studies of the effects of turbid water on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The TSS levels expected for all of the proposed activities (ranging from 105 mg/L to 500 mg/L) are below those shown to have adverse effects on fish (580 mg/L for the most sensitive species, with 1,000 mg/L more typical; see summary of scientific literature in Burton 1993). We expect sturgeon to either swim through the plumes associated with dredging or disposal activities, or make small evasive movements to avoid them. Based on the best available information, we will not be able to meaningfully detect, evaluate, or measure the effects of re-suspended sediment on sturgeon when added to baseline conditions. Therefore, effects on sturgeon are insignificant.

7.3 Vessel Traffic

7.3.1 Background Information on the Risk of Vessels to Sturgeon

The factors relevant to determining the risk to Atlantic and shortnose sturgeon from vessel strikes are currently unknown, but based on what is known for other species we expect they are related to size and speed of the vessels, navigational clearance (i.e., depth of water and draft of the vessel) in the area where the vessel is operating, and the behavior of sturgeon in the area (e.g., foraging, migrating, etc.). Geographic conditions (e.g. narrow channels, restrictions, etc.) may also be relevant risk factors. Large vessels have been typically implicated because of their deep draft relative to smaller vessels, which increases the probability of vessel collision with demersal fishes like sturgeon, even in deep water (Brown and Murphy 2010). Larger vessels also draw more water through their propellers given their large size and therefore may be more likely to entrain sturgeon in the vicinity. Miranda and Killgore (2013) estimated that the large towboats on the Mississippi River, which have a propeller diameter of 8.2 ft (2.5 m), a draft of up to 9 ft, and travel at approximately the same speed as tugboats (less than ten knots), kill a large number of fish by drawing them into the propellers. They indicated that shovelnose sturgeon (*Scaphirhynchus platorynchus*), a small sturgeon (~19.7-33.5 in long) with a similar life history to shortnose sturgeon, were being killed at a rate of 0.02 individuals per kilometer traveled by the towboats.

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

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

7.3.2 Effects of Project Vessel Traffic on Sturgeon

Vessel traffic resulting from the proposed action will be limited to dredging, disposal, and support vessels. Specifically, you have indicated that project vessels will consist of a dredge barge, a dump barge (scow), and a tugboat to maneuver the two barges, which are not self-propelled (Table 14)(email from BIW, Nadeau, June 26, 2020).

Table 15: Project Vessel Characteristics

Vessel Type	Vessel Characteristics		
	Length (ft)	Draft (ft)	Speed (knots)
Tugboat	85	11	<10
Dredge Barge	154	4.5	Not self-propelled
Dump Barge (Scow)	240	18.5 (loaded)	Not self-propelled

A typical dredging and disposal event lasts for approximately 20-30 days, and require 8-10 trips to the Bluff Head in-river disposal site for every 30,000 cy of dredging. As we expect an average annual dredge total of approximately 17,300 cy, with some seasons requiring up to 70,000 cy if the sinking basin requires dredging, annual vessel trips to Bluff Head could range from 6-23. The maximum speed of any project vessel will be 10 knots; however when the tug is moving a full scow, it will likely be much slower.

The proposed ten years of maintenance dredging at BIW (10 events) will maintain the baseline condition in the action area that allows for the access for naval warships to navigate from the BIW shipyard to the open ocean.

Adding the aforementioned project vessels to the existing baseline will not increase the risk that any vessel in the area will strike an individual, or will increase it to such a small extent that the effect of the action (i.e., any increase in risk of a strike caused by the project) cannot be meaningfully measured or detected. While we know vessel strikes of sturgeon do occur in the

Kennebec River, the baseline risk of a vessel strike in the action area is unknown. The increase in traffic associated with the proposed project is extremely small, intermittent (project vessels for 20-30 days annually), and restricted to a small portion of the overall action area on any given day (i.e., only minor movements within dredge area unless moving to and from Bluff Head disposal site). Furthermore, we do not expect the project vessel drafts to exceed 18.5 ft, leaving no less than 8.5 ft of clearance above the river bottom when transiting through the main channel. While this does not obviate the risk of sturgeon vessel strikes, it does minimize disturbance of the river bottom, which may uncover prey and attract sturgeon. It also creates a buffer between the area where we normally expect sturgeon to be foraging (i.e., along the river bottom). As such, any increased risk of a vessel strike caused by the project will be too small to be meaningfully measured or detected. As a result, the effect of the action on the increased risk of a vessel strike in the action area is insignificant.

7.4 Habitat Modification from Dredging and Disposal Activities

Shortnose and Atlantic sturgeon feed on a variety of benthic invertebrates. While shortnose sturgeon feed on shellfish and other benthic invertebrates, shellfish typically make up a very small percentage of the prey base of Atlantic sturgeon; Atlantic sturgeon prey primarily on soft bodied invertebrates such as worms (Guilbard *et al.* 2007b, Savoy 2007). The proposed dredging will occur in several of BIWs piers, landing grids, and the sinking basin. Dredging is likely to entrain and kill at least some of these potential sturgeon forage items. Placement of barge spuds, turbidity, and suspended sediments from dredging activities, as well as the placement of dredged material at the Bluff Head disposal site may also affect benthic resources in those areas. As noted in Section 7.2.5, some of the TSS levels expected for all of the proposed activities (ranging from 105 mg/L to 500 mg/L) exceed the levels shown to have adverse effects on benthic communities (390 mg/L (EPA 1986)).

Benthic sampling done by O'Herron and Hastings (1985) in association with past USACE maintenance dredging in the Delaware River found that *Corbicula* (a river clam) recolonized the dredge areas during the subsequent growing season. However, the post-dredge individuals collected were smaller than pre-dredge individuals and provided less biomass. O'Herron and Hastings (1985) found that adult shortnose sturgeon may not be able to efficiently utilize new molluscan colonizers due to the limited biomass until the end of the second growing season after dredging. Based on this information, sturgeon should only be exposed to a reduction in forage in the areas where dredging occurs every one to two years.

Effects on benthic invertebrates from dredge material disposal depends on the quantity disposed and consequently the depth of the overburden (i.e. the thickness of the dredged material layer) as well as the frequency of deposition (Wilber and Clarke 2007). Burrowing Polychaeta worms, amphipods, and mollusks can migrate vertically through sediment 5.9-12.6 in (15-32 cm) deep (Maurer *et al.* 1982, Robinson *et al.* 2005). Benthic fauna that survived the dredging and dumping process can also contribute to quick recovery of the depositional sediment. Recovery of dredged disposal sites usually occur within a year in temperate waters (Wilber and Clarke 2007). This should be possible at the BIW sites, as well, as dredging rarely occurs at the same site in consecutive years. However, the near annual use of the site for open water sediment disposal may cause a chronic reduction in the quantity of fauna and the quality of the site for sturgeon foraging (Hatin *et al.* 2007).

Based on your description of the proposed action, dredging and disposal in the action area may occur every year (ten events). Bluff Head disposal site is a dynamic area where we expect dredged material (which is primarily sand) to be transported elsewhere in the system (i.e., downstream), potentially lessening the effects of prey item burial.

Both species of sturgeon may forage in the full extent of the action area, primarily over soft substrates. Using the data you have provided, dredging and disposal activities will affect approximately 23.6 non-contiguous acres of potential foraging habitat. This area may be slightly larger due to the effects of turbidity plumes from these activities. This area represents approximately 2.3% of the overall action area. As discussed in sections 4.1.2 and 5.2, the environmental baseline includes maintenance dredging of the Kennebec River FNP. Maintenance dredging of the Kennebec River FNP will alter an additional 45 acres of foraging habitat within the action area every two to three years. Therefore, when the proposed action is added to the baseline, we estimate that 93.1% (938.4 acres) of the unaffected, contiguous habitat in the action area supporting foraging habitat remains available to support sturgeon foraging and development. Given the limited area where benthic resources will be removed or displaced, and the expectation that dredging sites will be fully recovered and available for foraging for at least a year prior to the next event, effects on sturgeon from reductions in benthic resources will be too small to be meaningfully measured or detected, and are therefore insignificant.

8.0 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. The effects of future state and private activities in the action area that are reasonably certain to occur are continuation of recreational fisheries and the discharge of pollutants. It is important to note that the definition of “cumulative effects” in the section 7 regulations is not the same as the NEPA definition of cumulative effects.

Impacts to Atlantic sturgeon and shortnose sturgeon from non-federal activities are largely unknown in the Kennebec River. It is possible that occasional recreational fishing for anadromous fish species may result in the illegal capture of these species. Within the action area, despite strict state and federal regulations, sturgeon remain vulnerable to injury and mortality due to incidental capture by recreational anglers.

Commercial fisheries for elvers (juvenile eels) and alewives may also capture Atlantic sturgeon and shortnose sturgeon as bycatch. No estimate of the numbers of these ESA-listed species caught incidentally in recreational or commercial fisheries exists.

Pollution from point and non-point sources has been a major problem in this river system, which continues to receive discharges from sewer treatment facilities and paper production facilities (metals, dioxin, dissolved solids, phenols, and hydrocarbons). Atlantic sturgeon and shortnose sturgeon are vulnerable to impacts from pollution and are likely to continue to be impacted by water quality impairments in the Kennebec River and its tributaries.

Contaminants associated with the action area are directly linked to industrial development along the waterfront. PCBs, heavy metals, and waste associated with point source discharges and refineries are likely to be present in the future due to continued operation of industrial facilities. In addition, many contaminants such as PCBs remain present in the environment for prolonged periods of time and thus would not disappear even if contaminant input were to decrease. It is likely that Atlantic sturgeon and shortnose sturgeon will continue to be affected by contaminants in the action area in the future.

Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from development, groundwater discharges, and industrial development. Chemical contamination may have an effect on listed species reproduction and survival. As noted above, impacts to listed species from all of these activities are largely unknown. However, we have no information to suggest that the effects of future activities in the action area will be any different from effects of activities that have occurred in the past.

9.0 INTEGRATION & SYNTHESIS

In the effects analysis outlined above, we considered potential effects to Atlantic and shortnose sturgeon from the following sources: (1) maintenance dredging of BIWs piers, landing grids, and sinking basin; (2) disposal at Bluff Head; and (3) physical alteration of the action area including effects to benthic communities in the action area. In addition to these categories of effects, we considered the potential for collisions between listed species and project vessels, and the potential effects to vessel traffic in the action area as a result of maintenance dredging.

Over the 10-year duration of the action, you have proposed 10 dredge events using mechanical dredge. As analyzed in Section 7.1, we anticipate the mortality of as many as 3 Gulf of Maine DPS Atlantic sturgeon (adults, subadults, or juveniles) and 3 shortnose sturgeon (adults or juveniles). We do not anticipate any mortality of sturgeon due to any of the other effects including vessel traffic, turbidity related to dredging or disposal, or habitat removal.

In the discussion below, we consider whether the effects of the proposed action reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of Atlantic sturgeon (GOM DPS) and shortnose sturgeon in the wild by reducing the reproduction, numbers, or distribution of sturgeon affected by the action. The purpose of this analysis is to determine whether the proposed action, in the context established by the status of the species, environmental baseline, and cumulative effects, would jeopardize the continued existence of either species of sturgeon in the action area or result in destruction or adverse modification of critical habitat. In the NMFS/USFWS Section 7 Handbook, for the purposes of determining jeopardy, survival is defined as, “the species’ persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species’ entire life cycle, including reproduction, sustenance, and shelter.” Recovery is defined as, “Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." Below, for the listed species that may be affected by the proposed action, we summarize the status of the species and consider whether the proposed action will result in reductions in reproduction, numbers or distribution of Atlantic and shortnose sturgeon and then we consider whether any reductions in reproduction, numbers or distribution resulting from the proposed action would reduce appreciably the likelihood of both the survival and recovery of Atlantic and shortnose sturgeon, as those terms are defined for purposes of the ESA.

9.1 Shortnose Sturgeon

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 248.5 mi (400 km). 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 Schnabel estimate of approximately 9,500 adult shortnose sturgeon, based on Maine DMR survey data from 1998-2000 is the most recent population estimate for the Kennebec River shortnose sturgeon population; however, this estimate includes fish from the Androscoggin and Sheepscot rivers, as well, and does not include an estimate of the size of the juvenile population. A comparison of the population estimate for the estuarine complex from 1982 (Squiers et al. 1982) to 2000 (Squiers 2003; Wippelhauser and Squiers 2015) suggests that the adult population grew by approximately 90% in the intervening twenty years. Based on this information, NMFS believes that the shortnose sturgeon population in the Kennebec River is increasing.

While no reliable estimate of the size of either the shortnose sturgeon population in the Northeastern US 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 Kennebec River are affected by habitat alteration, bycatch in commercial and recreational fisheries, water quality, in-water construction activities (including dredging), and vessel traffic.

We have estimated that proposed maintenance dredging activities from 2020-2029 will kill up to 3 shortnose sturgeon (adults or juveniles). The best available population estimates indicate that there are approximately 9,500 adult shortnose sturgeon in the Kennebec River and an unknown number of juveniles (Wippelhauser and Squiers 2015). While the death of 3 juvenile or adult shortnose sturgeon 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 increasing trend as this loss represents a very small percentage of the population of adult shortnose sturgeon in the Kennebec River (0.03%), and it is not likely that this reduction in numbers would be detectable at the population scale. The effect of this loss is also lessened as it will be experienced slowly over time, with the death of an average of less than one (0.3) shortnose sturgeon adults or juveniles per year during the next 10 years of maintenance dredging.

A reduction in the number of shortnose sturgeon in the Kennebec 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 9,000 adult shortnose sturgeon in the Kennebec River, it is reasonable to expect that there are at least 3,000 adults spawning in a particular year. It is unlikely that the loss of 3 shortnose sturgeon over the course of 10 years would affect the success of spawning in subsequent years. Additionally, this small reduction in potential spawners is expected to result in an insignificant reduction in the number of eggs laid or larvae produced in future years and similarly, an insignificant effect on the strength of subsequent year classes. Additionally, the proposed action will not affect spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds.

The proposed action is not likely to reduce distribution because the action will not impede shortnose sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the Kennebec River. Further, the action is not expected to reduce the river by river distribution of shortnose sturgeon. As the number of shortnose sturgeon likely to be killed as a result of the proposed action is approximately 0.03% of the Kennebec River population, there is not likely to be a loss of any unique genetic haplotypes and therefore, it is unlikely to result in the loss of genetic diversity.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable effect on the numbers, reproduction, and distribution of the species, this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range, or the species has extremely low levels of genetic diversity. This situation is not likely in the case of shortnose sturgeon because the species is widely geographically distributed, it is not known to have low levels of genetic diversity (see Status of the Species section above), and there are thousands of shortnose sturgeon spawning each year.

Based on the information provided above, the death of up to 3 shortnose sturgeon resulting from the proposed dredging will not appreciably reduce the likelihood of survival (i.e., it will not increase the risk of extinction faced by this species) for this species given that: (1) the population trend of shortnose sturgeon in the Kennebec River is increasing; (2) the death of 3 shortnose sturgeon represents an extremely small percentage of the number of shortnose sturgeon in the Kennebec River and a even smaller percentage of the species as a whole; (3) the loss of these shortnose sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population (4) the loss of these shortnose sturgeon will not change the status or trends of the species as a whole; (5) the loss of these shortnose sturgeon is likely to have an undetectable effect on reproductive output of the Kennebec River population of shortnose sturgeon or the species as a whole; (6) the action will have only a minor and temporary effect on the distribution of shortnose sturgeon in the action area and no effect on the distribution of the species throughout its range; and (7) the action will have no effect on the ability of shortnose sturgeon to shelter or overwinter and only an insignificant effect on 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 Plan 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 impact their fitness. Here, we consider whether this proposed action will affect the Kennebec River population of shortnose sturgeon in a way that would affect the species' likelihood of recovery.

The Kennebec River population of shortnose sturgeon is growing. This action will not change the status or trend of the Kennebec 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 growing trend of the population. The proposed action will have only insignificant effects 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. This is because the impact to forage will be limited to temporary loss of prey in areas being dredged. Impacts to habitat will be limited to temporary increases in suspended sediment during dredging and disposal and increased water depth; however, as discussed in the Opinion, we do not anticipate any changes to substrate type, nor do we anticipate that any impacts to habitat will impact how shortnose sturgeon use the action area.

The proposed action will not affect shortnose sturgeon outside of the Kennebec River. Because it will not reduce the likelihood that the Kennebec 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. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of this species.

9.2 Atlantic Sturgeon (Gulf of Maine DPS)

The GOM DPS is listed as threatened. While Atlantic sturgeon occur in several rivers in the GOM DPS, recent spawning has only been documented in the Kennebec; spawning is suspected to also occur in the Androscoggin River. No total population estimates are available for any river population or the DPS as a whole. As discussed in the Status of the Species section, we have estimated a total of 7,455 GOM DPS adults and subadults in the ocean (1,864 adults and 5,591 subadults). This estimate is the best available at this time and represents only a percentage of the total GOM DPS population as it does not include young of the year or juveniles and does not include all adults and subadults. GOM origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. While there are some indications that the status of the GOM DPS may be improving, there is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

We have estimated that proposed maintenance dredging activities from 2020-2029 will kill up to 3 Atlantic sturgeon. Based on mixed-stock analysis, we expect 93% of adult and subadult Atlantic sturgeon in the action area to be from the GOM DPS, and 7% from the NYB DPS. Given the low numbers of NYB DPS fish in the action area and the low number of mortalities anticipated over 10 years, it is unlikely that there will be any mortality of NYB DPS Atlantic sturgeon adults or subadults. Therefore, all 3 Atlantic sturgeon, be they juveniles, subadults, or adults, will be from the GOM DPS.

The 3 GOM DPS Atlantic sturgeon mortalities (juvenile, subadult, or adult) estimated from all dredging activities over a 10-year period represents a very small percentage of the population (considering the minimum population estimate of 7,455 GOM DPS adults and subadults, this represents 0.04% of the population. The effect of this loss is also lessened as it will be experienced slowly over time, with the death of less than one (0.3) GOM DPS Atlantic sturgeon juvenile, subadult, or adult per year during the next 10 years of maintenance dredging. While the death of these juvenile, subadult, or adult Atlantic sturgeon will reduce the number of GOM DPS

Atlantic sturgeon 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 species as this loss represents a very small percentage of the juvenile and subadult population and an even smaller percentage of the overall population of the DPS (juveniles, subadults and adults combined).

The reproductive potential of the GOM DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of as many as 3 female juveniles, subadults, or adults over a 10-year period (less than one per year on average) would have the effect of reducing the amount of potential reproduction as any dead GOM DPS Atlantic sturgeon would have no potential for future reproduction. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. The loss of as many as 3 male juveniles, subadults, or adults may have less of an impact on future reproduction as other males are expected to be available to fertilize eggs in a particular year. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. The proposed action will also not affect the spawning grounds within the rivers where GOM DPS fish spawn, since all dredging and disposal activities do not take place in spawning habitat. The proposed action will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by GOM DPS fish.

The proposed action is not likely to reduce distribution because while sturgeon may temporarily avoid areas where dredging or disposal activities are underway, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will impact how GOM DPS sturgeon use the action area and all impacts will be insignificant. Additionally, given the small percentage of the species that will be killed as a result of the proposed actions, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity

Based on the information provided above, the death of up to 3 GOM DPS Atlantic sturgeon (juveniles, subadults, or adults) over the life of the proposed action, will not appreciably reduce the likelihood of survival of the GOM DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect GOM DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it 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 3 GOM DPS Atlantic sturgeon represents an extremely small percentage of the population of the DPS (approximately 0.03% of the population of adults and subadults); (2) the death of 3 GOM DPS Atlantic sturgeon will not change the status or trends of the DPS as a whole; (3) the loss of 3 GOM DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of 3 GOM DPS Atlantic sturgeon 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 DPS; (5) the action will have only a minor and temporary effect on the distribution of GOM DPS Atlantic sturgeon in the action area and no effect on the distribution of the DPS throughout its range; and, (6) the action will have no effect on the ability of GOM DPS Atlantic sturgeon to overwinter or shelter and only an insignificant effect on foraging GOM DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that the GOM DPS will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under 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 the GOM DPS of Atlantic sturgeon can rebuild to a point where it is no longer in danger of becoming endangered within the foreseeable future throughout all or a significant portion of its range.

A Recovery Plan for the GOM DPS has not yet been developed. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained, would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. In order for that to happen for GOM Atlantic 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. For 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. Here, we consider whether this proposed action will affect the GOM DPS likelihood of recovery. The proposed action is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of GOM DPS Atlantic sturgeon and since it will not affect the overall distribution of GOM DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of GOM DPS Atlantic sturgeon to carry out any necessary behaviors or functions including spawning, migration, overwintering, and foraging. Any impacts to available forage will also be insignificant. The proposed action will result in an extremely small amount of mortality over the life of the project (three individuals) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the GOM DPS of Atlantic sturgeon. This action will not change the status or trend of the GOM DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the GOM DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the GOM DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual GOM DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the mortality of 3 GOM DPS Atlantic sturgeon (juveniles, subadults, or adults) over the life span of the project, is not likely to appreciably reduce the survival and recovery of this species.

10.0 CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under our jurisdiction, the environmental baseline for the action area, the effects 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 the shortnose sturgeon and GOM DPS of Atlantic sturgeon and is not likely to adversely affect GOM DPS of Atlantic salmon. The proposed action is not likely to adversely affect critical habitat designated for the GOM DPS of Atlantic sturgeon or the GOM DPS of Atlantic salmon.

11.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species of fish and wildlife. "Fish and wildlife" is defined in the ESA "as any member of the animal kingdom, including without limitation any mammal, fish, bird (including any migratory, non-migratory, or endangered bird for which protection is also afforded by treaty or other international agreement), amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or parts thereof." 16 U.S.C. §1532(8). "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by NMFS to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. On December 21, 2016, we issued *Interim Guidance on the Endangered Species Term "Harass"*[7]. For use on an interim basis, we interpret "harass" to mean to "…create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. "Otherwise lawful activities" are those actions that meet all State and Federal legal requirements except for the prohibition against taking in ESA Section 9 (51 FR 19936, June 3, 1986), which would include any state endangered species laws or regulations. Section 9(g)

[7] http://www.nmfs.noaa.gov/op/pds/documents/02/110/02-110-19.pdf

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). See also 16 U.S.C. § 1532(13)(definition of "person"). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not the purpose of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

The measures described below are non-discretionary, and must be undertaken by you so that they become binding conditions for the exemption in section 7(o)(2) to apply. You have a continuing duty to regulate the activity covered by this ITS. If you (1) fail to assume and implement the terms and conditions or (2) fail to require any contractors to adhere to the terms and conditions of the ITS through enforceable terms that are added to contracts or other documents as appropriate, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, you 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). This ITS exempts take for activities that have not yet occurred as of the date of the Biological Opinion.

11.1 Amount or Extent of Incidental Take

The proposed action has the potential to result in the mortality of shortnose sturgeon and individuals from the GOM DPS of Atlantic sturgeon due to capture in a mechanical dredge. In this Opinion, we determined that the following levels of take are not likely to jeopardize the continued existence of listed species.

This ITS exempts the following lethal take from dredging through 2029:

- Shortnose sturgeon:
    - 3 juveniles or adults
- GOM DPS Atlantic sturgeon:
    - 3 juveniles, subadults, or adults

As explained in the accompanying Opinion, some of the captured sturgeon may survive and be released. As the risk of injury or mortality once captured is high, and survival if captured and released is unknown, it is reasonable to expect that any captured sturgeon will suffer mortality.

11.2 Reasonable and Prudent Measures, Terms and Conditions, and Justifications

We believe the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize and monitor impacts of incidental take resulting from the proposed action. In order to be exempt from prohibitions of section 9 of the ESA, you must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. Specifically, these RPMs and Terms and Conditions will keep us informed of when and where dredging and disposal activities are taking place and will require you to report any take in a reasonable amount of time, as well as implement measures to monitor for capture during dredging. The third column below explains why each of these RPMs and Terms and Conditions are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed action and how they represent only a minor change to the action as proposed by you.

Table 16: RPMs, TCs, and Justifications Applicable to the Action

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
1. We must be contacted prior to the commencement of dredging and again upon completion of the dredging and disposal activity.	1. You must contact us at incidental.take@noaa.gov 3 days before the commencement of each dredging activity and again within 3 days of the completion of the activity. This correspondence will serve both to alert us of the commencement and cessation of dredging activities and to give us an opportunity to provide you with any updated contact information or reporting forms. At the start of dredging activities, you must include an estimate of the total volume (cy) and area (acres) of dredge work and the location where dredging and disposal will occur. At the end of the dredging event, you must report to us the actual volume and area removed and location where dredging and disposal occurred.	These RPMs and TCs are necessary and appropriate because they serve to ensure that we are aware of the dates and locations of all dredging that may result in take. This will allow us to monitor the duration and seasonality of dredging activities as well as give us an opportunity to provide you with any updated species information or contact information for our staff. This is only a minor change because it is not expected to result in any delay to the project and will merely involve occasional e-mails between you and our staff.
2. For all dredge operations at BIW, a NMFS-approved observer must be present on board while the dredge is operating in the river.	2. The observer(s) must conduct daily inspections for biological materials, including sturgeon or sturgeon parts and must be able to identify parts and the difference between species. 100% inspection coverage (with all	These RPMs and TCs are necessary and appropriate to ensure that any direct take is accounted for during maintenance dredging operations. These RPMs and TCs represent only a minor change as compliance will not

	appropriate schedules and procedures sufficient enough to ensure a high likelihood of documenting captured sturgeon) must occur. Observer should follow NMFS monitoring specifications, available here: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic	delay the project or cause a decrease in the efficiency of the dredging operations
3. All sturgeon captures, injuries, mortalities in the immediate dredging area must be reported to us within 24 hours.	3. In the event of any observed captures of sturgeon (lethal or non-lethal), you must follow the Sturgeon Take Standard Operating Procedures (SOPs) found at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics If the cause of death is unknown, NMFS will have the mortality assigned to the incidental take statement **unless** a necropsy determines that the death was due to injuries other than those sustained from an interaction with dredge gear. We shall have the final say in determining if the take should count	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 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 delay of the project or decrease in the efficiency of the dredging operations.

	towards the Incidental Take Statement. Take reporting forms and sturgeon salvage forms are available at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics These forms must be used. All take should be reported to incidental.take@noaa.gov.	
4. Any and all Atlantic sturgeon captured must have a fin clip taken for genetic analysis. This sample must be transferred to a NMFS-approved laboratory capable of performing the genetic analysis.	4. You must ensure that fin clips are taken (according to the "Procedure for Obtaining Sturgeon Fin Clips" document located at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic) of any Atlantic sturgeon captured during the project and that the fin clips are sent to a NMFS approved laboratory capable of performing genetic analysis. Fin clips must be taken prior to preservation of other fish parts or whole bodies. To the extent authorized by law, you are responsible for the cost of the genetic analysis.	These RPMs and TCs are necessary and appropriate to ensure the proper handling and documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. Genetic analysis must be conducted on Atlantic sturgeon samples to determine the appropriate DPS of origin and accurately record take of this species. These RPMs and TCs represent only a minor change as compliance will not result in delay of the project or decrease in the efficiency of the dredging operations.

12.0 CONSERVATION RECOMMENDATIONS

In addition to Section 7(a)(2), which requires agencies to ensure that all 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 agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. As such, we recommend that you, consistent with your authorities, consider implementing the following Conservation Recommendations:

1. When at all possible, dredging at BIW should occur from December 1 to March 1 to avoid the times of year when both species of sturgeon are most likely to be present.

2. Support or conduct studies that further characterize use of the lower Kennebec estuary by GOM DPS Atlantic and shortnose sturgeon from December to March.

3. Support or conduct study to update population estimates of shortnose sturgeon and GOM DPS Atlantic sturgeon in the Kennebec River system.

13.0 REINITIATION OF CONSULTATION

This concludes formal consultation on your proposal to maintenance dredge BIW from 2020 through 2029. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or; or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

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