Gulf of Maine Distinct Population Segment of Atlantic Sturgeon
(Acipenser oxyrinchus oxyrinchus)

5-Year Review:
Summary and Evaluation

National Marine Fisheries Service
Greater Atlantic Regional Fisheries Office
Gloucester, Massachusetts

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5-YEAR REVIEW
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1.0 GENERAL INFORMATION

The Gulf of Maine DPS of Atlantic sturgeon includes Atlantic sturgeon spawned in the watersheds that drain into the Gulf of Maine from the Maine/Canadian border and extending southward to Chatham, Massachusetts, as well as Atlantic sturgeon held in captivity that are progeny of such fish (50 CFR 224.101).

1.1 Reviewers

Lead Regional or Headquarters Office: Greater Atlantic Regional Fisheries Office, Jennifer Anderson, Assistant Regional Administrator for Protected Resources, 978-281-9226, jennifer.anderson@noaa.gov

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1.2 Methodology used to complete the review:

The National Marine Fisheries Service (NMFS), Greater Atlantic Regional Fisheries Office (GARFO) led the 5-year review for the Gulf of Maine Distinct Population Segment (DPS) of Atlantic sturgeon. NMFS is required to consider new information that has become available since the Gulf of Maine DPS of Atlantic sturgeon was listed as threatened in February 2012. 16 USC 1533 (4)(c)(2). NMFS reviewed and considered new information for the Gulf of Maine DPS, specifically, as well as other new information for Atlantic sturgeon in general because there is still a relatively limited amount of DPS-specific information.

NMFS used several methods to acquire the new information. In addition to reviewing the literature generally made available to us (e.g., journal articles sent to us by the author, notifications of new publications via a group email list), NMFS requested a literature search from the NOAA Central Library. NMFS received 10 public comments in response to our Federal Register notice (83 FR 11731; March 16, 2018). None of the comments were specific to the Gulf of Maine DPS. NMFS also considered the information provided in the conclusions of the Atlantic States Marine Fisheries Commission (ASMFC) 2017 Atlantic Sturgeon Stock Assessment (hereafter "Stock Assessment"). NMFS did not request copies of the data compiled by the ASMFC or conduct our own analyses of the data. All of the information in the Stock Assessment that is not yet available through peer-reviewed publications was considered best available information because the Stock Assessment was peer-reviewed in accordance with the ASMFC's procedures. NMFS requested courtesy review and comment from the ASMFC Sturgeon Technical Committee for sections 1.0 through 2.3 of this draft 5-year review to help ensure that we are using the best available information.

1.3 Background

1.3.1 FR Notice citation announcing initiation of this review

83 FR 11731, March 16, 2018 - Initiation of 5-Year Review for the Endangered New York Bight, Chesapeake Bay, Carolina and South Atlantic Distinct Population Segments of Atlantic Sturgeon and the Threatened Gulf of Maine Distinct Population Segment of Atlantic Sturgeon.

83 FR 12942, March 26, 2018 - Initiation of 5-Year Review for the Endangered New York Bight, Chesapeake Bay, Carolina and South Atlantic Distinct Population Segments of Atlantic Sturgeon and the Threatened Gulf of Maine Distinct Population Segment of Atlantic Sturgeon; Correction.

1.3.2 Listing history

Original Listing
FR notice: 77 FR 5880
Date listed: February 6, 2012
Entity listed: Gulf of Maine Distinct Population Segment of Atlantic sturgeon
Classification: Threatened

1.3.3 Associated rulemakings

4(d) Interim Final Rule
FR notice: 78 FR 69310
Date listed: November 19, 2013
Determination: This regulation extended the prohibitions listed in section 9 of the ESA to the Gulf of Maine DPS of Atlantic sturgeon. The prohibitions are necessary and advisable for the conservation of the Gulf of Maine DPS. We published this rule as an interim final rule because we made changes based on new information that was not submitted as public comment on the proposed rule. We also solicited additional public comment but no additional comments were submitted.

Critical Habitat
FR notice: 82 FR 39160
Date designated: August 17, 2017
Determination: Five critical habitat units were designated for the Gulf of Maine DPS of Atlantic sturgeon encompassing approximately 244 kilometers (152 miles) of tidally-affected waters of the Penobscot, Kennebec, Androscoggin, Piscataqua, Salmon Falls, Cocheco, and Merrimack rivers. All of the critical habitat units are in the geographic area occupied by the Gulf of Maine DPS.

1.3.4 Review History

1998 Status Review: On June 2, 1997, the U.S. Fish and Wildlife Service (USFWS) and NMFS (collectively, the Services) received a petition from the Biodiversity Legal Foundation requesting that NMFS list Atlantic sturgeon in the United States as threatened or endangered and designate critical habitat within a reasonable period of time following the listing. In 1998, after completing a comprehensive status review, the Services published a 12-month determination in the *Federal Register* announcing that listing was not warranted at that time (63 FR 50187; September 21, 1998). NMFS retained Atlantic sturgeon on the candidate species list (subsequently changed to the Species of Concern List (69 FR 19975; April 15, 2004)).

2003 Workshop: NMFS sponsored a workshop with USFWS and the ASMFC titled "Status and Management of Atlantic Sturgeon," to discuss the status of Atlantic sturgeon along the Atlantic Coast and determine what obstacles, if any, were impeding their recovery. The results of the workshop indicated some riverine populations seemed to be recovering while others were declining, and bycatch and habitat degradation were noted as possible causes for continued declines (Kahnle et al. 2005).

2007 Status Review: NMFS initiated a new status review of Atlantic sturgeon in 2005 based on the outcomes of the 2003 Workshop and other new information. The Atlantic Sturgeon Status Review Team (ASSRT) concluded that Atlantic sturgeon of U.S. origin comprised five DPSs, and the team recommended identifying these as the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs. The ASSRT further recommended that the New York Bight, Chesapeake Bay, and Carolina DPSs should be considered threatened under the ESA but made no listing recommendation for the Gulf of Maine or South Atlantic DPSs because of insufficient data. A Notice of Availability of this report was published in the *Federal Register* on April 3, 2007 (72 FR 15865).

On October 6, 2009, NMFS received a petition from the Natural Resources Defense Council to list Atlantic sturgeon throughout its range as endangered under the ESA. As an alternative, the petitioner requested that the species be listed as the five DPSs described in the 2007 Atlantic sturgeon status review with the Gulf of Maine and South Atlantic DPSs listed as threatened, and the remaining three DPSs listed as endangered. NMFS published a Notice of 90-Day Finding on January 6, 2010 (75 FR 838), stating that the petition presented substantial scientific or commercial information indicating that the petitioned actions may be warranted. NMFS considered the information provided in the 2007 Status Review and all other best available information. NMFS proposed and subsequently listed the Gulf of Maine DPS under the ESA as threatened (77 FR 5880; February 6, 2012), and issued protective regulations under section 4(d) of the ESA that applied all of the ESA section 9 prohibitions to the Gulf of Maine DPS (78 FR 69310; November 19, 2013).

1.3.5 Species' Recovery Priority Number at start of 5-year review

The recovery priority number for the Gulf of Maine DPS is 3C based on the Listing and Recovery Priority Guidelines (84 FR 18243, April 30, 2019). Additional information is available in the Recovering Threatened and Endangered Species Report to Congress 2017-2018, available

at https://www.fisheries.noaa.gov/feature-story/recovering-threatened-and-endangered-species-report-congress-2017-2018.

1.3.6 Recovery Plan or Outline

Recovery Outline for the Atlantic Sturgeon Distinct Population Segments (available at https://www.fisheries.noaa.gov/species/atlantic-sturgeon#conservation-management)
Date issued: January 2018
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate? **Yes**

2.1.2 Is the species under review listed as a DPS? **Yes**

2.1.3 Was the DPS listed prior to 1996? **No**

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy? **No**

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? **No**

2.3 Updated Information and Current Species Status

The biology and life history information for the Gulf of Maine DPS was reviewed in 2007 (ASSRT 2007) and updated for the proposed and final rules when the DPS was listed as threatened (75 FR 61872, October 6, 2010; 77 FR 5880, February 6, 2012). The habitat needs for the DPS were reviewed and described in the critical habitat designation (82 FR 39160, August 17, 2017) and in the supplementary document (https://repository.library.noaa.gov/view/noaa/18671). Section 2.3.1 provides a summary of the previously available information, and then provides updates from new information that has become available since the ESA-listing and critical habitat designation for the Gulf of Maine DPS.

2.3.1 Biology and Habitat for the Gulf of Maine DPS of Atlantic Sturgeon at the Time of the ESA-Listing

The Gulf of Maine DPS of Atlantic sturgeon has the same basic life history characteristics of all Atlantic sturgeon. Atlantic sturgeon are reliant upon freshwater for spawning and embryo and larval rearing habitat, and brackish and marine waters for growth and development of the

juveniles as well as sustenance of adults. Atlantic sturgeon are easily distinguished from most other fish species within their range because of their relatively large size, visible bony scutes, protruding snout, and heterocercal tail. Atlantic sturgeon belonging to different DPSs can be distinguished from each other based on the unique genetic characteristics of each DPS and of each spawning river population.

The Gulf of Maine DPS is comprised of all Atlantic sturgeon that are spawned in the watersheds that drain into the Gulf of Maine from the Maine/Canadian border and extending southward to Chatham, Massachusetts (77 FR 5880; February 6, 2012). Within this range, Atlantic sturgeon historically spawned in the Penobscot, Kennebec, Androscoggin, Sheepscot, and Merrimack rivers (ASSRT 2007). Of these rivers, there was evidence of current spawning only in the Kennebec River when we listed the Gulf of Maine DPS as threatened.

The spawning area for the Gulf of Maine DPS was broadly identified in the listing rule as occurring within the tidal freshwater reach of the Kennebec River upriver of the former Edwards Dam site at river kilometer (rkm) 74 up to the Ticonic Falls (approximately rkm 103). We also explained in the listing rule that, from 1837 to 1999, the Edwards Dam was an impassable barrier to Atlantic sturgeon and prevented them from accessing the full extent of their historical habitat in the river. Atlantic sturgeon were found in the newly accessible area after the dam was removed (Wippelhauser and Squiers 2015). Atlantic sturgeon spend two to three years in the natal estuary, using and moving within the brackish waters of the natal estuary that are most suitable for their growth and development, before emigrating to the marine environment. NMFS did not have information at the time of listing for the specific location of juvenile rearing habitat although the best available information supported NMFS' determination that suitable habitat was likely present in Merrymeeting Bay as well as other brackish waters of the Kennebec Estuary.

The directed movement of subadult[1] and adult Atlantic sturgeon in the spring is from marine waters to river estuaries. River estuaries provide foraging opportunities for subadult and adult Atlantic sturgeon in addition to providing access to spawning habitat. Brackish waters of the Kennebec River as well as of other Gulf of Maine rivers including the Penobscot, Sheepscot, Saco, Presumpscott, and Merrimack rivers are used by subadults, non-spawning adults, and post-spawned adults during the spring through fall. These include subadults and adults that are not natal to the Gulf of Maine DPS. The directed movement of subadult and adult Atlantic sturgeon is reversed in the fall as the fish move back into marine waters for the winter.

In the marine environment, subadults and adults typically occur within the 50-meter (m) depth contour. Genetic analyses indicated the presence of Atlantic sturgeon belonging to the Gulf of Maine DPS in many parts of the marine range including the Gulf of Maine, the New York Bight, and the Bay of Fundy (77 FR 5880; February 6, 2012).

Life history information for the Gulf of Maine DPS is sparse. When NMFS listed the DPS, age at maturity for Atlantic sturgeon belonging to the Gulf Of Maine DPS was unknown. However,

[1] We use the term "subadult" to refer to immature Atlantic sturgeon that have emigrated from the natal river estuary and we use the term "juvenile" to refer to immature fish that have not yet emigrated from the natal river estuary. Some of the published literature for Atlantic sturgeon uses the term juvenile to refer to all sexually immature Atlantic sturgeon, including sexually immature fish that have emigrated from the natal river estuary.

age at maturity for both sexes was considered as likely within the range of values for age at maturity of Atlantic sturgeon that originated from the Hudson River and age at maturity for Atlantic sturgeon that originated from the Saint Lawrence River. The best available information supported this approach. Of the 18 sturgeon examined from the commercial fishery that occurred in the Kennebec River in 1980, age estimates for the 15 males ranged from 17-40 years, and for the 3 females from 25-40 years old (Squiers et al. 1981). Spawning periodicity for the Gulf of Maine DPS was unknown. The spawning periodicity for the Atlantic sturgeon DPSs, in general, was described as being 1 to 5 years for males and 2 to 5 years for females. NMFS considered that the lifespan for Atlantic sturgeon, in general, was approximately 60 years (Mangin 1964; Stevenson and Secor 1999).

There was no abundance estimate for the Gulf of Maine DPS when NMFS listed it under the ESA. The ASSRT (2007) concluded that most of the spawning populations, including in the Kennebec River, likely numbered less than 300 spawning adults per year because the ASSRT considered that the Hudson River spawning population and the Altamaha River spawning population, for which there were estimates of 870 and 343 spawning adults per year, respectively, were likely the most robust of all of the Atlantic sturgeon spawning populations. Therefore, the ASSRT made a reasoned conclusion that all of the other Atlantic sturgeon spawning populations likely numbered less than 300 spawning adults per year.

Studies have shown that Atlantic sturgeon can only sustain low levels of anthropogenic mortality (Boreman 1997; ASSRT 2007; Brown and Murphy 2010). NMFS concluded at the time of the listing that the Gulf of Maine DPS was at risk of becoming endangered in the foreseeable future (i.e., is a threatened species) given its low abundance, anthropogenic mortality of Gulf of Maine DPS Atlantic sturgeon from bycatch, the lack of measures to address the threats, and the likelihood of increased impact from existing threats. NMFS also noted, however, that the DPS was showing signs of potential recovery (e.g., increased abundance and/or expansion into its historical range).

2.3.1.1 New information on the species' biology and life history

New information for the Gulf of Maine DPS of Atlantic sturgeon is available as a result of scientific capture efforts and a variety of tagging methods, including tags for acoustic telemetry. Use of acoustic telemetry for Atlantic sturgeon requires surgically implanting the tag within the sturgeon's body cavity (Kahn and Mohead 2010), and then placing acoustic receivers in the water, which detect and record the unique signal of the tag when the sturgeon is within range of a receiver. Acoustic receivers are often fixed in specific locations but a receiver can also be towed or fixed to a moving object. Researchers use an array of receivers to track the movements of acoustically-tagged sturgeon in areas across the range of each DPS.

New evidence from capture efforts and acoustic tag detections confirm that the Gulf of Maine DPS spawns in the Kennebec River. The new information also confirms the areas where spawning is occurring (i.e., between rkm 70 and rkm 75) and the spawning period (i.e., during June and July) (Wippelhauser et al. 2017). Further evidence of sturgeon spawning in the Kennebec River includes the capture of three Atlantic sturgeon larvae between rkm 72 and rkm 75 in July 2011. During the study period of 2009-2011, eight sturgeon, including one male in

spawning condition, were also captured in the Androscoggin River estuary, which suggests that spawning may be occurring in the Androscoggin River as well (Wippelhauser et al. 2017). However, additional evidence, such as capture of a spawning female, sturgeon eggs or larvae, is not yet available to confirm that spawning for the Gulf of Maine DPS is occurring in that river (NMFS 2018).

There is limited new information for spawning periodicity. From 2010 to 2014, 21 acoustically-tagged Atlantic sturgeon were detected in the Kennebec River spawning grounds. Of these, one fish was detected in three consecutive years. However, most of the sturgeon (12 of 21) were only detected during one spawning season of the study period (Wippelhauser et al. 2017).

Data collected from 11 Atlantic sturgeon found dead in the Bay of Fundy provides additional information regarding the range of the Gulf of Maine DPS, age at maturity, and the size of mature adults. Based on genetic analysis, seven of the sturgeon belonged to the Gulf of Maine DPS. The seven sturgeon ranged in age from 17 to 28 years old and ranged in size from 134 cm to 181 cm total length. The smallest, youngest sturgeon was a male. Five of the sturgeon, including the largest and oldest sturgeon, were females. The sex and stage of maturity of the seventh sturgeon could not be identified but, it was within the size range of the other sturgeon and, therefore, was likely also an adult (Stewart et al. 2017).

The use of acoustic telemetry has provided new information on the presence of Atlantic sturgeon in the Penobscot and Saco rivers and has helped to better inform sturgeon use of these rivers. NMFS indicated in the listing rule that spawning was possibly occurring in the Penobscot River and that the Penobscot River Restoration Project, when completed, would provide Atlantic sturgeon with access to all of its historical spawning habitat in the river. The project has been completed and acoustically-tagged Atlantic sturgeon have been detected in the previously inaccessible habitat. However, the new information shows that Atlantic sturgeon primarily occur within the mesohaline reach of the river, particularly in areas with high densities of sturgeon prey which means that the Penobscot River is likely an important foraging area for Atlantic sturgeon belonging to the Gulf of Maine DPS (Altenritter et al. 2017). There is no current evidence that spawning is occurring in the Penobscot River. Acoustic tag detections suggest that the adults that forage in the Penobscot River travel to the Kennebec River to spawn (Altenritter et al. 2017; Wippelhauser et al. 2017).

In the listing rule, NMFS suggested that the Gulf of Maine DPS of Atlantic sturgeon might be recolonizing rivers historically suitable for spawning because Atlantic sturgeon were observed in Gulf of Maine rivers where they were unknown to occur or had not been observed to occur for many years (e.g., the Saco River and the Presumpscot River). New information demonstrates that the Saco River supports a large aggregation of Atlantic sturgeon that forage on sand lance in Saco Bay and within the first few kilometers of the Saco River, primarily from May through October. Detections of acoustically-tagged sturgeon indicate that both adult and subadult Atlantic sturgeon use the area for foraging and come back to the area year after year (Little 2013; Novak et al. 2017). Some sturgeon also overwinter in Saco Bay (Little et al. 2013; Hylton et al. 2018) which suggests that the river provides important wintering habitat as well, particularly for subadults. However, none of the new information indicates recolonization of the Saco River for spawning. It remains questionable whether sturgeon larvae could survive in the Saco River even

if spawning were to occur because of the presence of the Cataract Dam at rkm 10 of the river (Little 2013) which limits access to the freshwater reach. Some sturgeon that spawn in the Kennebec have subsequently been detected foraging in the Saco River and Bay (Novak et al. 2017; Wippelhauser et al. 2017).

NMFS described in the listing rule that, based on genetic analyses, approximately 35 percent of the Atlantic sturgeon captured in Canadian fisheries in the Bay of Fundy belonged to the Gulf of Maine DPS (Wirgin et al. 2012). New information is available from Dadswell et al. (2016) that describes characteristics of the seasonal aggregation of sturgeon in the Bay of Fundy. Dadswell et al. does not identify the natal origin of each of the 1,453 Atlantic sturgeon captured and sampled for their study. However, based on Wirgin et al. (2012) and Stewart et al. (2017), NMFS considers the results of Dadswell et al. as representative of the movement of the Gulf of Maine DPS of Atlantic sturgeon. Dadswell et al. determined Atlantic sturgeon occur seasonally (approximately May to September) in the Bay of Fundy for foraging, and many return in consecutive years. Subadults and adults are present. Fork length (FL) of the 1,453 sampled sturgeon ranged from 45.8 to 267 cm, but the majority (72.5 percent) were less than 150 cm FL. The age of the sturgeon (i.e., 4 to 54 years old) is also indicative of the two different life stages. Detailed seasonal movements of sturgeon to and from the Bay of Fundy are described in Beardsall et al. (2016).

2.3.1.2 New information on the abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends

There are no abundance estimates for the Gulf of Maine DPS or for the Kennebec River spawning population. Collecting this information has proven difficult and time consuming given the Atlantic sturgeon's life history, the environments in which they occur, and mixing of the DPSs in estuarine and marine waters. Wippelhauser and Squiers (2015) reviewed the results of studies conducted in the Kennebec River System from 1997-2001. In total, 371 Atlantic sturgeon were captured, but the abundance of adult Atlantic sturgeon in the Kennebec spawning population could not be estimated because too few tagged fish were recaptured (i.e., 9 of 249 sturgeon).

Another method for assessing the number of spawning adults is through determinations of effective population size[2], which measures how many adults contributed to producing the next generation based on genetic determinations of parentage from the offspring. Effective population size is always less than the total abundance of a population because it is only a measure of parentage, and it is expected to be less than the total number of adults in a population because not all adults successfully reproduce. Measures of effective population size are also used to inform whether a population is at risk for loss of genetic diversity and inbreeding (see section 2.3.1.3). The effective population size of the Gulf of Maine DPS was assessed in two studies based on sampling of adult Atlantic sturgeon captured in the Kennebec River in multiple

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

years. The studies yielded very similar results which were an effective population size of: 63.4 (95% CI=47.3-91.1) (ASMFC 2017a) and 67 (95% CI=52.0–89.1) (Waldman et al. 2019).

NMFS estimated adult and subadult abundance of the Gulf of Maine DPS based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters (Damon-Randall et al. 2013, Kocik et al. 2013). NMFS has relied upon these numbers in the ESA section 7 consultation context, and concluded that subadult and adult abundance of the Gulf of Maine DPS was 7,455 sturgeon (NMFS 2013). This number encompasses many age classes since, across all DPSs, subadults can be as young as one year old when they first enter the marine environment, and adults can live as long as 64 years (Balazik et al. 2012a; Hilton et al. 2016). For example, Dunton et al. (2016) determined that the 742 Atlantic sturgeon that they captured in the New York Bight represented 21 estimated age classes and that, individually, the sturgeon ranged in age from 2 to 35 years old.

Very few data sets are available that cover the full, multi-decade, potential life span of an Atlantic sturgeon which could be as much as approximately 40 to 60 years. The ASMFC concluded for the Stock Assessment that it could not estimate abundance of the Gulf of Maine DPS or otherwise quantify the trend in abundance because of the limited available information. However, the Stock Assessment was a comprehensive review of the available information, and used multiple methods and analyses to assess the status of the Gulf of Maine DPS and the coast wide stock of Atlantic sturgeon. For example, the Stock Assessment Subcommittee defined a benchmark, the mortality threshold, against which mortality for the coast wide stock of Atlantic sturgeon as well as for each DPS were compared[3] to assess whether the current mortality experienced by the coast wide stock and each DPS is greater than what it can sustain. This information informs the current trend of the Gulf of Maine DPS.

In the Stock Assessment, ASMFC concluded that abundance of the Gulf of Maine DPS is "depleted" relative to historical levels and there is a 51 percent probability that abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium. The ASMFC also concluded that there is a relatively high likelihood (74 percent probability) that mortality for the Gulf of Maine DPS exceeds the mortality threshold used for the Stock Assessment (ASMFC 2017a).

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.)

There are some indications of genetic bottlenecks for the Kennebec River spawning population (ASMFC 2017a; Waldman et al. 2019). NMFS does not have information to indicate whether or to what extent the Gulf of Maine DPS is negatively affected by any reduced genetic variation.

2.3.1.4 Taxonomic classification or changes in nomenclature

[3] The analysis considered both a coast wide mortality threshold and a region-specific mortality threshold to evaluate the sensitivity of the model to differences in life history parameters among the different DPSs (e.g., Atlantic sturgeon in the northern region are slower growing, longer lived; Atlantic sturgeon in the southern region are faster growing, shorter lived).

There are no changes in taxonomic classification or changes in nomenclature for the Gulf of Maine DPS of Atlantic sturgeon. Additional genetic analyses were conducted for the Stock Assessment, which concluded that the genetic designations of the Atlantic sturgeon DPSs are sound, and that the general delineations first suggested in 2007 continue to accurately describe the geographic groups of Atlantic sturgeon encountered along the U.S. Atlantic coast (ASMFC 2017a). As described in section 2.3.1.5, there is additional, new, information that supports our conclusion in the listing rule that the Gulf of Maine DPS persists in an ecological setting unusual or unique for the taxon, and loss of the DPS would result in a significant gap in the range of the taxon.

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.)

New information from Wippelhauser et al. (2017) better informs the marine range of the Gulf of Maine DPS based on detection of acoustically-tagged Atlantic sturgeon. These include detections within the Gulf of Maine as well as near the mouth of Chesapeake Bay, in the New York Bight off of Long Island, and in the Connecticut River and adjacent areas of Long Island Sound. Based on genetic analyses, Atlantic sturgeon belonging to the Gulf of Maine DPS have been identified among those captured in marine waters of the Gulf of Maine including the Bay of Fundy, as well as in Long Island Sound and the lower Connecticut River, off western Long Island, New Jersey, Delaware, Virginia, and North Carolina (Dunton et al. 2012; Waldman et al. 2013; Wirgin et al. 2015a; Wirgin et al. 2015b; Wirgin et al. 2018). A new, comprehensive analysis of Atlantic sturgeon stock composition coast wide provides further evidence that natal origin influences the distribution of Atlantic sturgeon in the marine environment. Atlantic sturgeon that originate from each of the five DPSs and from the Canadian rivers were represented in the 1,704 samples analyzed for the study. However, there were statistically significant differences in the spatial distribution of each DPS, and individuals were most likely to be assigned to a DPS in the same general region where they were collected (Kazyak et al. 2021). For the Gulf of Maine DPS, the results support the findings of previous genetic analyses that Atlantic sturgeon belonging to the DPS are most prevalent in the Gulf of Maine.

New information from Rothermel et al. (2020) provides more detailed information for marine habitats used by Atlantic sturgeon off the coast of Maryland, and the migratory patterns of Atlantic sturgeon through the area. Their findings also provide additional information indicating that Atlantic sturgeon occur further offshore in the late fall and winter months than in the spring and summer. Breece et al. (2016; 2018a; 2018b) further investigated the distribution and occurrence of Atlantic sturgeon in the Mid-Atlantic Bight based on associated habitat features, as well as the habitat features associated with presence of adults in the Delaware River, and their distribution and movements within Delaware Bay. The research provides evidence that specific habitat features such as substrate composition and distance from the salt front in the river estuary, water depth and water temperature in Delaware Bay, and depth, day-of-year, sea surface temperature, and light absorption by seawater in marine waters affect where and when Atlantic sturgeon occur). The Rothermel et al. and the Breece et al. literature do not identify the natal origin of the detected sturgeon. However, their studies likely included detections of Atlantic sturgeon belonging to the Gulf of Maine DPS because most of the sturgeon were initially

captured and tagged off of Delaware, and separate studies (Wirgin et al 2015a; Kazyak et al. 2021) have confirmed the presence of Atlantic sturgeon belonging to the Gulf of Maine DPS in that area. Therefore, NMFS assumes that the results of Rothermel et al. (2020) and Breece et al. (2016; 2018a; 2018b) are representative of the movement patterns and habitats used by Gulf of Maine DPS Atlantic sturgeon in mid-Atlantic marine waters.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem)

NMFS designated critical habitat for the Gulf of Maine DPS in tidally-affected riverine waters of the Penobscot, Kennebec, Androscoggin, and Merrimack rivers, and the Piscataqua river system (including areas of the Cocheco and Salmon Falls rivers) based on the best available information at the time of the designation (82 FR 39160; August 17, 2017). In total, these designations encompass approximately 244 kilometers (152 miles) of aquatic habitat that is essential to the recovery of the Gulf of Maine DPS.

As described in section 2.3.1.5, there is new information describing the distribution of Gulf of Maine DPS Atlantic sturgeon in the Gulf of Maine and in Mid-Atlantic waters as far south as Cape Hatteras. NMFS did not, however, designate critical habitat in marine waters, bays, or sounds despite evidence that Atlantic sturgeon belonging to the Gulf of Maine DPS are prevalent in certain areas because NMFS is required to designate critical habitat based on the physical or biological features that are essential to the conservation of the species, and not based solely on the presence of the listed species. The available information was too limited to inform what the physical or biological features are in the marine environment, bays, or sounds that are essential to the conservation of the Gulf of Maine DPS. Further, NMFS cannot designate critical habitat within foreign countries or in other areas outside of United States jurisdiction (50 CFR § 424.12(g)), such as the Bay of Fundy. Section 2.3.2 provides information for on-going and emerging threats to designated critical habitat and the habitats that are otherwise used by the Gulf of Maine DPS.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

Section 4(a)(1) of the ESA requires the Services to determine whether a species is endangered or threatened because of any of the following factors (or threats) alone or in combination:

A. The present or threatened destruction, modification, or curtailment of its habitat or range;

B. Overutilization for commercial, recreational, scientific, or educational purposes;

C. Disease or predation;

D. Inadequacy of existing regulatory mechanisms to address identified threats; or

E. Other natural or human factors.

New information relative to each of these factors and the status of the Gulf of Maine DPS is described below.

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range

Summary of Factor A: NMFS described in the ESA-listing rule that barriers (e.g., dams, tidal turbines) are threats that affect the habitat or range of the Gulf of Maine DPS. NMFS also described that dredging and water quality (e.g., dissolved oxygen levels, water temperature, and contaminants) were stressors to the Gulf of Maine DPS but to a lesser extent than for the other four Atlantic sturgeon DPSs.

New information is available on the effects of these threats to the Gulf of Maine DPS, and the actions taken to address the threats. As anticipated, following the listing, the Veazie Dam was removed as part of the Penobscot River Restoration Project and 100 percent of the Atlantic sturgeon's historical habitat in the Penobscot River is now accessible. There is no current evidence, however, that Atlantic sturgeon are using the previously inaccessible habitat for spawning or that Atlantic sturgeon are spawning anywhere within the freshwater reach of the river (Wippelhauser et al. 2017; Altenritter et al. 2017).

NMFS also raised concern in the listing rule regarding the threat posed by the use of tidal turbines in Minas Passage of the Minas Basin, Bay of Fundy. As described above, new information has become available that confirms the regular occurrence of Atlantic sturgeon belonging to the Gulf of Maine DPS in Minas Basin (Dadswell et al. 2016; Stewart et al. 2017). There is no new information on the permanent use of tidal turbines in Minas Passage. NMFS will continue to evaluate the risk to the DPS if tidal turbines come into use in this area.

Since the listing, NMFS has consulted with the United States Army Corp of Engineers (USACE) under section 7 of the ESA on the effects of on-going, regular, maintenance dredging of the Kennebec River at Bath Iron Works, which includes a part of the Kennebec River Federal Navigation Channel (NMFS 2020). Studies conducted elsewhere demonstrated that Atlantic sturgeon did not avoid but were not attracted to dredge activity, and that dredge activity was not a barrier (e.g., from the sound or turbidity plume produced by dredging) to Atlantic sturgeon movements within the river (Reine et al. 2014; Balazik et al. 2020). The study results support the conclusions of the most recent biological opinion on the effects of on-going maintenance dredging of the Kennebec River, which concluded that the proposed dredging is unlikely to pose a barrier to Atlantic sturgeon but that takes (e.g., capture and killing) of Atlantic sturgeon might occur in the dredge gear. The biological opinion describes the anticipated lethal take of Atlantic sturgeon belonging to the Gulf of Maine DPS which is three adult, subadult, or juvenile Atlantic sturgeon from dredging through 2029. NMFS determined that this level of take is not likely to jeopardize the continued existence of the Gulf of Maine DPS (NMFS 2020). Additional information is available at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-biological-opinions-greater-atlantic-region.

NMFS described in the listing rule that potential changes in water quality as a result of global climate change (temperature, salinity, dissolved oxygen, contaminants, etc.) in rivers and coastal waters inhabited by Atlantic sturgeon will likely affect riverine populations, and we expected these effects to be more severe for southern portions of the U.S. range. However, new information shows that the Gulf of Maine is one of the fastest warming areas of the world as a result of global climate change (Pershing et al. 2015; Brickman et al. 2021). Hare et al. (2016) provide a method for assessing the vulnerability of all Atlantic sturgeon to climate change using

the best available information from climate models and what we know of the subspecies life history, biology, and habitat use. Based on their comprehensive assessment, Hare et al. determined that Atlantic sturgeons (all DPSs) are highly vulnerable to climate change. Contributing factors include their low potential to change distribution in response to climate change (e.g., spawning locations are specific to a DPS within a specific geographic region), and their exposure to climate change throughout their range, including in estuarine and marine waters. The determinations are supported by the information of Balazik et al. (2010) that suggests individual spawning populations will respond to changing climate temperatures with physiological changes (e.g., changes in growth rate) rather than redistributing to a more southern or northern habitat to maintain their exposure to a consistent temperature regime. Markin and Secor (2020) further demonstrate the effect of temperature on the growth rate of juvenile Atlantic sturgeon, and informs how global climate change may impact growth and survival of Atlantic sturgeon across their range. Their study showed that all juvenile Atlantic sturgeon had increased growth rate with increased water temperature regardless of their genetic origins. However, based on modeling and water temperature data from 2008 to 2013, they also determined that there is an optimal water temperature range, above and below which juveniles experience a slower growth rate, and they further considered how changes in growth rate related to warming water temperatures associated with global climate change might affect juvenile survival given the season (e.g., spring or fall) in which spawning currently occurs. Atlantic sturgeon's low likelihood to change distribution in response to current global climate change will also expose them to climatic effects on estuarine habitat such as changes in the occurrence and abundance of prey species in currently identified key foraging areas.

NMFS continues to consult with federal agencies on other actions that may affect Atlantic sturgeon belonging to the Gulf of Maine DPS, such as dam operations and marine aquaculture projects. The biological opinions for these consultations are available at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-biological-opinions-greater-atlantic-region. NMFS is also consulting with federal agencies on federal actions related to the construction and operation of wind farms in marine waters. Consultation on the Vineyard Wind project that is located south of Nantucket, Massachusetts was completed in September 2020, and included NMFS conclusion that the project was not likely to adversely affect the Gulf of Maine DPS of Atlantic sturgeon. However, consultation was reinitiated to consider the effects of several surveys that were not part of the originally proposed project. That consultation is on-going. Other Federal actions related to the construction and operation of wind farms in marine waters have been proposed or are in development within the Gulf of Maine DPS's marine range. Currently, there is not enough information to determine whether and to what extent these are an emerging threat to the Gulf of Maine DPS. NMFS expects to consult with the lead federal agency, as necessary, as each project develops.

Conclusion for Factor A: The new information suggests that dredging may pose less of a threat with respect to being a barrier to sturgeon movements. However, injury and mortaltiy of Atlantic sturgeon in dredge gear still occurs. A tidal turbine power generation project in Minas Passage could pose a barrier to sturgeon movements but it is still in development so the likely effects to the Gulf of Maine DPS are uncertain. There continue to be areas affected by poor water quality but, overall, water quality is less of a stressor for the Gulf of Maine DPS compared to the other DPSs. Despite NMFS' new understanding that these threats may not be as severe as

previously anticipated, construction projects and maintenance dredging continue to be a stressor for the Gulf of Maine DPS throughout its range, particularly in the areas nearest to and within the Kennebec River, the single river that supports spawning habitat. New information shows that Atlantic sturgeon (all DPSs) are highly vulnerable to climate change, and that the Gulf of Maine is one of the fastest warming areas of the world. Therefore, the new information suggests that climate change is more of a stressor to the Gulf of Maine DPS than what NMFS anticipated when the Gulf of Maine DPS was listed as threatened.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes

Summary of Factor B: A moratorium on the possession and retention of Atlantic sturgeon had already ended directed harvest of Atlantic sturgeon when NMFS listed the five DPSs. However, bycatch in Federal and state regulated fisheries continued to occur and, in the final listing rule (77 FR 5880), NMFS considered bycatch to be one of the primary threats to the Gulf of Maine DPS.

New information continues to demonstrate bycatch of the Gulf of Maine DPS in federally-managed fisheries (NMFS 2021). NMFS completed several biological opinions after the ESA-listings to document our conclusions on the anticipated effects of federally-managed fisheries on the Atlantic sturgeon DPSs. The biological opinion on the continued implementation of the Northeast multispecies, monkfish, spiny dogfish, Atlantic bluefish, Northeast skate complex, mackerel/squid/butterfish, and summer flounder/scup/black sea bass fisheries (aka "batched biological opinion") is the most relevant of the fisheries biological opinions because it includes the fisheries most likely to take Atlantic sturgeon belonging to the Gulf of Maine DPS, and provides the most comprehensive analysis with respect to the number of fisheries considered in one opinion. In the first batched biological opinion that followed the listing, NMFS determined that, on average, 35 sturgeon (adults and subadults combined) belonging to the Gulf of Maine DPS were likely to be killed annually as a result of capture in gillnet and trawl gear that is used in the fisheries (NMFS 2013). NMFS concluded that this level of take was not likely to jeopardize the continued existence of the DPS. A new batched biological opinion was completed in May 2021. The conclusions of the new final opinion are unchanged for the Gulf of Maine DPS; however, the estimate of annual take is different. NMFS concluded that continued operations of the fisheries are likely to result in the average annual lethal take of 15 sturgeon (adults and subadults combined) belonging to the Gulf of Maine DPS, and that this level of take was not likely to jeopardize the continued existence of the Gulf of Maine DPS. The take estimates in the original opinion and in the new opinion are not directly comparable because the approach for distributing the total take among the DPSs changed based on the new information in Kazyak et al. (2021), and the models used to estimate total take of Atlantic sturgeon in the fisheries differed in the two opinions. The total take must be estimated because the actual take is primarily recorded by observers that are part of the Northeast Fisheries Monitoring Program and the At-Sea Monitoring Program, selection of where observer coverage is assigned is not specific to monitoring for take of Atlantic sturgeon, and observers are not present at all times and on all fishing vessels. The biological opinions are available at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-biological-opinions-greater-atlantic-region

Since the ESA listing, research has been conducted on gear modifications that could reduce the capture of Atlantic sturgeon in the federally-managed gillnet fisheries, and to examine post-release mortality for sturgeon captured in gillnet gear (Fox et al. 2013; He and Jones 2013; Bouyoucos et al. 2014; Fox et al. 2019). Management measures have not been implemented based on the results. Additional research is proposed to be conducted under ESA permit number 17225. The batched biological opinion discussed above currently includes requirements that: (1) NMFS must continue to work with the fishing industry and partners to promote, fund, conduct, and/or review research on gear modifications to reduce incidental takes, and the severity of interactions that do occur; (2) GARFO's Sustainable Fisheries Division will convene a working group to review all the available information on Atlantic sturgeon bycatch in the federal large gillnet (≥ 7 inches stretched) mesh fisheries; and, (3) within one year of publication of the batched opinion, the working group will develop an action plan to reduce Atlantic sturgeon bycatch in these fisheries by 2024.

New information also shows that the incidental take of Atlantic sturgeon in state-managed fisheries is still occurring. The reported take of Atlantic sturgeon in each state's managed fisheries is provided annually to the ASMFC. These numbers are likely a minimum count of what actually occurs because many of the state fisheries rely upon voluntary reporting of sturgeon takes (ASMFC 2019). Nearly all of the Atlantic sturgeon takes reported to the ASMFC for the period 2013 through 2017 were attributed to the South Carolina shad fishery, the North Carolina inshore gillnet fishery, and the Georgia shad fishery (ASMFC 2016; ASMFC 2017b; ASMFC 2018; ASMFC 2019). In 2013, South Carolina implemented measures to reduce the take of Atlantic sturgeon in its shad fishery including statewide gear restrictions (i.e., 50 percent statewide reduction in allowable gear; 80 to 90 percent reduction for high priority rivers) (ASMFC 2019). North Carolina and Georgia are each addressing the take of Atlantic sturgeon in their respective fisheries through an ESA section 10 incidental take permit (see section 2.3.2.4 for additional information).

Atlantic sturgeon belonging to the Gulf of Maine DPS are incidentally taken in trawl and weir fisheries that are conducted in the Bay of Fundy, Canada (Wirgin et al. 2012; Dadswell et al. 2016). The results from Beardsall et al. (2013) suggest that Atlantic sturgeon post-release survival after capture in trawls and weirs is high. Of the 63 Atlantic sturgeon captured during their study (i.e., 19 captured in weirs and 44 captured in otter trawl gear), all were alive when removed from the gear and then released. Detections of the acoustic tag placed in 34 of the sturgeon before release indicate that at least 32 of the sturgeon survived post-release. However, some mortalities have occurred (Stewart et al. 2017). There is very little information that documents the extent of bycatch of Atlantic sturgeon in these fisheries. The 2017 Stock Assessment recommends that future consideration should be given to the transboundary movement of individuals into Canadian waters in the Gulf of Maine and potentially into the Gulf of St. Lawrence, and greater Canadian-U.S. Atlantic sturgeon data sharing, cooperative research, and monitoring should be promoted to better explore interactions between Canadian and U.S. Atlantic sturgeon, particularly with regards to the Gulf of Maine DPS.

There are anecdotal as well as documented reports of Atlantic sturgeon caught in recreational fishing gear (Dunton et al. 2015; ASMFC 2017a). Regulations are in place for all state waters in which Atlantic sturgeon occur that require that the fish be immediately released from the gear.

In addition, NMFS provides information for how to safely release Atlantic sturgeon from recreational fishing gear. Based on social media posts and voluntary reports to us, it appears that many recreational fishermen are complying with the regulations and the guidance. However, NMFS does not have complete information to quantify how often Atlantic sturgeon are caught, the fate of the individual fish, or to what extent, if any, poaching may occur.

Seven permits issued under section 10 of the ESA currently exempt the taking of live, wild, Atlantic sturgeon belonging to the Gulf of Maine DPS for scientific research. In addition, NMFS possesses a permit for the take of opportunistically found dead Atlantic sturgeon or mortalities from other actions (e.g. permitted research, fisheries bycatch, hatchery operations). By maximizing the use of these salvaged specimens through a large network of sturgeon researchers, NMFS provides opportunities to obtain new information while reducing the need for taking (e.g., capture, collecting, sampling) living, wild specimens.

There are currently three permits issued under section 10 of the ESA for the anticipated incidental take of Atlantic sturgeon belonging to the Gulf of Maine DPS. The activities include: a study of non-ESA listed fish in the lower Kennebec River; a nature education program in the Hudson River; and operation of the North Carolina inshore gillnet fishery described above. NMFS issues an incidental take permits if the taking will occur incidental to an otherwise legal activity, the permit applicant minimizes and mitigates the impacts of such taking to the maximum extent practicable, the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild, and the applicant ensures that the minimization and mitigation measures will be implemented. Each of the permits is available at https://www.fisheries.noaa.gov/national/endangered-species-conservation/incidental-take-permits.

There are no permits that authorize retention of living Atlantic sturgeon captured from the wild for the purpose of public display or for scientific research. Some Atlantic sturgeon that were brought into captivity before the ESA-listing are on public display for educational purposes or are housed for scientific research. NMFS is unaware of whether any of these belong to the Gulf of Maine DPS.

Conclusion for Factor B: The available information continues to support our conclusion in the listing rule that overutilization of the Gulf of Maine DPS is not occurring as a result of educational or scientific purposes. However, overutilization in terms of bycatch remains one of the primary stressors for the Gulf of Maine DPS. Based on the best available information, bycatch in federally-managed fisheries remains the highest enumerated source of capture, injury, and mortality of Atlantic sturgeon belonging to the Gulf of Maine DPS among all known stressors. All of the Atlantic sturgeon that are killed as bycatch in federally-managed fisheries are subadults or adults. Bycatch as a result of state managed fisheries can result in the capture, injury, and mortality of any of the Atlantic sturgeon life stages depending on where and when those fisheries occur. There continues to be limited information from which to estimate the number of Atlantic sturgeon belonging to the Gulf of Maine DPS that are taken and killed as a result of fisheries bycatch. The lack of information hinders our ability to fully address this threat. We have no regulatory mechanism for addressing the bycatch of Atlantic sturgeon belonging to the Gulf of Maine DPS that occur in Canadian fisheries.

2.3.2.3 Disease or predation

Summary of Factor C: NMFS described in the listing rule that very little is known about natural predators of Atlantic sturgeon. After reviewing the limited information, NMFS concluded that neither disease nor predation are considered primary factors affecting the continued persistence of the Gulf of Maine DPS of Atlantic sturgeon.

Hilton et al. (2016) reviewed diseases and parasites known to affect Atlantic sturgeon. There is no new information for the Gulf of Maine DPS.

There is new information regarding seal predation on Atlantic sturgeon. On February 9, 2021, a team flying a survey for right whales off of Cape Cod, Massachusetts sighted and photographed a grey seal biting into and eating an apparently fresh dead Atlantic sturgeon (Center for Coastal Studies, pers. comm.). There were no other apparent wounds on the sturgeon, which suggests that the seal captured and killed the sturgeon. There are very few documented incidents of seal predation on sturgeon along the U.S. East Coast (ASSRT 2007; SSSRT 2010). There is also new information regarding bird predation on Atlantic sturgeon. Hilton and McGrath (2021) describe the apparent predation of a juvenile Atlantic sturgeon (512 mm total length) along the York River, Virginia by a bird of prey which was likely an osprey or a bald eagle. This is the first evidence of possible bird predation of a juvenile Atlantic sturgeon. Although the sturgeon likely belonged to the Chesapeake Bay DPS, it also suggests the possibility of predation wherever any juvenile Atlantic sturgeon and birds of prey occur. Given the rarity of these predation events, it is not known whether they were unique incidents or if they are indicative of emerging threats from the increased seal populations occurring within and expanding beyond the Gulf of Maine, and from increased populations of osprey and bald eagles, including throughout the range of the Gulf of Maine DPS.

Conclusion for Factor C: The new, best available, information does not change NMFS determination from the listing rule that neither disease nor predation are primary factors affecting the continued persistence of the Gulf of Maine DPS of Atlantic sturgeon.

2.3.2.4 Inadequacy of existing regulatory mechanisms

Summary of Factor D: The inadequacy of existing regulatory mechanisms was not considered a primary stressor when NMFS listed the Gulf of Maine DPS because regulatory mechanisms to address many of the known stressors, including bycatch in federally-managed fisheries, were available. However, NMFS noted that a lack of information (e.g., for the DPSs life history, or for enumerating the effects of the stressor upon the DPS) made it more difficult to fully utilize the existing regulatory mechanisms.

Information on bycatch of Atlantic sturgeon in state-managed fisheries is still limited. As noted in the Stock Assessment, bycatch of Atlantic sturgeon is not well monitored by the existing fishery-independent and -dependent data collection programs (ASMFC 2017a). For the Gulf of Maine DPS, there appears to be the potential for take in fisheries that occur near their natal rivers, such as within the Gulf of Maine, as well as in fisheries that occur in other areas of the

DPSs range such as the New York Bight (Melnychuk et al. 2017). Incidental capture of Atlantic sturgeon in the Maine and New Hampshire fishery surveys using trawl gear suggest that capture of Atlantic sturgeon may occur in commercial fisheries that operate in the same areas and at times when sturgeon are present.

The existing regulatory mechanism for addressing Atlantic sturgeon bycatch in state-managed fisheries is through issuance of an ESA section 10 incidental take permit. NMFS has issued section 10 permits for the incidental take of Atlantic sturgeon (all DPSs) in the North Carolina commercial inshore gillnet fishery, and for the incidental take of Atlantic sturgeon belonging to other than the Gulf of Maine DPS in the Georgia commercial shad fishery. The permit conditions require each state to implement measures that minimize and mitigate the impacts of such taking to the maximum extent practicable, and to monitor the take of Atlantic sturgeon. Currently, there are no section 10 incidental take permits for fisheries managed by any of the Gulf of Maine states or by mid-Atlantic states from New York through Virginia; areas where Atlantic sturgeon belonging to the Gulf of Maine DPS are more likely to occur. Representatives for Maine, New Hampshire, and Massachusetts state that a section 10 incidental take permit for Atlantic sturgeon is not necessary because take of Atlantic sturgeon in their respective state-managed fisheries is not expected to occur (ASMFC 2019). Some of the other coastal states are working to complete applications for a section 10 incidental take permit. The large mesh gillnet restrictions for waters off of Virginia and North Carolina (71 FR 24775; April 26, 2006) also provide some protection to the Gulf of Maine DPS. However, these restrictions extend only as far north as Chincoteague, Virginia.

Atlantic sturgeon belonging to the Gulf of Maine DPS are incidentally taken in trawl and weir fisheries that are conducted in the Bay of Fundy, Canada (Wirgin et al. 2012; Dadswell et al. 2016). The results from Beardsall et al. (2013) suggest that Atlantic sturgeon post-release survival after capture in trawls and weirs is high. Of the 63 Atlantic sturgeon captured during their study (i.e., 19 captured in weirs and 44 captured in otter trawl gear), all were alive when removed from the gear and then released. Detections of the acoustic tag placed in 34 of the sturgeon before release indicate that at least 32 of the sturgeon survived post-release. Nevertheless, the deaths of some sturgeon such as those described in Stewart et al. (2017) continue to suggest that Bay of Fundy fisheries pose a potential threat to the Gulf of Maine DPS. NMFS does not have a regulatory means to collect data on these fisheries or to address the threat to the Gulf of Maine DPS.

The threat of vessel strike appears to be less for Atlantic sturgeon belonging to the Gulf of Maine DPS compared to the New York Bight or Chesapeake Bay DPSs based on the number of Atlantic sturgeon vessel struck carcasses that are found in Gulf of Maine rivers, and given the differences in vessel activity in the respective natal rivers. Nevertheless, some strikes do occur within the Gulf of Maine and sturgeon belonging to the Gulf of Maine can also be struck in other areas of their range including higher salinity waters of the Hudson River Estuary, Delaware River Estuary, and Chesapeake Bay. Section 2.3.2.5 provides new information for the threat of vessel strikes to the Gulf of Maine DPS when the fish are in rivers, bays, and sounds.

In general, the three fundamental regulatory mechanisms for addressing threats to ESA-listed species are through rulemaking, section 7 consultation, and permitting. NMFS has not

conducted rulemaking to address the threat of vessel strikes for Atlantic sturgeon because it is not yet known what measures are necessary to reduce the number of, or impact from, vessel strikes. NMFS has used rulemaking to require vessel speed restrictions in certain coastal waters (i.e., no more than 10 knots for vessels 19.8 m (65 feet) or greater in overall length) to reduce the likelihood of vessel strikes for North Atlantic right whales at certain times of the year. However, based on the best available information, speed restrictions for vessels in navigable rivers (e.g., the Kennebec River) are unlikely to reduce the number of vessel strikes for Atlantic sturgeon. Regulations implemented by the U.S. Coast Guard (see 33 CFR 83.06) require that vessels proceed at a "safe speed" within navigable waters but, the regulations do not specify speed limits because many factors can influence what is the safe speed for the conditions. Further, the average swim speed of an adult Atlantic sturgeon is slow (1.27 to 1.86 mph or 0.57 to 0.83 mps; Balazik et al. 2020) relative to vessel speed. Finally, studies conducted in the Delaware River and in the James River indicate that Atlantic sturgeon do not avoid or move away from vessels (Reine et al. 2014; Barber 2017; Balazik et al. 2017; DiJohnson 2019; Balazik et al. 2020). Therefore, in the unlikely scenario that a maximum speed at which large (e.g., commercial) vessels could safely proceed in Gulf of Maine rivers could be identified, the best available information indicates that vessel strikes may still occur because Atlantic sturgeon are unlikely to move away from oncoming vessels. Other methods for potentially reducing risk, such as posting a lookout, are not practical because Atlantic sturgeon are not visible below the water surface and a large vessel could not reasonably stop or alter course even if a sturgeon was visible (e.g., jumping out of the water).

Some effects of vessel activity to the Gulf of Maine DPS can be addressed through section 7 consultation if a federal agency is proposing to authorize, fund, or carry out the vessel-related action (e.g., issuing a license or permit for construction of a commercial port). In some cases, the federal agency taking the action chooses to include measures as part of its proposed action that reduce the risk of vessel strike to Atlantic sturgeon. For example, the Federal Highway Administrations proposed action for replacement of the Frank J. Wood Bridge over the Androscoggin River excluded the use of certain large vessels during months when adult sturgeon were likely to be present. Alternatively, and depending on the outcome of consultation and consistent with the section 7 regulations, NMFS can include reasonable and prudent measures to minimize the amount or extent of taking identified in an Incidental Take Statement ; the federal agency must comply with those measures for the exemption from the section 9 prohibitions on take to apply. However, those measures cannot alter the basic design, location, scope, duration, or timing of the action and they must involve only minor changes. Although the risk of vessel strike for Atlantic sturgeon that belong to the Gulf of Maine DPS appears to be less than for sturgeon belonging to either the New York Bight DPS or the Chesapeake Bay DPS given differences in vessel activity within the respective natal rivers, NMFS does not expect to address all of the effects of vessel activities to the Gulf of Maine DPS through section 7 consultation because not all activities will have the necessary federal nexus, and even with a federal nexus NMFS may not be able to identify measures to reduce the amount or extent of that take.

Some effects of vessel activities may also be addressed through a section 10 incidental take permit. To meet the permit issuance criteria, the permit applicant is required to identify measures that will minimize and mitigate the impacts of the incidental taking to the maximum extent practicable. Application for a section 10 incidental take permit is premised, however, on

the applicant knowing that take is likely to occur. Operators of either large (e.g., commercial) or small (e.g., recreational) vessels may never anticipate that their vessel will strike a sturgeon because of both a lack of awareness of vessel strike as an issue of concern and the volume of vessel traffic compared to the number of known sturgeon strikes which may make it appear that risk is very low. Additionally, it is unlikely that a vessel operator would know that a sturgeon has been struck because the fish are rarely visible from the surface and the operator could reasonably attribute any sensation of a strike to debris in the water. Discovery of a sturgeon carcass with a vessel strike injury rarely provides information to identify the vessel that struck the sturgeon because it occurs after the fact, and many vessels use the navigable waters. Finally, issuance of a section 10 incidental take permit would only address the take attributed to the individual applicant's activity.

Conclusion for Factor D: The inadequacy of existing regulatory mechanisms is still a stressor for the Gulf of Maine DPS. Existing regulatory mechanisms appear to be inadequate to address the threat of vessel strikes. However, vessel strikes are less of a stressor for the Gulf of Maine DPS, particularly for adults when they are within or traveling to and from their Kennebec River spawning habitat. There are no regulatory mechanisms available to us to address the threat to the Gulf of Maine DPS from capture of Atlantic sturgeon in Canadian fisheries.

2.3.2.5 Other natural or manmade factors affecting its continued existence

Summary of Factor E: Vessel strikes were considered a threat to the Gulf of Maine DPS when NMFS listed the DPS as threatened. However, NMFS did not consider it a primary threat to the DPS because the risk appeared to be less than that of the New York Bight and Chesapeake Bay DPSs based on the limited number of known vessel struck carcasses in Gulf of Maine rivers and given differences in vessel presence, particularly of large vessels, in the DPS's natal river. We also considered that artificial stocking of Atlantic sturgeon for use in restoration of extirpated riverine populations or recovery of severely depleted wild riverine populations had the potential to be both a threat to the species and a tool for recovery.

New information since the listing rule supports NMFS conclusion that vessel strikes of Atlantic sturgeon occur within the Gulf of Maine, for example in the Kennebec River, Maine and in the Merrimack River, Massachusetts. Atlantic sturgeon belonging to the Gulf of Maine DPS are also at risk of being struck by vessels when the sturgeon occur in other areas of its range, including estuarine waters of the Hudson, Delaware, and James rivers. It is apparent that vessel strikes from both large (e.g., commercial) and smaller (e.g., recreational) vessels are a threat to the Gulf of Maine DPS throughout its range. However, examination of the salvaged carcasses indicates that most fatalities are the result of the sturgeon being struck by a large vessel causing either blunt trauma injuries (e.g., broken scutes, bruising, damaged soft tissues) or propeller injuries (e.g., decapitation, complete transection of other parts of the sturgeon body, or deep slices nearly through the body depth of large sturgeon) (Balazik et al. 2012b). As described above, multiple studies have shown that Atlantic sturgeon are unlikely to move away from vessels or avoid areas with vessel activity (Reine et al. 2014; Barber 2017; Balazik et al. 2017; DiJohnson 2019; Balazik et al. 2020).

There have been no artificial stocking programs for Atlantic sturgeon since the listings. While it is possible that these could be a tool for recovery in the future, there is no apparent need for these programs at present because current evidence suggests that remnant, albeit very small, populations may exist in rivers where Atlantic sturgeon were previously believed to be extirpated. In addition, it is uncertain whether an artificial stock would establish in a non-natal river. For example, genetic analyses for the spawning adult sturgeon captured in the Nanticoke River system (Chesapeake Bay DPS) indicates that the fish are a remnant of the historical spawning population and are not the sturgeon or the progeny of the sturgeon that were introduced to the Nanticoke River in the late 1990s (Secor et al. 2021).

NMFS has received a number of reports from members of the Atlantic sturgeon scientific community regarding the advertised sale for the hobbyist aquarium trade of non-native, non-ESA listed, sturgeon species of the genus Acipenser. Hybridization between Acipenser species is known to occur (Ludwig et al. 2009), and hybridization has even occurred between an Acipenser species and American paddlefish (*Polyodon spathula*) (Káldy et al. 2020). A spawning population of shortnose sturgeon (*Acipenser brevirostrum*) occurs in the Kennebec River, and spawning populations occur in many of the Gulf of Maine DPSs historical spawning rivers. However, spawning for the two species is separated temporally (i.e., different spawning seasons) and geographically (i.e., different spawning areas of the same river). There is no current information that any non-ESA listed Acipenser species has been intentionally or accidentally released into habitat used by the Gulf of Maine DPS of Atlantic sturgeon. However, the known risk of hybridization as well as other potential threats (such as competition for habitat or food resources) is a concern and a potential threat to the Gulf of Maine DPS that NMFS was not aware of when the DPS was listed as threatened.

Conclusion for Factor E: New information confirms that vessel strikes are a threat to the Gulf of Maine DPS albeit with fewer discovered carcasses compared to the Hudson, Delaware, and James rivers. The likelihood of a vessel strike is likely greater when Atlantic sturgeon belonging to the Gulf of Maine DPS occur in estuaries where vessel strikes are more frequent (e.g., within the higher salinity waters of the Hudson River Estuary, Delaware Bay Estuary, and the Chesapeake Bay). The sale and trade of non-native Acipenser species poses a potential threat to the Gulf of Maine DPS.

2.4 Synthesis

NMFS recommends classification for the Gulf of Maine DPS of Atlantic sturgeon with the continued implementation of the protective regulations issued under section 4(d) of the ESA (50 CFR § 223.211) as "threatened". The status of the DPS has likely neither improved nor declined from what it was when we listed the DPS in 2012.

The Kennebec River remains the only known spawning population for the Gulf of Maine DPS despite the availability of suitable spawning and rearing habitat in other Gulf of Maine rivers. The estimated effective population size is less than 70 adults which suggests a relatively small spawning population. It is currently the only DPS with only one known spawning population.

The new information further supports NMFS determination in the listing rule that the Gulf of Maine DPS has low abundance, and that the current numbers of spawning adults are one to two orders of magnitude smaller than historical levels.

Atlantic sturgeon belonging to the Gulf of Maine DPS are still captured and killed as a result of fishery interactions, vessel strikes, and dredging but, to a lesser degree than for the other DPSs. There is new information that dredging does not adversely affect Atlantic sturgeon behavior when in the vicinity of dredge gear (e.g., the sturgeon do not avoid areas where dredging is occurring and dredge activity may not pose a barrier to sturgeon that are migrating to and from spawning areas). However, takes of Atlantic sturgeon continue to occur in the dredge gear. Capture of Atlantic sturgeon in fishing gear continues to occur in other areas of the DPSs range but appears to be less prevalent in Gulf of Maine waters where sturgeon belonging to the DPS are most likely to occur. As described above, NMFS has issued section 10 permits for the incidental take of Atlantic sturgeon (all DPSs) in the North Carolina commercial inshore gillnet fishery, and in the Georgia commercial shad fishery. The large mesh gillnet restrictions for waters off of Virginia and North Carolina (71 FR 24775; April 26, 2006) also provide some protection to the Gulf of Maine DPS. There are no known major construction projects (e.g., port expansion, navigational channel deepening) within designated critical habitat for the Gulf of Maine DPS.

Based on the Stock Assessment, there is a 51 percent probability that abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium but also a relatively high likelihood (74 percent probability) that mortality for the Gulf of Maine DPS exceeds the mortality threshold used for the Stock Assessment (ASMFC 2017a). However, Atlantic sturgeon are data poor, in general, and among these, the Gulf of Maine DPS is very data poor. The Stock Assessment Peer Review Report described that it was not clear if: (1) the percent probability for the trend in abundance was a reflection of the actual trend in abundance or of the underlying data quality for the DPS; and, (2) the percent probability that the Gulf of Maine DPS exceeds the mortality threshold actually reflects lower survival or was due to increased tagging model uncertainty owing to low sample sizes and potential emigration.

New information suggests that the observed seasonal abundance of Atlantic sturgeon in the Saco River is a large feeding aggregation and may be, but is not necessarily, indicative of an increased abundance for the DPS, overall. New information also supports that the Gulf of Maine is one of the fastest warming areas of the world as a result of global climate change. There is no new information for climate change impacts to water quality (e.g., temperature, salinity, dissolved oxygen, contaminants) within Gulf of Maine rivers that we anticipated might occur when we listed the Gulf of Maine DPS as threatened. However, new information indicates that all Atlantic sturgeons are highly vulnerable to climate change, and that the Atlantic sturgeon's low likelihood to change distribution in response to current global climate change will also expose them to climate's other effects on estuarine habitat such as changes in the occurrence and abundance of prey species in currently identified key foraging areas.

The new information supports NMFS determination in the listing rule that the Gulf of Maine DPS continues to be affected by the persistent threat from bycatch, and that the effects of global climate change on the Gulf of Maine DPS will likely be greater than what we anticipated when

we listed the DPS. Vessel strikes, take in dredge gear, and the loss or alteration of habitat also continue to occur but to a lesser degree than for the other Atlantic sturgeon DPSs. Further, the new information supports NMFS determinations in the listing rule that there is a lack of existing regulatory mechanisms to adequately address some of these threats where they occur in U.S. waters. Although the limited studies suggest that there is low Atlantic sturgeon bycatch mortality in the Bay of Fundy weir and trawl fisheries, NMFS does not have a regulatory mechanism to address bycatch in the fisheries, or incidental take of Gulf of Maine DPS Atlantic sturgeon in other activities (e.g., tidal turbine) that may occur within Canadian jurisdiction in the future.

New information better informs the physical features of marine waters and estuaries where Atlantic sturgeon belonging to the Gulf of Maine DPS occur. The studies demonstrate that the fish are sensitive to and selective of specific habitats with certain features that are often dynamic and only occur at specific times of the year (e.g., sea surface temperature and the degree of light absorption by seawater in marine habitat, and distance from the salt front, substrate composition, and water depth in estuaries). The results may inform NMFS' further consideration of critical habitat designations for the Gulf of Maine DPS, particularly in key foraging areas for subadults and adults (e.g., higher salinity waters of the Penobscot, Kennebec, and Saco rivers). NMFS could not identify what the specific features are of marine waters, bays and sounds that make them essential to the conservation of Atlantic sturgeon when critical habitat was designated for the Gulf of Maine DPS given the limited and confounding information available at the time.

3.0 RESULTS

3.1 Recommended Classification: No change is needed

3.2 New Recovery Priority Number: No change is needed

The Gulf of Maine DPS's demographic risk is "Moderate" because of its low productivity (e.g., relatively few adults compared to historical levels), low abundance (e.g., only one known spawning population and low DPS abundance, overall), and limited spatial distribution (e.g., limited spawning habitat within the one river known to support spawning). There is also new information indicating genetic bottlenecks as well as low levels of inbreeding. Based on the Listing and Recovery Priority Guidelines, meeting any one of these risk conditions for a threatened species ranks the Gulf of Maine DPS as at moderate demographic risk (84 FR 18243; April 30, 2019).

The Gulf of Maine DPS' potential to recover is, however, also likely high because man-made threats that have a major impact on the species' ability to persist have been identified (e.g., bycatch in federally-managed fisheries), the DPS' response to those threats are well understood, and management or protective actions are technically feasible with respect to reducing fisheries bycatch even if they require further testing (e.g., gear modifications to minimize dredge or fishing gear interactions). In addition, with the exception of fisheries and other projects (e.g., marine energy projects) that occur in the Bay of Fundy, the management or protective actions to address major threats are primarily under U.S. jurisdiction or authority.

There is conflict with construction projects including bridge construction activities, and projects associated with on-going, operating dams that are used for energy generation. Therefore, based on the Listing and Recovery Priority Guidelines (84 FR 18243, April 30, 2019), the recovery priority number for the Gulf of Maine DPS is 3C, and is unchanged.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

NMFS, GARFO, PRD should convene an internal group, with external expert opinion as needed, to identify information needs and next steps to address the essential data (e.g., life history) gaps for the Gulf of Maine DPS.

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NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW
Gulf of Maine Distinct Population Segment of Atlantic Sturgeon
(Acipenser oxyrinchus oxyrinchus)

Current Classification: **Threatened**

Recommendation resulting from the 5-Year Review

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change is needed

Review Conducted By: Lynn Lankshear, Sturgeon Recovery Coordinator, GARFO, Protected Resources Division

REGIONAL OFFICE APPROVAL:

Lead Regional Administrator, NOAA Fisheries

Approve: _____ Date: _October 21, 2021_

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

___X__Concur _____ Do Not Concur

Signature RAUCH.SAMUEL.D.III.1365850948 Digitally signed by RAUCH.SAMUEL.D.III.1365850948 Date: 2022.02.16 13:39:04 -05'00' Date_____