NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7
BIOLOGICAL OPINION

Title:	Reinitiation of the Programmatic Biological Opinion on the Implementation of a Program for the Issuance of Permits for Research and Enhancement Activities on Atlantic and Shortnose Sturgeon Pursuant to Section 10(a) of the Endangered Species Act
Consultation Conducted By:	Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
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Date:	
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1. Introduction

The Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. §1531 et seq.) establishes a national mandate for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the Act and its implementing regulations require every federal agency, in consultation with and with the assistance of the Secretary (16 U.S.C. §1532(15)), to insure that any action it authorizes, funds, or carries out, in whole or in part, in the United States or upon the high seas, is not likely to jeopardize the continued existence of any listed species or results in the destruction or adverse modification of critical habitat.

Section 7(b)(3) of the ESA requires that, at the conclusion of consultation, the National Marine Fisheries Service (NMFS) provides an opinion stating whether the federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify their designated critical habitat. This action is a reinitiation of a programmatic biological opinion (FPR-2016-9176; NMFS 2017). The action agency for this consultation is the NMFS Office of Protected Resources, Permits and Conservation Division (Permits Division). The Permits Division proposes to incorporate muscle biopsy, oocyte extraction, and translocation into the program; modify the existing practices of laparoscopy, transport, and trawling; and finally revise the mortality bank structure to allow for in-hand mortalities in systems with unknown populations.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

Consultation in accordance with section 7(a)(2) of the statute (16 U.S.C 1536 (a)(2)), associated implementing regulations (50 C.F.R. §402), and agency policy and guidance (USFWS and NMFS 1998) was conducted by the NMFS OPR ESA Interagency Cooperation Division (hereafter referred to as 'we' or 'us'). We prepared this reinitiated programmatic biological opinion (opinion) in accordance with section 7(b) of the ESA and implementing regulations at 50 CFR Part §402. This document represents NMFS's opinion on the effects of these actions on Atlantic and shortnose sturgeon and Atlantic sturgeon designated critical habitat.

1.1. Consultation History and Updates to the Program

On March 20, 2017, we completed a programmatic consultation with the Permits Division on the implementation of a new sturgeon research and enhancement program.

On August 17, 2017, NMFS issued a final rule (82 FR 39160; effective date September 18, 2017) to designate critical habitat for the threatened Gulf of Maine distinct population segment (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 pursuant to the ESA.

On January 22, 2018, NMFS designated the giant manta ray as a threatened species (83 FR 2916).

On January 30, 2018, NMFS designated the oceanic whitetip sharks as a threatened species (83 FR 4153).

On December 5, 2019, NMFS determined that designating critical habitat for giant manta rays was not warranted (84 FR 66652).

On March 5, 2020, NMFS determined that designating critical habitat for oceanic whitetip sharks was not warranted (85 FR 12898).

On September 13, 2021, the Permits Division requested to re-initiate formal programmatic consultation on Atlantic and shortnose sturgeon research.

On October 13, 2021, we provided notice to the Permits Division that we disagreed with their assessment and request for reinitiation and a formal response would be forthcoming. Then on November 3, 2021, we provided the letter justifying the reasons we could not initiate consultation to the Permits Division.

On August 15, 2022, the Permits Division provided an updated request to re-initiate formal programmatic consultation on Atlantic and shortnose sturgeon research.

On October 17, 2022, we notified the Permits Division that, based on our review of the submitted information, we determined there was sufficient information to reinitiate formal consultation pursuant to section 7 of the ESA on proposed changes to the sturgeon research permitting program. We indicated that we were reinitiating this consultation as of August 15, 2022.

On October 20, 2022, the Permits Division identified an upper size range for early life stage Atlantic and shortnose sturgeon and provided the best scientific information supporting that size designation. While designating this size limit has no effect to Atlantic or shortnose sturgeon, this serves to update the use of that size limit within the Atlantic and shortnose sturgeon research permitting program.

On December 20, 2022, the Permits Division proposed to amend the sturgeon research and enhancement permit program to authorize the use cast nets as a method for capturing sturgeon adult, subadult, juvenile and early life stages (larvae) as part of the suite of permitted activities. The Permits Division requested our concurrence that reinitiation of consultation was not required to make this change because the use of cast nets falls within the scope of effects considered for sturgeon research and the adaptive management process under the 2017 programmatic biological opinion.

On December 22, 2022, we responded to the Permits Division that the proposed addition of cast nets as a capture method falls within the scope of the effects analyzed in our 2017 biological opinion and, therefore, we concur that cast nets can be added as a capture method to the Program without reinitiation of this consultation.

2. Proposed Action

The Permits Division proposes to revise three research techniques that are currently part of the programmatic framework established in 2017, add three new research techniques to the programmatic framework, and modify the calculations for the established mortality banks based on monitoring data collected over the previous 5 years. The rest of the 2017 programmatic framework remains unchanged and the effects of those actions are considered in the Environmental Baseline section of this reinitiated programmatic biological opinion. In general, for any section where we have determined that there is no new information requiring an update, we incorporate the corresponding section from the 2017 programmatic biological opinion, by reference, into this reinitiated biological opinion. The 2017 biological opinion is available online from the NOAA Repository website at: http://doi.org/10.7289/V5D21VSJ

2.1. Revised Research Techniques

The Permits Division proposes revising the accepted methodology for 1) transport of sturgeon, 2) trawling, and 3) laparoscopy. The new research protocols are identified in their initiation package: transport of sturgeon is described in Appendix A; trawling in Appendix E; and laparoscopy in Appendix B (NMFS 2022a).

The current transport protocols for sturgeon are for 0.75 pounds of fish per gallon for up to 48 hours. The proposed modification would increase the weight allowed per gallon, but only for short trips (up to 4 hours). The new transport protocol for short trips would be for up to 2 pounds per gallon.

The current protocols for trawling are for a maximum speed of 3.5 knots. The modified protocols would allow for an average maximum speed of 3.5 knots without changing the duration of the trawl times.

The current laparoscopy protocols only allow for its performance in a laboratory setting. The proposed protocols would allow experienced researchers to perform the same procedure but in the field (Figure 1).

Figure 1. Size and location of laparoscopic incision before the gonads are viewed through the scope.

2.2. New Research Techniques

The Permits Division proposes to add three new procedures under the framework of the programmatic. These new procedures are muscle biopsies, translocation, and oocyte extraction. Translocation is described with transport in Appendix A of the initiation package (NMFS 2022a), muscle biopsies are described in Appendix D, and oocyte extraction is described in Appendix C.

Translocation is proposed to be used rarely and only in situations where the movement of fish from one location to another will enhance the population. Translocation will only be used when moving fish provides a recovery benefit. For instance, it may be utilized to provide access to otherwise inaccessible spawning habitat, increase fish passage, or facilitate safe access of foraging or marine areas. Translocation will follow the transport protocols described in the 2017 programmatic with modifications described in section 2.1 of this programmatic reinitiation. Appropriate mitigation, which will be permit conditions, are described in Appendix E (NMFS 2022a).

Muscle biopsies are a new procedure, but gonadal biopsies were considered in the 2010 sturgeon capture and handling protocols (Kahn and Mohead 2010). Muscle biopsies are less invasive, though also involve a careful incision. For muscle biopsies, two shallow incisions are made in a V-shape to pull the skin away from the dorsal musculature just anterior to the dorsal fin. This is the same general area where the PIT tag is injected (Kahn and Mohead 2010). A disposable 5 mm biopsy punch is then used to collect a muscle sample. After collection, the skin is replaced over the muscle and two sutures applied to close the wound (Figure 2). Appropriate mitigation, which will be included as permit conditions, are described in Appendix D (NMFS 2022a).

Figure 2. Muscle biopsy locations upon recapture of a white sturgeon.

Oocyte extraction is proposed as a new, less invasive method of collecting female gonadal samples. Currently, gonadal biopsies are allowed under the programmatic framework. These require a ventral incision and sutures to close (Conte et al. 1988, Van Eenennaam et al. 2001). The oocyte extractor (described in Candrl et al. 2011) uses a 3.76 mm diameter beveled stainless-steel needle and 30 mL syringe to penetrate the body wall and then remove egg samples via suction. This method of oocyte extraction leaves a small (diameter of the needle), self-healing wound, which heals rapidly without suturing. The entire extraction process takes less than 30 seconds and, therefore, also reduces fish handling time from the current method of egg collection.

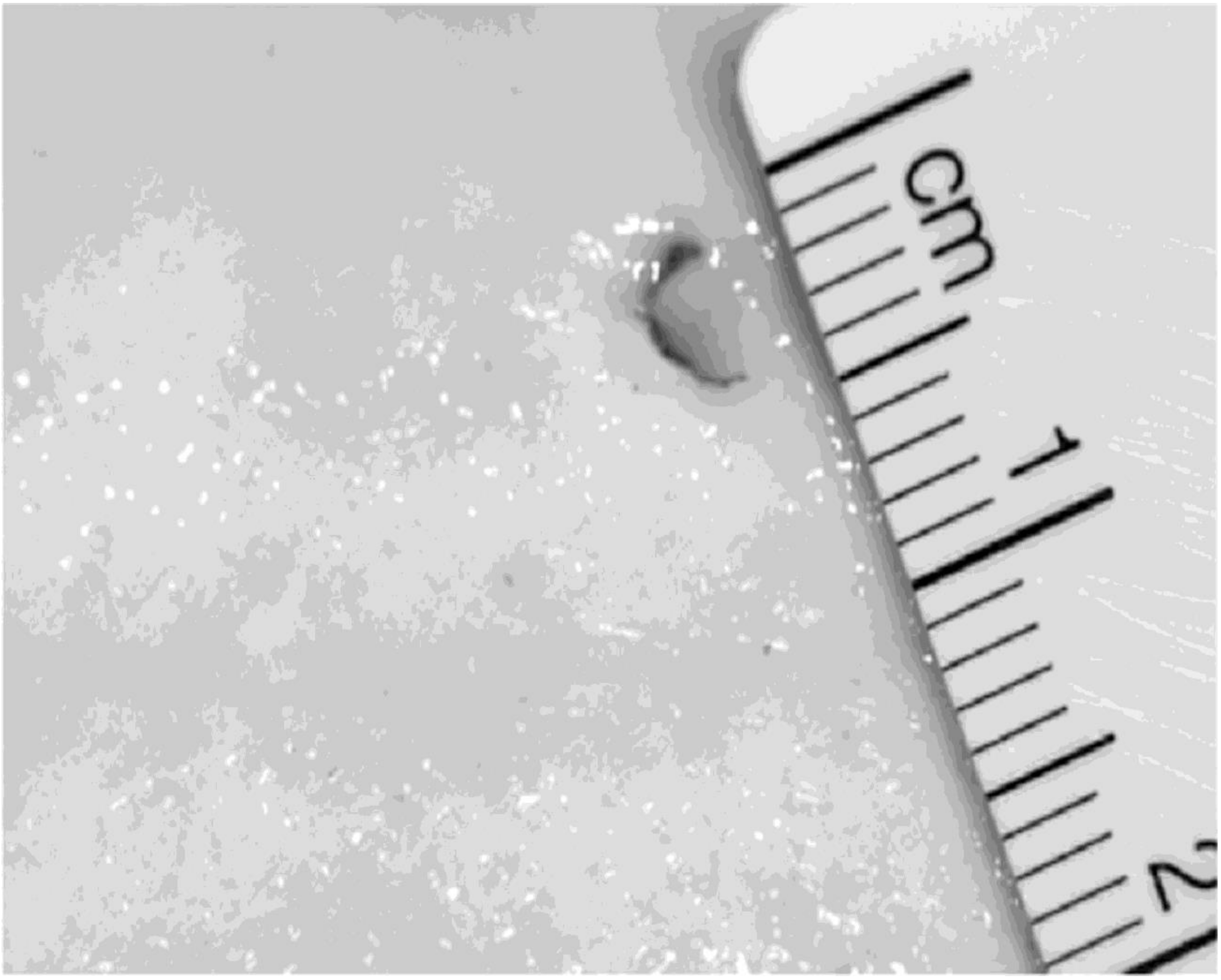

Figure 3. The wound left following oocyte extraction following the procedures described in Candrl et al. 2011.

2.3. Updated Mortality Limit Calculations

The current mortality limits described in the 2017 program (section 2.5 of the 2017 programmatic biological opinion) is the foundation for ensuring the lethal amounts of take permitted under this program are appropriate for each individual sturgeon population along the East Coast. The potential for lethal take can occur from either 1) "in-hand" mortality as a result of known mortality while being captured, handled, or undergoing a procedure; or 2) delayed mortality that occurs following an invasive procedure but is likely due to that procedure. Under the current framework, and continuing under this reinitiation, mortality is monitored at the population (natal river system) level, separately for Atlantic sturgeon adults/sub-adults (over 1,000 mm fork length) and juveniles (60 mm total length to 1,000 mm fork length), and shortnose sturgeon adults/sub-adults (over 450 mm fork length) and juveniles (60 mm total length to 450 mm fork length).

The two categories of mortality ("in-hand" and delayed) are calculated and monitored dependent on the health and size of each population (see Section 2.5 of 2017 programmatic biological opinion for details). When there is insufficient information on the health or size of a population, the mortality for that system is limited to 1 fish per year until basic population information can be obtained. The Permits Division determines how best to allocate take to researchers working in different systems. In-hand mortality is allocated in terms of whole fish, but can be considered over several years. Delayed mortality is calculated based on the probability of post-release mortality (a single dead fish) resulting from those procedures that carry a risk of delayed mortality. Surgical procedures and gastric lavage were estimated to have a delayed mortality rate of 2.5% for adult or subadult fish and 5% for juvenile fish. Therefore, for every 40 procedures of surgery or lavage on adult/subadult fish issued through permits, the Permits Division would note that allocation in terms of 1 mortality from the established mortality limits.

Based on information collected since 2017, the Permits Division is proposing to align the mortality rates observed for adult and juvenile fish. Further, the delayed mortality rate from an analysis of 217 transmitters implanted between 2017 and 2019 suggests the delayed mortality rate for surgical procedures should be adjusted from 2.5% to 2.0%. Analysis of gastric lavage conducted by experienced researchers reveals the delayed mortality rate is 0% (NMFS 2022a). Therefore, the Permits Division is proposing to revise the delayed mortality rates for surgery and lavage to 2.0% and 0%, respectively. Additionally, because low rates of in-hand mortality are known to occur, even in systems with undescribed populations, the Permits Division is requesting to include a single in-hand mortality every 5 years, functionally changing the mortality limit for populations of unknown status to 1.2 fish per year, up from a single fish per year. These three changes in the way mortality rates are calculated would be applied by the Permits Division to understand the risks of existing permits and to guide the issuance of future permits.

3. May Effect, Not Likely to Adversely Affect

The proposed changes to the framework of the Atlantic and shortnose sturgeon research program will not cause effects to non-target species, nor will these modifications affect critical habitat in new ways or to a greater extent than was considered in the 2017 programmatic biological opinion. Therefore, the non-target species and Atlantic sturgeon critical habitat are not discussed in this reinitiation.

Since 2017, two species of marine elasmobranchs have been listed: oceanic whitetip shark (*Carcharhinus longimanus*) and giant manta ray (*Manta birostris*). These species (Table 1) can be found in the action area of this programmatic (Section 2.9 of the 2017 programmatic biological opinion) and are therefore addressed below. Critical habitat has not been designated for either species. Likewise, no recovery plans have been developed.

Table 1. Species listed under the ESA since 2017 in the programmatic action area.

Species	Listing Status	Critical Habitat	Recovery Plan
Oceanic whitetip shark (*Carcharhinus longimanus*)	T – 83 FR 4153	Not Prudent 85 FR 12898	In Prep 84 FR 55143
Giant manta ray (*Manta birostris*)	T – 83 FR 2916	Not Prudent 84 FR 66652	NA

Gill nets, trammel nets, cast nets, seines, and trawls are used to target Atlantic and shortnose sturgeon. Only gill nets, trammel nets, and trawls are used in the ocean and could pose a risk to oceanic white tip sharks and giant manta rays. These gears can pose an entanglement risk to non-target species, including oceanic whitetip sharks and giant manta rays. However, the majority of sturgeon research is conducted in rivers or estuaries where these species do not exist. When research is conducted in marine waters, it is often near shore because Atlantic and shortnose sturgeon tend to remain near the coastline when in the ocean. Oceanic whitetip sharks live offshore over deep water, spending most of their time at or near the surface. Giant manta rays can be found near shore, most often associated with thermal fronts (Farmer et al. 2022). Giant manta rays, however, feed on zooplankton, and therefore spend most of their time above the thermocline. Both sturgeon species are benthic and, whether using gill nets, trammel nets, or trawl nets, the target sampling location would be the benthos. Because oceanic whitetip sharks and giant manta rays prefer different habitats than Atlantic or shortnose sturgeon, it is extremely unlikely capture gear intended for the benthically oriented sturgeon would lead to interactions with the pelagically oriented oceanic whitetip shark and giant manta ray. Therefore, we believe the probability of interaction with research gear is discountable. Additionally, because of soak times meant to protect captured Atlantic and shortnose sturgeon, if bycatch of oceanic whitetip sharks or giant manta rays were to occur, they would be in the nets for durations that would be protective of captured fish. Thus, the probability of a response to capture would also be undetectable. Therefore, we conclude the entirety of the programmatic action considered in 2017 (PPR-2016-00009) may effect, but is not likely to adversely affect oceanic whitetip sharks or giant manta rays.

4. Updated Status of the Species

The status of the species section establishes the health and trends of Atlantic and shortnose sturgeon populations. In this section, we place emphasis on reproduction, abundance, and distribution as well as recovery planning. This update reflects new information relevant to this opinion that has come out since the 2017 programmatic was finalized. We incorporate information from the status of the species and critical habitats from the 2017 biological opinion (NMFS 2017), by reference, into this reinitiated biological opinion.

4.1. Atlantic sturgeon

There are five distinct population segments (DPSs) of Atlantic sturgeon: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic. The following sections provide relevant updates to the status of each DPS of Atlantic sturgeon.

4.1.1. Gulf of Maine DPS

Since 2017, there were several updates about reproduction, numbers, and distribution in the Gulf of Maine DPS. An open population estimate of marine-oriented Atlantic sturgeon (sub-adult and adult) foraging in the Saco River from May to November is between 1,400 and 6,800 individuals annually (Flanigan et al. 2021). The Kennebec River effective population size and 95% confidence limits (CL) were estimated at 67.0 (52.0-89.1) and 79.4 (60.3-111.7) by Waldman et al. (2019; n = 62) and White et al. (2021; n = 48). Effective population size is essentially an estimate of the number of breeding individuals in a population required to maintain the amount of genetic variability observed within samples from that population. Furthermore, 2 larval Atlantic sturgeon were captured just above the Kennebec River estuary between 24 and 25 °C in mid-July, confirming successful reproduction in this location (Wippelhauser et al. 2017). It is thought the Penobscot may have historically supported a spawning population, but it is possibly extirpated (ASMFC 2017). Wippelhauser et al. (2017) suggest Atlantic sturgeon use the upper Kennebec River, the Kennebec River estuary, and the Androscoggin River estuary for reproduction. It is unknown whether the Merrimack River supports a reproductive population of Atlantic sturgeon (ASMFC 2017). And while the Androscoggin represents an additional known spawning location for this DPS, non-spawning individuals were observed to use the Penobscot, Androscoggin, Saco, Merrimack, St. John, and Minas Passage (Altenritter et al. 2017, Novak et al. 2017, Wippelhauser et al. 2017). Survival rates of all ages is estimated to be approximately 74% annually (95% confidence limits, 15-99%; ASMFC 2017).

A recovery outline was produced for Atlantic sturgeon (NMFS 2018). The goal for recovery is to have reproductive populations across their historic range of sufficient size and diversity to support reproduction and recovery from mortality events. There have been no new threats identified to the Gulf of Maine DPS since 2017.

4.1.2. New York Bight DPS

There have been minimal updates to the underlying information regarding reproduction. The Connecticut, Hudson, and Delaware Rivers all support reproductive populations while the Taunton River population appears to be extirpated. A recent assessment of relatedness of these populations to others along the coast reveals, as was the case at the time of listing, that the Hudson and Delaware populations appear to be a separate group from other populations but also different from one another (White et al. 2021a). The Connecticut River was not included in that study. A recent study using acoustic telemetry to estimate spawning duration and return intervals shows that Hudson River adults return much more frequently than previously thought; females every 1.66 years and males every 1.28 years (Breece et al. 2021). This is in agreement with recent studies conducted in the York River (Hager et al. 2020), both suggesting females, in particular, spawn more often than previously thought. In the Hudson River, males were on spawning grounds on average from May 27 through July 11 and females from June 8 through June 29. The average male is also more likely to travel further upriver than the average female (Breece et al. 2021).

There are a number of updated abundance estimates for each river. The Hudson River most likely supports the largest population of Atlantic sturgeon in the United States. Effective population estimates for the Hudson River are 156 (95% CL, 138.3-176.1; n = 459; Waldman et al. 2019) and 145.1 (82.5-299.4; n = 307; White et al. 2021). Kazyak et al. (2020) produced an abundance estimate of the 2014 adult spawning run size of 466 individuals (95% CL, 310-745). While this spawning run size is nearly identical to that estimated by Kahnle et al. (2007), monitoring of relative abundance of juveniles from 2004 through 2019 has shown production may have doubled during those 16 years (Pendelton and Adams 2021).

In the Delaware River, the effective population size has been estimated to be 40 (95% CL, 34.7-46.2; n = 108) and 60.4 (42-85.6; n = 488) by Waldman et al. (2019) and White et al. (2021a), respectively. The significant difference between estimates is likely due to sample size. Therefore, White et al.'s (2021a) estimate is likely most accurate. Additionally, a recent close-kin mark-recapture estimate was produced for the Delaware River and suggests there are fewer than 250 adults (census) in the Delaware River population (White et al. 2021b).

In the Connecticut River, despite only limited collection of juvenile sturgeon (n = 47), there is an estimate of effective population size of 2 (95% CL, 2-2.7; Waldman et al. 2019). This would suggest there has been a single spawning event in the Connecticut River that produced all of the juvenile fish collected or the spawning adults were so closely related as to be indistinguishable from a single pair. Either way, it is clear there is limited genetic diversity in this population and, unless these adults continue returning to the Connecticut River, it could take approximately 20 years to learn whether these juveniles have survived in sufficient numbers to sustain this new population.

Recent survival estimates do not suggest much of an improvement since the last estimates made during the commercial fishery (Boreman 1997, Kahnle et al. 1998). Melnychuk et al. (2017) provided an updated estimate of survival of Hudson River Atlantic sturgeon of approximately 88.22%, while for similar life stages over a longer time frame, the Atlantic States Marine Fisheries Service (ASMFC 2017) estimated survival of the entire New York Bight to be 91% (95% confidence limits, 71-99%).

Distribution of fish from the different populations of Atlantic sturgeon in the New York Bight DPS have also been updated since 2017. The range of Atlantic sturgeon can be measured from north to south or inshore to offshore. While there has been no change to the range along the East

Coast, there are detection data of acoustic transmitters much further offshore than had previously been documented.

To understand movement along the coast, White et al. (2021c) assessed the river of origin of Atlantic sturgeon harvested during the commercial fishery. This was a duplication of a study done by Waldman et al. (1996), but showed fish harvested in the Hudson River were from many locations other than the Hudson. The makeup of the harvested fish in the 1990s was 82.3% Hudson, 7.3% Delaware, 4.7% James River spring run, 2.4% St. Lawrence, 2.1% Kennebec, 1.3% Pee Dee spring run, rather than 98% Hudson as had been estimated during the fishery. The reasons for the difference are likely a more thorough baseline consisting of 18 known populations rather than only 9 (White et al. 2021a) and the use of microsatellite DNA rather than mitochondrial. However, Wirgin et al. (2018) sampling 148 sub-adult sturgeon in the Hudson River estuary and relying on microsatellite DNA, found 142 of those were of Hudson River origin with additional contributions from the Kennebec (2), Delaware (2), Ogeechee (1), and James (1) Rivers. This may suggest adults are more likely to enter estuaries than sub-adults.

In terms of nearshore habitat use, Breece et al. (2018a) showed habitat selection is driven by depth, time of year, sea surface temperature, and light absorption by seawater, while sex and natal river do not seem to be important predictors of habitat selection. Therefore, regardless of the makeup of the mixed populations in these estuarine areas, the drivers of where the fish are located affect all sexes and populations similarly. Inshore and offshore movement is highly dependent on photoperiod and temperature, with fish residing offshore from November to January and inshore from June to September (Ingram et al. 2019). Fish gradually move inshore from February to May but rapidly move offshore during October (Ingram et al. 2019). In the Delaware Bay, when fish have moved inshore for the spring and summer months, Breece et al. (2018b) showed Atlantic sturgeon prefer shallow water and warmer bottom temperatures primarily in the eastern portion of the bay during residency but that this preference changes to deep, cool water and the western edge of the bay during migration.

Kazyak et al. (2021) studied the offshore composition of sturgeon between Cape Hatteras and Cape Cod (mid-Atlantic, which comprises the New York Bight, Chesapeake Bay, and part of the Carolina DPSs) and found that 37.5% and 30.7% of all bycaught fish in this region were from the New York Bight and Carolina DPSs, respectively. This was primarily driven by 27.3% of fish from the Albemarle complex and 26.2% from the Hudson River. Estuarine bycatch in this area was primarily from Albemarle Complex, with many of the samples being obtained in waters of North Carolina, and most offshore fish were from the Hudson and James Rivers.

A recovery outline was produced for Atlantic sturgeon (NMFS 2018). The goal for recovery is to have reproductive populations across their historic range of sufficient size and diversity to support reproduction and recovery from mortality events. There have been no new threats identified to the New York Bight DPS since 2017.

4.1.3. Chesapeake Bay DPS

Much like the New York Bight DPS, there have been minimal updates on reproduction in the Chesapeake Bay DPS. There are still only three known spawning populations for this DPS in the James, York, and Nanticoke Rivers. Edwards et al. (2020) noted an adult male Atlantic sturgeon was detected at the saltwater interface of the Patuxent River, which may indicate potential spawning. However, Kahn et al. (2019) noted that telemetry detections are not a meaningful indicator of whether a male is spawning. Because males are often in spawning condition during non-spawning situations (Van Eenennaam et al. 1996), even if this individual had been captured and observed in spawning condition, that would not have been enough to suggest spawning was occurring in the Patuxent River.

Monitoring in the York River reveals that males return to spawn every 1.13 years and females every 2.19 years (Hager et al. 2020). Males in the Nanticoke River system return to spawn every 1.68 years (calculated from Table 2 in Secor et al. 2022) but there is insufficient information to estimate female return intervals. Hager et al. (2020) show spawning in the York River occurs on descending temperatures from 25.1 °C to 21.5 °C. This narrow temperature window is bounded by increased egg mortality at 25 °C and peak bioenergetic growth around 22 °C. Secor et al. (2022) similarly show adults present on Nanticoke River spawning grounds from 26.7 °C down to 17.8 °C with most fish leaving the system by 20 °C. Spawning in both systems appears to be driven by temperature and photoperiod with a peak of spawning around the autumn equinox (Hager et al. 2020, Secor et al. 2022). Sex ratios when spawning range from approximately 64 to 75% male in the York River, though the overall population appears to be approximately 51% male (95% CL, 43-58%; Kahn et al. 2021).

A recent assessment of relatedness of all Atlantic sturgeon populations showed that, when all populations along the coast are grouped, the James River (spring and fall runs) is most closely related to rivers in the northeast, while the York River is most closely related to rivers in the southeast (White et al. 2021a). The York River population was distinct when compared to those southeastern rivers; the James River, meanwhile, when compared to northeastern rivers, remains closely related to a group of rivers in Canada and Maine but is differentiated from the Hudson and Delaware Rivers. At this point in the analysis, Program COLONY, which was used to estimate closeness of relationships, could have identified three clusters (James spring and fall, Hudson and Delaware, and Maine/Canada), but did not. When compared only with rivers from Maine and Canada (White et al. 2021a), the James River spring and fall runs both appear to be unique but can be further separated from each other when compared to one another (Balazik et al. 2017, White et al. 2021a). This analysis shows that the York River population (and Nanticoke River population, which appear to form an upper Chesapeake Bay metapopulation [J. Kahn, unpublished data]) is significantly different from the two James River populations at the most basic level of comparison.

Considerable advances have been made in understanding the abundance of each of these populations. There are no estimates of abundance for any life stage in the James River. The York River has estimates of adult abundance on spawning runs from 2014 through 2019 (Table 2). Census estimates of adult Atlantic sturgeon on spawning runs in the Nanticoke River in 2020 and 2021 are 36 (25-55) and 74 (52-109; Nick Coleman, personal communication to Jason Kahn, email 11/29/2022). Effective population size of the James River (as a single spawning population) was estimated from 116 samples to be 32 (28.8-35.5; Waldman et al. 2019). White et al. (2021a) assessed the James River spring (n = 45) and fall (n = 131) spawning adults separately and identified effective population sizes of 24.7 (21-29.4) and 85.5 (61.1-127.5), respectively. The lone effective population estimate for the York River (n = 203) is 9.3 (6.9-11.8; White et al. 2021a) and for the Nanticoke River (n = 32) is 12.2 (6.7-21.9; Secor et al. 2022).

Table 2. Estimated abundance of spawning runs in the Pamunkey River, the primary spawning tributary of the York River, derived from a model relying on capture probability (Kahn et al. 2021) and a mark recapture heterogeneity model (Kahn et al. 2019).

Year	Male*	Female*	Spawning abundance*	95% CL*	Jackknife model†	95% CL†
2014	117	41	158	127-189	152	115-215
2015	125	68	192	154-230	182	145-243
2016	112	38	149	120-179	219	166-298
2017	150	68	218	175-260	215	167-292
2018	92	30	122	98-145	154	112-222
2019	153	86	239	192-286	330	257-434

*estimates from Kahn et al. 2021, † estimates from Kahn et al. 2019

Several recent survival estimates have been produced. At the DPS level, the Chesapeake Bay DPS is estimated to have an apparent annual survival of approximately 88% (95% CL, 46-99%; ASMFC 2017). A recent estimate for adult York River Atlantic sturgeon by Kahn et al. (In Press) shows much higher survival than other estimates with an annual apparent survival of 99.2% (97.9-99.7%). Kahn et al.'s (In Press) estimate was higher because it accounted for different detection probabilities between sexes and identified tag loss rates of 12.8% through concurrent mark recapture research.

Oceanic distribution of the Chesapeake Bay DPS is best known from the analysis by Kazyak et al. (2021). This is the same information as presented for the New York Bight DPS because both populations occupy waters between Cape Hatteras and Cape Cod. Rothermel et al. (2020), like Ingram et al. (2019), noted an inshore movement in the spring and offshore movement in the fall and winter. And like Breece et al. (2018b) observed, Atlantic sturgeon appear to prefer warmer, shallower water while residing offshore.

A recovery outline was produced for Atlantic sturgeon (NMFS 2018). The goal for recovery is to have reproductive populations across their historic range of sufficient size and diversity to support reproduction and recovery from mortality events. The invasive blue catfish has become a more notable threat to native fish in the Chesapeake Bay region. A recent analysis of stomach contents reveals that 22 of 560 fish sampled (4%) comprising 27 species consumed Atlantic sturgeon during the fall spawning period (Bunch et al. 2021). The primary consumers of Atlantic sturgeon were striped bass (1 of 8 guts, 12.5%), carp (6 of 52 guts, 11.5%), and blue catfish (8 of 131 guts, 6%). No hard parts were present and the assumption is that the Atlantic sturgeon DNA was either from eggs or larvae that were quickly digested (Bunch et al. 2021).

4.1.4. Carolina DPS

The Carolina DPS is likely the least studied. Spawning likely occurs in the Roanoake, Tar/Pamlico, Neuse, Cape Fear, Pee Dee, Santee, and Cooper Rivers. Census abundance is not available for any system. The effective population size of juveniles collected in the Albemarle Sound is approximately 19 (95% CL, 16.5-20.6; n = 88; Waldman et al. 2019) to 29.5 (24.2-36.3; n = 71; White et al. 2021a). There is also a new effective population size estimate for the Pee Dee River spring (n = 66) and fall (n = 50) spawning runs, amounting to 13.5 (11.9-15.3) and 82 (60.3-122.1), respectively (White et al. 2021a). Also, updating Hightower et al. (2016), the ASMFC (2017) produced an updated survival estimate for the entire Carolina DPS, suggesting Atlantic sturgeon survival rates are approximately 78% (95% CL, 39-99%).

Relatedness of known spawning populations was also assessed for the Carolina DPS, both in terms of its relationships to other populations outside of the DPS and within. Once the York River is isolated as being unique and different from all other southeastern populations, those populations then break into two groups with a bit of overlap. One group is the Albemarle Complex, Pee Dee spring run, Pee Dee fall run, Edisto spring run, Ogeechee spring run, and Satilla river populations while the other group is the Albemarle Complex, Pee Dee fall run, Edisto fall run, Savannah, Ogeechee fall run, and Altamaha populations (White et al. 2021a). When compared amongst each other further, those groupings break out into 1) the Albemarle Complex, Pee Dee spring run, and Pee Dee fall run separate from the rest of the southeastern rivers (White et al. 2021a).

The only updated information since 2017 about distribution also relates to offshore habitat utilization. As mentioned in the discussion of the New York Bight DPS sturgeon distribution, the Carolina DPS made up 30.7% of detections between Cape Cod and Cape Hatteras. This DPS also makes up 6.2% of detections south of Cape Hatteras (Kazyak et al. 2021). From Cape Cod to Florida, Carolina DPS fish were most likely to be encountered in nearshore waters. Rulifson et al. (2020), relying on acoustic telemetry, showed that, similar to what has been documented for New York Bight and Chesapeake Bay DPS fish, Carolina DPS sturgeon move inshore and offshore seasonally. The greatest number of detections along the North Carolina Atlantic Coast occur from November to April (Rulifson et al. 2020).

A recovery outline was produced for Atlantic sturgeon (NMFS 2018). The goal for recovery is to have reproductive populations across their historic range of sufficient size and diversity to support reproduction and recovery from mortality events. There have been no new threats identified to the Carolina DPS since 2017.

4.1.5. South Atlantic DPS

There has been no new information regarding spawning rivers used by this DPS, but there is new information about spawning populations and seasonal runs within rivers. The Edisto and Ogeechee Rivers appear to have a spring and a fall run (White et al. 2021a). When exploring the possibility of spring and fall spawning migrations, without any knowledge of the reproductive condition of the individuals, Vine et al. (2019a) identified temperature as a primary driver of upriver movement in both the spring and fall. In the spring, Atlantic sturgeon moved upriver as temperatures increased between 11 and 15 °C and in the fall, as temperatures were descending, between 29 and 24 °C (Vine et al. 2019a). For Atlantic sturgeon, discharge did not influence upriver movement (Vine et al. 2019a).

New abundance estimates were also produced for the South Atlantic DPS since 2017. A census estimate was produced for the upper 20 km of the Savannah River (river kilometers 281-301) to estimate the number of purported spawning adults in that stretch on a given day over 50 sampling occasions. The maximum estimate of daily abundance in those 20 km was 35 to 55 adults of unknown sex (Vine et al. 2019b). Effective population estimates were also produced for many rivers in the South Atlantic DPS. The Edisto River (n = 145) was estimated to have an effective population of 60 (95% CL, 51.9-69.0; Waldman et al. 2019), but was broken into two spawning populations by White et al. (2021a) following the identification of two distinct spawning groups (Farrae et al. 2017) for estimates of a spring run (n = 123) of 16.4 (12.8-20.6) and a fall run (n = 373) of 47.9 (25.3-88.8). The Savannah River was estimated to have an effective population size (n = 161) of approximately 123 (103.1-149.4) and also (n = 134) of approximately 154.5 (99.6-287.7) by Waldman et al. (2019) and White et al. (2021a), respectively. The Ogeechee River (n = 200) was estimated to have an effective population of 26 (23.9-28.2; Waldman et al. 2019), but was also broken into two spawning populations by White et al. (2021a) for estimates of a spring run (n = 92) of 31.1 (24.3-40.2) and a fall run (n = 55) of 56.5 (36.3-103.6). The Altamaha River appears to support the largest Atlantic sturgeon population in the South Atlantic DPS, and one of the largest on the East Coast, with effective population estimates of 149 (128.7-174.3; n = 245; Waldman et al. 2019) and 141.7 (73.4-399; n = 189; White et al. 2021a). The effective population estimates for the Satilla River population are 21 (18.7-23.2; n = 68; Waldman et al. 2019) and 11.4 (9.1-13.9; n = 74; White et al. 2021a). Work in the St. Marys River on the Florida-Georgia border captured 25 fish including 14 river resident juveniles. Analysis of those individuals reveals an effective population size of 1 (1.3-2.0), but this is a known under-estimate because those individuals were from a single spawning event (Fox et al. 2018a, Waldman et al. 2019). The St. Johns River in Florida does not appear to support an extant population (Fox et al. 2018b). Survival within the entire DPS was estimated to be approximately 86% (54-99%; ASMFC 2017).

The relatedness of the populations reveals three groups of related clusters within this DPS. The first cluster includes the Edisto spring run, the Ogeechee Spring run, and the Satilla River populations; the second includes the Edisto River fall run and Ogeechee River fall run; and the third includes the largest populations of the Savannah and Altamaha Rivers, but also the Ogeechee River fall run (White et al. 2021a). As was seen with other rivers with dual spawning populations, the spring and fall runs are genetically differentiated.

South of Cape Hatteras, Kazyak et al. (2021) showed that 91.2% of fisheries bycatch was from the South Atlantic DPS. In terms of population level distribution and susceptibility to commercial fisheries, 35.7% were from the Altamaha River, 21.4% from the Edisto River fall-run, 18.9% from the Savannah River, 7.2% from the Ogeechee River (both spring and fall), 5.5% Satilla, 3.7% Pee Dee (both spring and fall), and 2.0% Edisto spring-run. In the south, most offshore fish were from the Altamaha, followed by the Savannah (Kazyak et al. 2021). Within river movement studies also revealed that age-1 fish that were tagged in the summer remained in the rivers and overwintered before outmigrating between December and March (Fox and Peterson 2019). When observing the likelihood of becoming a coastally wandering sub-adult or remaining a river resident for another year, Fox and Peterson (2019) found that 36.7% returned as age 2 fish while 30.4% outmigrated as age 2. The St. Johns River, the furthest south in the South Atlantic DPS, has periodic use by sub-adults and adults, but is no longer spawning or rearing habitat.

A recovery outline was produced for Atlantic sturgeon (NMFS 2018). The goal for recovery is to have reproductive populations across their historic range of sufficient size and diversity to support reproduction and recovery from mortality events. There have been no new threats identified to the South Atlantic DPS since 2017.

4.2. Shortnose Sturgeon

There were updates to the metrics of reproduction, numbers, and distribution of shortnose sturgeon since 2017. Vine et al. (2019a) identified temperature and river discharge as important drivers for upriver spawning migrations in the Savannah River. Abundance of juveniles and adults in the Altamaha River are 725 (455-1192) and 1,493 (954-2,409), respectively (Ingram et al. 2020). Similar abundance estimates were produced for the Savannah River over a 3-year period (Table 3; Bahr and Peterson 2017). Finally, while a 400 km gap in the range of shortnose sturgeon has been well documented (NMFS 2010), a gravid shortnose sturgeon was captured in the lower James River, though after it was tagged it left the river and the Chesapeake Bay (Balazik 2017).

Table 3. Shortnose sturgeon abundance estimates from 2013 through 2015 for adults, age-2+ juveniles, and age-1 juveniles in the Savannah River.

	Year	Point Estimate	95% Confidence Limits
Adult	2013	1865	784-4,694
	2014	1564	1,005-2,513
	2015	940	535-1,753
Age 2+ Juveniles	2013	486	198-1,273
	2014	123	69-235
	2015	187	81-526
Age 1 Juveniles	2013	81	27-264
	2014	270	162-468
	2015	245	104-691

There have been no updates to the shortnose sturgeon recovery plan since 1998. No new threats to the species have been identified.

5. Updated Environmental Baseline

Environmental baseline is defined as, "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). As described above, the action area encompasses the entire inshore and offshore distribution of Atlantic and shortnose sturgeon. This section provides an update to the environmental baseline from 2017. Where there are no changes to baseline conditions, we preserve the sections (including section numbers) from the 2017 baseline and note there are no changes. This update reflects new information relevant to this opinion that has come out since the 2017 programmatic was finalized. We incorporate information from the Environmental Baseline (Section 5) of the 2017 biological opinion (NMFS 2017), by reference, into this reinitiated biological opinion.

5.1. Anthropogenic Effects to ESA Listed Species

The stressors discussed below continue to affect the condition of the environment across the range of Atlantic and shortnose sturgeon. In all watersheds, development has continued since 2017, though in no watershed has there been a major change to the proportion of each watershed's composition in terms of forested area, agricultural space, and impervious surfaces (NOAA 2022).

5.2. Dams

There are no new dams in the action area nor have any dams been removed since the 2017 biological opinion was issued.

5.3. Dredging

The effects of dredging impact the status of the species but the effects are generally direct from harm to Atlantic or shortnose sturgeon at the time of the dredging activity or indirect from modifications to their foraging habitat, affecting available food resources. Dredging activities have occurred in the St. John, St. Marys, Altamaha, Savannah, Cape Fear, James, Delaware, and Hudson Rivers. Most of these dredging projects are routine and ongoing.

5.4. Liquified Natural Gas Facilities

There have been no new liquified natural gas facilities built nor existing facilities removed in the action area since the 2017 biological opinion was issued.

5.5. Industrial and Power Generating Plants

There have been no new power plants built nor existing power plants removed in the action area since the 2017 biological opinion was issued.

5.6. Water Quality and Contaminants

There have been no new water quality reports for East Coast watersheds since 2017. The effects to sturgeon from these stressors in the action area are ongoing and we have no new information to indicate that they have changed appreciably from those discussed in the 2017 opinion

5.7. Fisheries

Commercial fisheries (state and Federal) in the action area have not been modified since 2017 and there is no information to indicate a change in the amount of sturgeon bycatch occurring.

5.8. Ship Strikes

Ship strikes remain a major concern for Atlantic sturgeon. In some DPSs this is likely the primary source of anthropogenic mortality, but there is very limited information on occurrence, and no new information, suggesting hot spots or areas of increased concern, regarding ship strikes of sturgeon in the action area since the 2017 biological opinion.

5.9. Scientific Research

With the exception of one permit (Number 24387), all current research is managed under this programmatic. Since 2017, there have been 2 in-hand mortalities of juvenile Atlantic sturgeon, one in the Carolina DPS and one in the South Atlantic DPS. There has been one in-hand mortality of a shortnose sturgeon juvenile in the southeastern complex of rivers. In terms of estimated Atlantic sturgeon mortalities due to delayed mortality from surgeries, those are shown in Table 4. Shortnose sturgeon research has been more limited, with range-wide delayed mortality estimates of adults and juveniles in the last 5 years being 8.295 and 1.75, respectively. There are an estimated 214 Atlantic sturgeon that will be captured under in addition to what is considered under the programmatic biological opinion. Of those 214 captures, approximately 84% will be from the South Atlantic DPS, 11% from the Carolina DPS, 3% from the Chesapeake Bay DPS, and 2% from the New York Bight DPS.

Table 4. Estimates of adult and juvenile Atlantic sturgeon cumulative delayed mortalities over the past 5 years.

DPS	Delayed adult mortality estimates	Delayed juvenile mortality estimates
Gulf of Maine	0.9	0.8
New York Bight	6.17	12.25
Chesapeake Bay	2.46	3.705
Carolina	1.28	4.44
South Atlantic	0.93	4.46

5.10. Climate Change

The risks posed by climate change are gradual and, while they have likely been exacerbated over the last 5 years, there is no information available to suggest to what additional extent the effects of climate change are affecting Atlantic or shortnose sturgeon in the action area since 2017.

6. Analysis of Effects of Additional Actions

This analysis of effects will focus on the newly proposed updates to the Atlantic and shortnose sturgeon research program. However, the overall effects of the program include those effects caused by procedures considered in the 2017 opinion, as well as these new procedures. For instance, most of the proposed modifications would require capturing a sturgeon before performing a new procedure. Therefore, the effects of new procedures replacing previously analyzed procedures become the new effects of those research techniques and the effects of new procedures never analyzed before are added to the other effects of the implementation of the sturgeon research program. For the effects of all other research activities (i.e., those previously included as part of the Program), we incorporate our effects analysis (Section 6.3) from the 2017 biological opinion (NMFS 2017), by reference, into this reinitiated biological opinion.

6.1. Exposure Analysis

This modification to the programmatic will make two different types of changes. First are the modifications to existing procedures or program functions. Second are the new procedures not considered in the previous programmatic biological opinion. The exposure analysis estimates the numbers, ages, sexes, and populations of sturgeon likely to be affected by each new procedure or program function.

6.1.1 **Modifying Existing Procedures and Mortality Bank Limits**

First, we consider proposed changes to existing components of the current sturgeon research program. These are: 1) transport of sturgeon, 2) trawling, 3) laparoscopy, and 4) changing mortality banks to update the response to tagging and lavage.

As before, transporting sturgeon is not common and must lead to a conservation benefit for the species in order to be permitted. The only change to this protocol is for transport events that are under 4 hours in duration. For those transport events, the pounds of fish per gallon of water is increased, but we do not anticipate this resulting in more Atlantic or shortnose sturgeon being transported, nor do we think this will affect the sex or life stage of the sturgeon that are transported. There are currently no proposed or existing permits that allow the transport of wild Atlantic or shortnose sturgeon.

As with transport, the modification for trawling is a very minor amendment that does not allow for longer trawls, but allows for the speed of the trawls to be changed from a maximum of 3.5 knots to an average of 3.5 knots. In calm water, this will have no effect to trawling but, in choppy water or when trawling with a strong following current when it is more difficult to hold a steady speed, this may result in brief periods of faster trawls and also periods of slower speeds. We do not expect that this change will affect the number, size, sex, or population of sturgeon captured, but instead will result in speed restrictions that better reflect real world conditions.

Laparoscopy also has only a minor proposed change, though this change is important for discussion in the exposure section. Procedures for laparoscopy are not changing; however, it can now be performed on fish in the wild without bringing them back to the laboratory. Because of this, we anticipate more fish will undergo this procedure. In some cases, as many fish as are captured may undergo this procedure, but in other cases when males are milting, the procedure will only be conducted when sex cannot be confirmed externally. Sex can now also be confirmed using genetic sex markers, so this procedure will likely be limited to times when the sex of a fish needs to be known to determine whether other procedures are appropriate, such as implanting a transmitter or taking a gonad sample to stage egg development. Another time this is likely to occur will be on larger juvenile fish to observe whether gonads have differentiated and the sex of the fish can be determined. Because of the ways in which laparoscopy is useful, we anticipate that, of the adults undergoing this treatment, most will be females and, for the sub-adults, both sexes are likely to be exposed opportunistically (the rate depending on the sex ratio of that population).

In 2017, establishing the mortality bank was a new concept for managing takes of listed species under the research program. The number of anticipated mortalities that can then be permitted under the research program through 10(a)(1)(A) permits is directly linked to the size of each population, such that larger populations can support more research under the program. There are two types of mortality to be considered: in-hand and delayed. In-hand mortality results from the act of capture or is immediate during a procedure and the animal dies while with the researchers. Delayed mortality is more difficult to identify, but is reasonably certain to occur based on monitoring of telemetry detections immediately following release. Generally, our understanding of delayed mortality rates is dependent on monitoring telemetry tags before and after events to see whether the sturgeon appear to have died.

As with the other proposed modifications to the program, these changes are relatively minor. For in-hand mortality, the only changes are to bring the way we handle "unknown" populations into alignment with how we treat "known" populations. Previously, there were no allowable in-hand mortalities for populations that were recently discovered or that didn't have an estimate of abundance from which to identify an acceptable level of mortality in the mortality bank. However, while counter-intuitive, this actually worked to the disadvantage of these populations because all capture practices carry a low level of mortality risk. Therefore, research procedures like acoustic telemetry that help identify critical habitat, spawning locations, spawning times, and times individuals are present in certain locations to establish protective work windows were not authorized to provide coverage for capture mortality instead. Additionally, the anticipated rates of delayed mortality from different procedures will be changed to match monitoring reports. In 2017, gastric lavage and surgery were suspected to carry a risk of delayed mortality. Further, the risk of delayed mortality from surgery was suspected to be higher for juvenile sturgeon than for adults. However, after 5 years of reviewing the effects of procedures, there is no evidence that gastric lavage has resulted in any delayed mortality, and the estimated rate of delayed mortality caused by surgery is lower than previously estimated, and the same for adults and juveniles.

In terms of exposure to each of these procedures, there is now no limit to the amount of gastric lavage that can be authorized in permits because there is no evidence that the procedure should be limited. Exposure to surgery will still be limited by the size of the populations receiving the surgery, but will certainly increase in each population because the rates of mortality are lower than previously estimated and because "unknown" populations will now be able to allocate delayed mortality from surgical implantation of transmitters separately from in-hand mortality. Previously, we assumed a 5.0% mortality rate for juvenile sturgeon and 2.5% mortality rate for adults, meaning twice as many adults could receive surgically implanted transmitters as juveniles. Both of those rates are changing to 2% delayed mortality rates, which will mean, for each acceptable mortality based on population health and size, there can now be 50 transmitters implanted rather than 40 previously for adults or 20 previously for juveniles. Therefore, the new rates of exposure are 50 individuals for each of adults and juveniles at which point 1 delayed mortality is likely to have occurred under each managed life stage.

6.1.2 **New Procedures**

The second category is proposed new procedures. These are 1) muscle biopsies, 2) translocation, and 3) oocyte extraction. These have not been analyzed before and any exposure would constitute new and additional effects beyond what was considered in the 2017 programmatic biological opinion.

Translocation is conducted similarly to the transport discussed above, but it is meant to move sturgeon from one location with poor habitat to another with good habitat. Translocation is proposed to be used rarely and only in situations where the movement of fish from one location to another will enhance the population. Translocation will only be used when moving fish provides a recovery benefit. For instance, it may be utilized to provide access to otherwise inaccessible spawning habitat, increase fish passage, or facilitate safe access to/from foraging or marine areas. In these situations, it is likely that as many juvenile and adult fish in the area as can be captured will be translocated to protect the population from death or reduced fitness.

Muscle biopsies and oocyte extraction are new procedures proposed. The muscle biopsy procedure can be conducted on adults or juveniles and is only limited by the number of sturgeon captured. Oocyte extraction will only be conducted on large adults that appear to be female or in conjunction with laparoscopy procedures. Like with muscle biopsies, oocyte extraction is only limited by the number of candidate individuals captured.

6.2. Response Analysis

The response analysis evaluates the likely response of Atlantic and shortnose sturgeon to each of the proposed changes in the sturgeon research program. Here, we present a range of documented responses to the procedures and identify the responses expected as a result.

6.2.1. Transport and Translocation

Transportation and translocation of sturgeon can be stressful. The stress from transport is generally related to water quality (Southgate 2008, Sampaio and Freire 2016). The Permits Division has permit requirements for maintaining water quality during transport. Increasing the density of sturgeon in transport tanks is likely to increase the amount of waste produced during transport. Ammonia can be acutely lethal to sturgeon at low levels, but past studies have shown that transport must last more than 8 hours before ammonia can become toxic (Sampaio and Freire 2016). Because the Permits Division is only proposing to allow increased densities for up to 4 hours, ammonia levels should not increase to the point of being dangerous. We would anticipate a short-term stress response to the transport process, but do not expect any permanent harm or even long-term consequences. In our 2017 biological opinion, we determined that, while transporting sturgeon may cause short-term stress responses, those responses are not likely to manifest into any long-term adverse effects, reduced fitness, or mortality. The proposed change for transporting sturgeon (i.e., from 0.75 to 2 pounds of fish per gallon for trips up to 4 hours) would not result in additional measurable negative effects to individual sturgeon, and does not change our determination from the 2017 opinion regarding the effects from transport.

Following transport and translocation, there are other possible responses to address. Moving individuals from one location to another could create a risk of changing the genetic structure of one or more populations of sturgeon. Shortnose sturgeon appear to comprise 3 metapopulations (King et al. 2014), so they would not be moved outside of those geographic ranges. Atlantic sturgeon would not be intentionally moved outside the range of their DPS for enhancement purposes and, in most cases, translocation would occur between systems where manmade structures disrupted the migrations between systems or within a system (e.g., Connecticut River) or inadvertently created a pathway between systems (e.g., Lakes Marion and Moultrie, Santee-Cooper Rivers). Although translocated sturgeon may require a period of adjustment after handling (Kahn and Mohead 2010), their natural behavior will resume within a timeframe where the fitness or reproductive success of the sturgeon will not be compromised. The sturgeon may exit the river system within days or weeks (Rust 2011, Kahn et al. 2019) after capture, handling, processing, and release, especially if the fish are adults in spawning condition.

6.2.2. Trawling

Modifying the speed of the trawl to an average speed of 3.5 knots will not result in a response from Atlantic or shortnose sturgeon that could be differentiated from trawling at a top speed of 3.5 knots. In our 2017 biological opinion, we determined that, while the capture of Atlantic and shortnose sturgeon in trawls may result in short-term negative effects (i.e., elevated stress levels, net abrasion), with the exception of those very rare instances of capture mortality, these activities are not expected to result in reduced fitness or have any long-term adverse effects on individual sturgeon. We believe the response analysis from the 2017 programmatic biological opinion is still an appropriate assessment of the probable response of sturgeon to trawling conducted under the sturgeon research program.

6.2.3. Laparoscopy

Laparoscopy is done under anesthesia, which was covered in the 2017 programmatic biological opinion, and the effects of anesthesia are unchanged by this action. The responses to anesthesia tend to be either minimal and short-term or immediate and lethal, which would still be tracked in the mortality bank, limiting the effects of research on wild populations.

Laparoscopy creates a surgical incision approximately 1 cm wide through the muscle followed by a final puncture into the body cavity using a 5 mm trocar. Compared with most traditional surgical procedures, laparoscopy is considered a minimally invasive form of surgery that typically involves relatively minor tissue trauma, shorter postoperative recovery periods, decreased postoperative care, and fewer postoperative complications (Kahn and Mohead 2010). Hernandez-Divers et al. (2004) performed lengthy laparoscopic surgeries (45 minutes to an hour) on 17 Gulf sturgeon in a laboratory setting. They reported 100 percent survival and no significant hemorrhaging, trauma, or postoperative swimming or buoyancy problems associated with any of the fish after surgery. Other studies involving laparoscopy of pallid and shovelnose sturgeon has also reported no adverse effects (Wildhaber et al. 2006; Wildhaber and Bryan 2006). The incision being located along the lateral wall near the ventral scutes reduces the risk of infections in wild fish compared with surgical implantation of transmitters.

Based on information in past annual reports submitted by sturgeon researchers to NMFS, laparoscopy is a safe procedure that can be routinely performed without complications when carried out by experienced researchers following recommended protocols. The small incision and insertion of the laparoscope typically heals within one to two weeks with no long-term sub-lethal effects on individual fish. In our 2017 biological opinion, we determined, while conducting laparoscopy on Atlantic and shortnose sturgeon may result in short-term negative effects (i.e., increased stress levels, puncture wound), responses to this activity are not likely to manifest into any long-term adverse effects, reduced fitness, or mortality. This conclusion can be reached as long as all of the sampling protocols, mitigation measures, and any other required conditions of the sturgeon research permit are followed by all permit holders. We believe the response analysis from the 2017 programmatic biological opinion is still an appropriate assessment of the probable response of sturgeon to laparoscopy conducted under the sturgeon research program.

6.2.4. Delayed Mortality and the Mortality Bank

The mortality bank captures delayed mortality rates generally for all procedures. But most procedures carry no risk of lethal response. Some procedures, like laparoscopy above, require anesthesia to be done safely. Anesthesia carries the risk of overdose, which is easily monitored with relative certainty in the mortality bank, though there may be occasions where a sturgeon is resuscitated and released that still dies shortly afterwards (Kahn, draft manuscript). The two procedures initially thought to carry a risk of delayed mortality, gastric lavage and surgical implantation of acoustic transmitters, both require anesthesia as well.

With minimal data, relying on outdated methodology, in our 2017 biological opinion, we conservatively estimated that gastric lavage could result in delayed mortality for Atlantic and shortnose sturgeon. Using current data collected from annual reports since 2017, there does not appear to be a risk of delayed mortality due to gastric lavage. The Permits Division will continue collecting end-of-year reports about this procedure and others to further validate our estimated delayed mortality rates. However, at this time, the response to gastric lavage appears to carry no risk of delayed mortality. Further, long-term monitoring showed that lavaged sturgeon gained length and weight normally (Collins et al. 2008).

The Permits Division also proposed to change the rate of delayed mortality used to estimate effects of surgical procedures. While surgical implantation of transmitters carries a risk of delayed mortality, based on monitoring data from the past 10 years (with particular emphasis on 2017-2022), this risk is lower than was estimated previously. While we estimated the rate of delayed mortality to be 2.5% in 2017, monitoring indicates the estimated rate is 2.0%. Therefore, the response to surgery is less than was anticipated in 2017. There were also no observed differences in delayed mortality estimates between adults and juveniles, so the Permits Division has proposed to change the estimates of delayed mortality to be the same for each of these life stages.

Because of the new rates of delayed mortality, the number of procedures that can be permitted changes, as was discussed in the exposure analysis. There is little evidence of sub-lethal effects from surgery, as changes in length, weight, direction of travel, and termination of spawning runs is generally no different between previously telemetered fish that are captured and fish undergoing surgery (Kahn, draft manuscript). It does appear that one fish (0.9% of individuals undergoing surgery) may have left the spawning grounds prematurely, but otherwise no statistically significant differences in behavior resulting from the surgical procedure (Kahn, draft manuscript). There is no change to the calculations of allowable mortality under the mortality bank for delayed mortalities. Therefore, the calculated risk of procedures that carry a risk of mortality to individuals, populations, and DPSs is no different than was calculated in the 2017 biological opinion.

6.2.5. Muscle Biopsy

Muscle biopsy on sturgeon species is described as a nonlethal method of collecting sturgeon muscle tissue (Moser et al. 2000; Davis 2015; Damon-Randall et al. 2010; Smith et.al. 2016; Keogh 2017). Sturgeon may experience minor injury at the tagging site and may experience short-term stress due to handling and biopsy with a chance of infection. However, similar to laparoscopy, because the plugs are taken dorsally, the risk of infection is much less than for surgical procedures and also less than for laparoscopic procedures. The above studies did not note a risk of delayed mortality from muscle biopsy. As with laparoscopy, which uses a similar sized incision, the site should be healed within one to two weeks. While conducting muscle biopsies on Atlantic and shortnose sturgeon may result in short-term negative effects (i.e., increased stress levels, puncture wound), responses to this activity are not likely to manifest into any long-term adverse effects, reduced fitness, or mortality. This conclusion can be reached as long as all of the sampling protocols, mitigation measures, and any other required conditions of the sturgeon research permit are followed by all permit holders.

6.2.6. Oocyte extraction

The beveled needle used for oocyte extraction is less than 5 mm in diameter with an inside diameter slightly wider than the diameter of a sturgeon egg. The needle punctures the ventral body wall and leaves a flap of skin in the plug after completion (Candrl et al. 2011). The sampling procedure takes less than 30 seconds and leaves a minute, self-sealing wound. No sutures are required and the wound heals in approximately 1 week. This procedure will reduce handling time and invasiveness for oocyte extraction compared with gonadal biopsies. The extractor device has been used regularly by the U.S. Fish and Wildlife Service (Holmquist et al. 2019) to sample endangered pallid sturgeon eggs in the wild. While conducting oocyte extractions on Atlantic and shortnose sturgeon may result in short-term negative effects (i.e., increased stress levels, puncture wound), responses to this activity are not likely to manifest into any long-term adverse effects, reduced fitness, or mortality. This conclusion can be reached as long as all of the sampling protocols, mitigation measures, and any other required conditions of the sturgeon research permit are followed by all permit holders.

6.3. Summary of Effects Analysis

Some procedures being added to the Atlantic and shortnose sturgeon research program will not measurably affect the numbers of individuals receiving procedures or the responses to those procedures. Those changes with imperceptible effects are the modifications to transport and trawling.

The modification for translocation establishes a new activity that can be permitted by the Permits Division. The use of translocation is expected to be limited to extreme situations where the effects to the population as a result of remaining in place would be worse than translocating them. It is unknown how often this will occur or which life stages or sexes may be affected, but when it is determined to be necessary, the response is expected to be overall beneficial despite a short-term stress response.

The modifications to the calculations for the mortality bank will not affect the numbers of individuals responding to a procedure. The changes to delayed mortality estimates for lavage and surgery will result in more of those procedures being permitted, but the effects of those procedures are generally expected to be short-term with no resulting impacts to individual fitness. For lavage, sturgeon appear to behave normally upon release with only a loss of calories and a need to forage again following release. For surgeries, there is a two- to four-week period required for the incision to heal, but no evidence of abnormal behavior in that time.

Laparoscopy was previously only allowed on captive fish. This modification will allow the procedure to be conducted on wild fish. Muscle biopsy and oocyte extraction are new procedures under the programmatic framework and will also be allowed on wild fish. Each of these procedures cannot be undertaken without first capturing the sturgeon. Laparoscopy requires anesthesia and, therefore, there is the potential for in-hand mortality. Muscle biopsies do not require anesthesia and, therefore, there may be a greater short-term stress response, but there is no indication of delayed risks or fitness consequences following release for either procedure. Oocyte extraction carries even less risk as there is no need for anesthetization or the use of scalpel or sutures. There is no risk of in-hand mortality, nor is there any indication of delayed effects or fitness consequences. Because of that, the only limit on the number of these procedures comes from the program structure related to capture and the in-hand mortality bank limits for each population.

7. Cumulative Effects

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

Projections are based upon recognized organizations producing best-available information and reasonable rough-trend estimates of change stemming from these data. Inclusion of actions and their effects would mean those actions are reasonably certain to occur. During this consultation, we searched for information on future state, tribal, local, and private (non-Federal) actions reasonably certain to occur in the action area. We were able to identify the following developments:

- Riverfront on the Connecticut River in Springfield, Massachusetts (https://www.wwlp.com/news/local-news/new-development-proposed-along-connecticut-river-in-springfield/)
- Development of a large movie studio along the Hudson River in Hastings, New York (https://cicbca.org/202211-100-million-movie-studio-project-proposed-for-hudson-river-village/)
- Railroad to trail conversions along the Hudson River to start in 2023 (https://www.nj.com/traffic/2022/12/commission-building-new-hudson-river-rail-tunnels-has-a-58m-budget-what-does-it-buy.html)
- Hotel development along the Delaware River in Easton, Pennsylvania (https://www.wfmz.com/news/area/lehighvalley/proposed-hotel-overlooking-delaware-river-gets-ok-from-easton-zoners/article_2f8533a2-070c-11ed-922d-372037a5435e.html)
- Large waterfront development along the Delaware River in New Castle, Delaware (https://www.delawareonline.com/restricted/?return=https%3A%2F%2Fwww.delawareonline.com%2Fstory%2Fnews%2F2023%2F01%2F05%2Fnew-castle-development-proposed-in-industrial-area-on-delaware-river%2F69728364007%2F)
- Hog farms affecting rivers in eastern North Carolina (https://pulse.ncpolicywatch.org/2022/12/06/hog-farm-that-used-dead-pigs-spoiled-meat-as-fuel-for-biogas-digester-fined-34k/#sthash.bvmHimEr.dpbs)
- A number of Neuse River developments (https://soundrivers.org/riverkeeper-report-updates-on-proposed-developments-along-neuse/)
- State of South Carolina Department of Transportation projects along the Pee Dee and Edisto Rivers, including large updates to Rts. 301 and 17 (https://www.scdot.org/projects/current-projects.aspx)
- Two development projects adjacent to the Savannah River in Savannah, Georgia (https://www.savannahga.gov/2281/Savannah-Under-Construction)

None of the proposed projects that we were able to identify are likely to produce effects that are more extreme than the conditions described in the Environmental Baseline (see Section 5 of the 2017 biological opinion, and updates in Section 5 above). As we discussed in the Environmental Baseline, the effects of those actions have resulted in degraded habitat for Atlantic and shortnose sturgeon. We anticipate the future actions in this analysis would produce the same threats currently facing the species and lead to the continuation of those effects to prevent the baseline conditions from recovering. These projects will cause population growth and land use changes, as well as drive the need for future energy generation. It is likely these projects and others that come later in time will affect water quality and contaminant concentrations in waterbodies, increase the likelihood of introducing non-native species, create a demand for fisheries, and increase the risk of ship strikes. Given these developments, it is possible some of them will lead to injury or mortality of Atlantic and shortnose sturgeon, but more likely will contribute to a continued degraded habitat condition.

8. Integration and Synthesis

The integration and synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the Effects of the Action (Section 6) to the Environmental Baseline (Section 5) and the Cumulative Effects (Section 7) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce appreciably the value of designated critical habitat for the conservation of the species. These assessments are made in full consideration of the Status of the Species (Section 4).

The integration and synthesis section of this reinitiation considers the original framework of the sturgeon research program and incorporates the effects of the modifications described above, such that the overall assessment of the reinitiated programmatic considers the effects of the entire program on Atlantic and shortnose sturgeon.

The components of the research program designed to minimize adverse effects on individual sturgeon and to mitigate risks to the survival and recovery of sturgeon populations are unchanged by this modification. The limits of research are tied directly to the health of each population of Atlantic and shortnose sturgeon. The amount of in-hand and delayed mortality are used to limit the numbers of captures and surgical transmitter implantations allowed under all permits in combination. The status of each population is re-evaluated each year. Further, the ESA regulations require the Permits Division only issue permits that meet standards to conserve species and require researchers with permits to report the effects of their research each year. In addition, the Permits Division can take actions independently or with our division to modify permits and the program to become more conservative. On an annual basis, the Permits Division will evaluate the status of each river system population of sturgeon and, with it, possible changes in anthropogenic threats. Thus, despite the inability to predict the future condition of each population, by its very nature, implementation of the research program accounts for changes in their condition.

Atlantic and shortnose sturgeon populations declined drastically between 1880 and 1905, followed by a century of commercial fishing that kept populations depressed. Shortnose sturgeon received federal protections in 1967 and were then listed as endangered under the ESA in 1973. Atlantic sturgeon were listed as threatened in the Gulf of Maine and endangered in the four DPSs south of there in 2012. In either case, there is not much information about population abundance and what does exist does not indicate that populations of either Atlantic or shortnose sturgeon have increased, with the exception of shortnose sturgeon in the Hudson River. These populations still face threats from degraded water quality, bycatch, vessel strikes, impingement and entrainment, and invasive species (NMFS 2022b, c, d).

The Gulf of Maine DPS of Atlantic sturgeon is listed as threatened and includes six river systems. The Kennebec River is the primary spawning and nursery area for Gulf of Maine Atlantic sturgeon. The removal of the Edwards Dam in 1999 resulted in 17 additional miles of historical spawning habitat accessible to Kennebec River Atlantic sturgeon and improved water quality. For purposes of the proposed Program, the Kennebec River continues to be rated as health category "high" based on the following health index criteria: regular spawning; juveniles present and progressing through age classes; no major ongoing threats; two minor threats (water quality and impingement/entrainment); and a relatively large estimated effective population size.

The New York Bight DPS of Atlantic sturgeon is listed as endangered and includes seven river systems, only three of which are known spawning populations: Delaware, Hudson, and Connecticut rivers. Recent spawning estimates of the Hudson River suggest the abundance has not changed since the end of the commercial fishery (Kazyak et al. 2020). Water quality, dredging, and ship strikes remain stressors to New York Bight DPS Atlantic sturgeon. For purposes of the research program, the Hudson and Delaware populations were both rated as health category "high" based on the following health index criteria: regular spawning; juveniles present and progressing through age classes; no major ongoing threats; a few minor threats including water quality and impingement/entrainment; and relatively large estimated effective population sizes.

The Chesapeake DPS of Atlantic sturgeon is listed as endangered and includes six river systems, only three of which are known spawning populations (James, York, and Nanticoke rivers). White et al. (2021a) indicates that there are two genetically distinct spawning runs in the James River during the spring and the fall, as well as showing the York River population is genetically distinct from the James River population(s). For purposes of the sturgeon research program, the James population is rated as health category "medium" based on the following health index criteria: regular spawning; juveniles present; one major ongoing threat due to invasive species;

two minor threats (impingement/entrainment, bycatch); and a relatively large estimated effective population size. The York population is rated as health category “low” primarily for having a small abundance.

The Carolina DPS of Atlantic sturgeon is listed as endangered and includes eight river systems, five of which are known spawning populations (Roanoke, Tar/Pamlico, Neuse, Pee Dee, and Cape Fear rivers; ASMFC 2017). Smith et al. (2015) identified fall spawning in the Roanoke River. White et al. (2021a) identified spring and fall spawning populations in the Pee Dee River system. The spring run in the Pee Dee is more closely related to spring runs in the South Atlantic DPS of Atlantic sturgeon than to the fall counterpart in the Pee Dee River. The Roanoke population is rated as health category “medium” based on the following health index criteria: average adult survival rate (84%); regular spawning; juveniles present and progressing through age classes; one major ongoing threat (bycatch); one minor threat (water quality); and a relatively small estimated effective population size.

The South Atlantic DPS of Atlantic sturgeon is listed as endangered and includes ten river systems. Currently, this DPS supports six known spawning populations: ACE Basin, Savannah, Ogeechee, Altamaha, Satilla, and St. Mary’s. As with the James River, the Ogeechee and Edisto rivers support both a spring and fall spawning population (White et al. 2021a). The spring spawning populations are more closely related to one another than to the fall populations within the same river basin. The Savannah and Altamaha populations are rated as health category “high” based on the following health index criteria: average adult survival rate; regular spawning; juveniles present and progressing through age classes; and relatively large estimated effective population sizes. The ACE, Ogeechee, and Satilla populations are rated as health category “medium” as these systems are somewhat smaller compared to the Altamaha and Savannah, and juvenile progression through age classes has not been confirmed in these systems. There are no known major threats in any of the ten river populations within this DPS; several face minor threats, mainly water quality and bycatch.

For shortnose sturgeon, the largest adult populations are found in the Northeastern rivers (i.e., Hudson, Delaware, Kennebec and St. John). Shortnose sturgeon populations in southern rivers are considerably smaller by comparison with the largest in this region occurring in the Altamaha and Savannah rivers. The Shortnose Sturgeon Status Review Team (2010) evaluated the extinction risk for three shortnose populations (Hudson, Cooper, and Altamaha) and concluded that the estimated probability of extinction was zero for all three under the default assumptions, despite the long (100-year) horizon and the relatively high year-to-year variability in fertility and survival rates. Regular spawning is known to occur in 12 river systems. Major threats to shortnose sturgeon, defined as threats that, if altered, could lead to recovery, are currently identified for four river systems: dams in the Connecticut, Santee, and Cooper rivers, and water quality in the St. Mary’s River. The most prevalent minor threats to shortnose sturgeon are water quality (ten populations), bycatch (eight populations), and impingement/entrainment (six populations). Based on information from the status matrices developed for this program, a health category rating of “high” was assigned to six shortnose sturgeon river populations: Kennebecasis, Androscoggin, Connecticut, Delaware, Savannah, and Altamaha. A “medium” health category rating was assigned to seven shortnose sturgeon river populations: St. John, Kennebec, Merrimack, Hudson, Cape Fear, Cooper, and Ogeechee rivers. Only the Satilla River was assigned a “low” health rating, based primarily on a very low estimated adult population size (100) and a slight decreasing population trend (-1 percent).

The proposed action would have both sublethal and lethal effects on Atlantic and shortnose sturgeon. Based on our sturgeon exposure and response analysis, we determine that sub-lethal effects on Atlantic and shortnose sturgeon resulting from research activities authorized under the proposed action will be minimal, short-term, and are not likely to result in any reduced fitness or loss of fecundity to individual fish. Mortality of sturgeon will be limited under the programmatic framework by annual maximum mortality limits created at the species, river system, and life stage (i.e., early life stages, juvenile and adult/subadult) level. The sturgeon maximum mortality limits that are an integral part of the proposed action are designed to be protective of each population by setting an upper limit on the relative mortality rate within each river system. This approach is based on the conservative assumption that the loss of any particular population within the species or DPS could appreciably impact the survival and recovery of the DPS as a whole. Maximum mortality limits are dynamic and can fluctuate from year to year based on new information regarding sturgeon population health and/or status and estimated population size. We find that the proposed annual maximum mortality limits are well below target mortality rates for sturgeon population growth and recovery reported in the literature, and also well below estimated natural mortality rates. We also find that updating the mortality level for “unknown” systems is conservative, while still allowing for some research activities necessary for the recovery of Atlantic and shortnose sturgeon populations to continue.

As a result of the above analysis of the entire Atlantic and shortnose sturgeon research program, we conclude the conservation measures, program structure, and adaptive management provide a number of benefits to Atlantic and shortnose sturgeon. While each population faces threats, both natural and anthropogenic, those threats have been maintained or minimized in the last 50 years and are expected to either remain at current levels, or possibly decrease with additional research efforts, conservation measures, and the continued implementation of existing environmental regulations. The sublethal effects to Atlantic and shortnose sturgeon resulting from research activities authorized under the proposed action will be minimal, short-term, and are not likely to result in any reduced fitness or loss of fecundity to individual fish. The sturgeon research program is protective of each population within the species or DPS, as it sets upper limits on mortality at the river system level. The proposed relative annual maximum mortality limits (as a proportion of population size) are not expected to reach levels that significantly affect the viability of Atlantic or shortnose sturgeon populations and, therefore, would also not be expected to affect the viability of Atlantic sturgeon DPSs or the shortnose sturgeon species.

In summary, we determine that the proposed modifications to the program, in combination with the entire sturgeon research program framework, will not reduce appreciably the likelihood of both the survival and recovery of the Gulf of Maine DPS, New York Bight DPS, Chesapeake Bay DPS, Carolina DPS, or South Atlantic DPS of Atlantic sturgeon. We also determine that this action will not reduce appreciably the likelihood of both the survival and recovery of shortnose sturgeon.

9. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the sturgeon research program, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of the Gulf of Maine DPS, New York Bight DPS, Chesapeake Bay DPS, Carolina DPS, or South Atlantic DPS of Atlantic sturgeon, or shortnose sturgeon. The effects to and, therefore, conclusions for the other species in the action area remain unchanged from the 2017 programmatic biological opinion (NMFS 2017).

10. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "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 regulation to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is further defined as an act which "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" (NMFS 2016). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

This reinitiation of programmatic consultation will introduce new effects to the target species of Atlantic and shortnose sturgeon. That take will be the intended purpose of the research program. There is no incidental take as a result of this reinitiation. The incidental take statement from the 2017 sturgeon research programmatic consultation (Section 8; NMFS 2017) remains in effect.

11. Conservation Recommendations

Section 7(a)(1) of the ESA requires Federal agencies, in consultation with the Services, to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are "suggestions … regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information" (50 CFR §402.02). The 2017 programmatic consultation (NMFS 2017) contained a list of conservation recommendations. We still believe it is appropriate to implement those recommendations.

12. Reinitiation of Consultation

This concludes reinitiation of formal consultation for the Atlantic and shortnose sturgeon research program under ESA section 10(a)(1)(A).

Consistent with 50 CFR §402.16, reinitiation of consultation is required and shall be requested by the Federal agency, where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and:

(1) The amount or extent of incidental taking specified in the ITS (located in NMFS 2017: http://doi.org/10.7289/V5D21VSJ) is exceeded.
(2) New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion.
(3) 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
(4) a new species is listed or critical habitat designated that may be affected by the action.

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