NOAA FISHERIES
Protected Resources

RECOVERY OUTLINE

ATLANTIC STURGEON

GULF OF MAINE, NEW YORK BIGHT, CHESAPEAKE BAY, CAROLINA, AND SOUTH ATLANTIC DISTINCT POPULATION SEGMENTS

This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, for the endangered New York Bight, Chesapeake Bay, Carolina, and South Atlantic distinct population segments (DPS) of the Atlantic sturgeon and the threatened Gulf of Maine DPS (77 FR 5880 and 77 FR 5914; February 6, 2012) until a full recovery plan is developed and approved. A preliminary strategy for recovery of the species is presented here, as are recommended high priority actions to stabilize and recover the species.

This Recovery Outline commences our recovery planning process. The Recovery Outline is intended primarily for internal use by NOAA Fisheries as a preplanning document. Formal public participation in recovery planning for these DPSs will be invited upon the release of the draft Recovery Plan for these DPSs. However, any new information or comments that members of the public may wish to offer as a result of this Recovery Outline will be taken into consideration during the recovery planning process. Parties interested in the Gulf of Maine, New York Bight, Chesapeake Bay DPS may contact Lynn Lankshear 978-282-8473, Lynn.Lankshear@noaa.gov. Parties interested in the Carolina and South Atlantic DPSs may contact Andy Herndon 727-824-5312, Andrew.Herndon@noaa.gov.

INTRODUCTION

This document presents the broad, preliminary outline for the recovery of all five DPSs of Atlantic sturgeon. A recovery team will likely be assembled for these species to inform the Recovery Plan, which will provide a complete roadmap for activities necessary to recover the DPSs so they no longer need the protections of the Endangered Species Act (ESA). Meanwhile, this outline will serve to guide recovery-planning efforts and provide information for ESA Section 7 consultations, permitting activities, and conservation efforts until the formal Recovery Plan has been developed, finalized, and approved.

Listing and Contact Information for Each DPS:

Common and Scientific Name	Distinct Population Segment	Listing Status
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)	Gulf of Maine[1]	Threatened
	New York Bight[1]	Endangered
	Chesapeake Bay[1]	Endangered
	Carolina[2]	Endangered
	South Atlantic[2]	Endangered
[1] Listing Rule: 77 FR 5880; February 6, 2012 Lead Office: Greater Atlantic Regional Fisheries Office, Gloucester, Massachusetts		
[2] Listing Rule: 77 FR 5914; February 6, 2012 Lead Office: Southeast Regional Office, St. Petersburg, Florida		

Available information on the life history, range, and habitat requirements of the five DPSs is described in the listing rules (77 FR 5880 and 77 FR 5914; February 6, 2012). The most significant uncertainties with respect to setting recovery objectives and prioritizing recovery actions include the following: availability of specific information on each DPS's current and historical distribution and abundance; success of spawning and recruitment; response to climate change; sub-lethal effects of pollution; vessel strikes; fishery bycatch mortality including post-release mortality; and the effects of habitat loss. These uncertainties are acknowledged as playing a limiting role in the early recovery efforts for these DPSs and should be resolved to the extent possible through coordination with the sturgeon research community during the recovery planning process.

RECOVERY NEEDS ASSESSMENT

BIOLOGICAL ASSESSMENT

Recovery implications of the species' demographic and genetic status

Atlantic sturgeon occur along the eastern coast of North America from Hamilton Inlet, Labrador, Canada to Cape Canaveral, Florida, USA. An anadromous species, Atlantic sturgeon spawn in freshwater of tidal-affected rivers that are part of a coastal estuary. Tagging records and the relatively low rate of gene flow observed provide evidence that Atlantic sturgeon return to their natal river to spawn (ASSRT 2007).

Atlantic sturgeon from the Gulf of Maine DPS spawn in the rivers of Maine, as well as rivers that drain into the Gulf of Maine from as far south as Chatham, Massachusetts. There are only two currently known spawning subpopulations within the Gulf of Maine DPS; the Kennebec River and Androscoggin River spawning subpopulations. There are no abundance estimates for either subpopulation or for the Gulf of Maine DPS as a whole (ASSRT 2007; Wippelhauser 2012; Wippelhauser et al. 2017). In 2017, the Atlantic States Marine Fisheries Commission (ASMFC) conducted a benchmark stock assessment of Atlantic sturgeon. The assessment contains the latest and best available information on the status of U.S. Atlantic sturgeon populations. The stock assessment concluded that the abundance of the Gulf of Maine DPS is "depleted" relative to historical levels. The assessment also concluded that there was a 51% probability that the abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium, but there was a 74% probability that mortality for the Gulf of Maine DPS exceeds the mortality threshold used for the assessment.

The New York Bight DPS of Atlantic sturgeon originates from rivers that drain into the coastal waters from Chatham, Massachusetts, to the Delaware-Maryland border at Fenwick Island. There were two known spawning subpopulations when the New York Bight DPS was listed as endangered under the ESA: the Hudson River and Delaware River spawning subpopulations. Since then, new information

provided from the capture of juvenile Atlantic sturgeon suggests the Connecticut River likely also supports a spawning subpopulation of Atlantic sturgeon for the New York Bight DPS. There are no abundance estimates at this time for the Connecticut River. The Hudson River spawning subpopulation is believed to be the most robust because animals from the Hudson River show up most frequently in genetic samples collected from Atlantic sturgeon in coastal aggregations, with the exception of the summer aggregation in the Bay of Fundy, Canada. Conversely, Atlantic sturgeon from the Delaware River subpopulation show up less frequently even when the sampling area is in proximity to the Delaware River. For example, of the 261 adult-sized Atlantic sturgeon captured for scientific purposes off the Delaware Coast between 2009 and 2012, 100 were subsequently identified by genetics analysis to belong to the Hudson River subpopulation while only 36 belonged to the Delaware River subpopulation (Wirgin et al. 2015). Researchers have had recent success capturing juvenile Atlantic sturgeon in the Delaware River and estimate there were 3,656 (95% CI = 1,935–33,041) age 0-1 juvenile Atlantic sturgeon in the Delaware River subpopulation in 2014 (Hale et al. 2016). The 2017 ASMFC stock assessment determined that abundance of the New York Bight DPS is "depleted" relative to historical levels. However, the assessment also determined there is a relatively high probability (75%) that the New York Bight DPS abundance has increased since the implementation of the 1998 fishing moratorium, and a 31% probability that mortality for the New York Bight DPS exceeds the mortality threshold used for the assessment.

The Chesapeake Bay DPS is comprised of Atlantic sturgeon that originate from rivers that drain into the Chesapeake Bay and into coastal waters from the Delaware-Maryland border on Fenwick Island to Cape Henry, Virginia. There are three known spawning subpopulations: the James River, the Pamunkey River of the York River system, and Marshyhope Creek of the Nanticoke River system (NMFS 2017). Comprehensive information on current abundance and population trends for any of the Chesapeake Bay spawning subpopulations is lacking (ASSRT 2007). Based on research captures of tagged adults, an estimated 75 Chesapeake Bay DPS Atlantic sturgeon spawned in the Pamunkey River in 2013 (Kahn et al. 2014). In the James River, the total number of adult-sized Atlantic sturgeon captured in the spring and fall for 2012 through spring 2014 is 239 sturgeon. This is a minimum count of the number of adult Atlantic sturgeon in the James River during the time period because capture efforts did not occur in all areas and at all times when Atlantic sturgeon were present in the river. In addition, more recent genetic evidence suggests that the James River spring and fall spawning Atlantic sturgeon are separate subpopulations (Balazik and Musick 2015). The 2017 ASMFC stock assessment determined that abundance of the Chesapeake Bay DPS is "depleted" relative to historical levels. The assessment also determined there is a relatively low probability (37%) that abundance of the Chesapeake Bay DPS has increased since the implementation of the 1998 fishing moratorium, and a 30% probability that mortality for the Chesapeake Bay DPS exceeds the mortality threshold used for the assessment.

Atlantic sturgeon from the Carolina DPS spawn in the rivers of North Carolina south to the Cooper River, South Carolina. There are currently seven spawning subpopulations within the Carolina DPS: Roanoke River, Tar-Pamlico River, Neuse River, Northeast Cape Fear and Cape Fear Rivers, Waccamaw and Great Pee Dee Rivers, Black River, Santee and Cooper Rivers; one is likely extinct (Sampit River). The existing subpopulations are likely at less than 3% of their historical abundance (ASSRT 2007). The 2017 ASMFC stock assessment determined the Carolina DPS abundance is "depleted" relative to historical levels. The assessment also determined there is a relatively high probability (67%) that the Carolina DPS abundance has increased since the implementation of the 1998 fishing moratorium, and a relatively high probability (75%) that mortality for the Carolina DPS exceeds the mortality threshold used for the assessment.

Atlantic sturgeon from South Atlantic DPS spawn from the Edisto River, South Carolina, to the St. Marys River at the Florida/Georgia border. The South Atlantic DPS historically supported eight spawning subpopulations. At the time of listing only six spawning subpopulations were believed to have existed: the Combahee River, Edisto River, Savannah River, Ogeechee River, Altamaha River, and Satilla River. The two remaining spawning subpopulations in the Broad-Coosawatchie River and St. Marys River were believed to be extinct. However, new information provided from the capture of juvenile Atlantic sturgeon suggests the spawning subpopulation in the St. Marys River is not extinct and continues to exist, albeit at very low levels. Two of the spawning subpopulations in the South Atlantic DPS are relatively robust and are considered the second (Altamaha River) and third (Combahee/Edisto River) largest spawning subpopulations across all five DPSs. These two spawning subpopulations are likely less than 6% of their historic abundance. There are an estimated 343 adults that spawn annually in the Altamaha River and less than 300 adults spawning annually (total of both sexes) in the river systems where spawning still occurs (75 FR 61904; October 6, 2010). The abundance of the remaining three spawning subpopulations in the South Atlantic DPS is likely less than 1% of their historical abundance (ASSRT 2007). The 2017 ASMFC stock assessment determined the South Atlantic DPS abundance is "depleted" relative to historical levels. The assessment concluded there was not enough information available to assess the abundance of the DPS relative to the 1998 fishing moratorium, but did conclude there was a (40% probability that mortality for the South Atlantic DPS exceeds the mortality threshold used for the assessment.

Although specifics vary from north to south, generally speaking, Atlantic sturgeon in all five DPSs live relatively long and do not become sexually mature until later in life. Atlantic sturgeon recovery will likely be slow because it is a late-maturing species. While a long life-span also allows multiple opportunities to contribute to future generations, it also increases their exposure to the multitude of threats facing each DPS.

THREATS ASSESSMENT

What are the recovery implications of the threats facing the species?

The threats to the five DPSs are generally the same and have been fully described through the listing process. Those general threat categories include: habitat changes; impeded access to historical habitat by dams and reservoirs; degraded water quality; reduced water quantity; vessel strikes; and bycatch in commercial fisheries. The impact of each of these threats varies by DPS.

For the Gulf of Maine, New York Bight, and Chesapeake Bay DPSs, historical spawning habitat is accessible in nearly all current and known historical spawning rivers. This is not the case for the Carolina and South Atlantic DPSs of Atlantic sturgeon. Within the range occupied by the Carolina DPS, dams have restricted Atlantic sturgeon spawning and juvenile developmental habitat by blocking over 60% of the historical sturgeon habitat upstream of the dams in the Cape Fear and Santee-Cooper River systems. Dams also prevent access to the vast majority of historical spawning habitat on the Savannah River in the South Atlantic DPS.

Even where spawning habitat is available, accessibility does not necessarily equate to functionality. In particular, water quality, while showing signs of improvement, continues to rate only fair to poor in areas of the New York Bight, Chesapeake Bay, Carolina and South Atlantic DPSs. Non-point sources for pollution from terrestrial activities have caused reductions in water quality leading to degradation of habitat. In addition, dredging for navigation channels has significantly altered depth, rates of sedimentation, substrate and water flow in some areas. Of the threats to habitat that were considered when the Atlantic sturgeon DPSs were listed, water quality was of greatest concern in terms of its contribution to the risk of endangerment for each DPS, overall.

For the Carolina and South Atlantic DPSs, water allocation issues are growing threats. Water withdrawals may potentially slow recovery by exacerbating existing water quality problems. Water withdrawals can alter natural water flows, which can affect DO levels, temperature, and a river's ability to assimilate pollutants (GWC 2006). Water quality within the river systems in the range of the South Atlantic and Carolina DPSs is negatively affected by large water withdrawals. Water shortages and "water wars" are already occurring in the rivers occupied by the Carolina and South Atlantic DPSs and will likely be compounded in the future by population growth and potentially by climate change.

Other in-river threats to the Atlantic sturgeon DPSs include predation by non-native species, impingement and entrainment at facilities that withdraw water from the rivers, and vessel strikes. The presence of introduced fish species in Atlantic sturgeon spawning rivers and the lack of evidence of sturgeon spawning success has raised concerns that introduced fish may be eating native fish. Throughout the range of the Atlantic sturgeon DPSs, most, if not all, subpopulations are at risk of entrainment or impingement in water withdrawal intakes for commercial uses, municipal water supply facilities, and agricultural irrigation intakes. Vessel strikes of Atlantic sturgeon have been documented in a number of rivers in the New York Bight and Chesapeake Bay DPSs, including the Hudson River, Delaware River, and James River. An increasing number of reports of Atlantic sturgeon with apparent vessel strike injuries suggest vessels strikes may also impact animals in the Carolina and South Atlantic DPSs. The information needed to accurately quantify the degree that vessel strikes threaten these populations is not currently available.

While directed fisheries for Atlantic sturgeon are prohibited in U.S. waters, all DPSs of Atlantic sturgeon are incidentally caught in many U.S. fisheries that operate in state and federal waters. Overall, there is limited observer coverage of fisheries that interact with Atlantic sturgeon. As a result, the total number of Atlantic sturgeon interactions with fishing gear in state and federal waters is unknown. Even when a fish is observed captured and released alive, the rate of post-release mortality is unknown.

Threats in the ocean also affect all five DPSs. Ocean temperature in the U.S. Northeast Shelf and surrounding Northwest Atlantic waters has increased faster than the global average over the last decade (Pershing et al. 2015). New projections for the U.S. Northeast Shelf and Northwest Atlantic Ocean suggest that this region will warm two to three times faster than the global average (Saba et al. 2015). A first-of-its-kind climate vulnerability assessment, conducted on 82 fish and invertebrate species in the Northeast U.S. Shelf, concluded that Atlantic sturgeon from all five DPSs were among the most vulnerable species to global climate change (Hare et al. 2016).

CONSERVATION ASSESSMENT

What steps have been taken to address the species' recovery needs?

Various governmental agencies, groups, and individuals are carrying out a number of efforts aimed at protecting and conserving the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs of Atlantic sturgeon. These actions are directed at reducing threats faced by Atlantic sturgeon and/or gaining additional knowledge of specific Atlantic sturgeon subpopulations. Such actions could contribute to the recovery of the Atlantic sturgeon DPSs in the future. However, there is still considerable uncertainty regarding whether the current efforts to reduce the threats to Atlantic sturgeon are being effective, and, if they are, the extent to which they are reducing threats.

In 1998, the ASMFC amended the Atlantic Sturgeon Fishery Management Plan (FMP) instituting a moratorium on the harvest Atlantic sturgeon. The expressed goal of the Amendment was to restore Atlantic sturgeon spawning stocks to population levels that will provide for sustainable fisheries, and ensure viable spawning populations. The 1998 Amendment strengthened conservation efforts by formalizing the closure of the directed fishery and banning retention of bycatch. However, bycatch is

known to still occur in several fisheries, and it is widely accepted that bycatch is underreported. Contrary to information available in 1998 when the Amendment was approved, Atlantic sturgeon bycatch mortality is now considered a primary threat affecting the recovery of all five DPSs of Atlantic sturgeon, despite actions taken by the states and NOAA Fisheries to prohibit directed fishing and retention of Atlantic sturgeon. There are also limited resources for assessing the current abundance of spawning females (the identified metric for assessing success of the ASMFC FMP measures for Atlantic sturgeon) for each of the DPSs. Almost 20 years after the implementation of the moratorium, there are signs of slow recovery for at least some Atlantic sturgeon populations. The ASMFC completed an Atlantic Sturgeon Benchmark Stock Assessment in 2017 that considered the status of each DPS individually, as well as all 5 DPSs collectively as a single unit. The assessment concluded all five DPSs of Atlantic sturgeon, as well as each individual DPS remain depleted relative to historic abundance. The assessment also concluded that the population of all five DPSs together appears to be recovering slowly since implementation of a complete moratorium in 1998. However, there were only two individual DPSs, the New York Bight DPS and Carolina DPS, for which there was a relatively high probability that abundance of the DPS has increased since the implementation of the 1998 fishing moratorium. In addition, there was a relatively high probability that mortality for animals of the Gulf of Maine DPS and the Carolina DPS exceeded the mortality threshold used for the assessment. Therefore, while Atlantic sturgeon populations are showing signs of slow recovery when all five DPSs are considered collectively, these trends are not necessarily reflected with individual DPSs.

Several states within the range of the Atlantic sturgeon DPSs have received funding under the ESA's Section 6, Species Recovery Grants to States, program to conduct studies that resulted in new information necessary for management and recovery of one or more of the Atlantic sturgeon DPSs. The new information has helped to further conservation efforts. Similarly, the Greater Atlantic and Southeast Regional Offices have funded studies directly. These studies, as well as others, have resulted in a greater number of acoustically tagged Atlantic sturgeon that can be detected for up to 10 years. However, there are still many unanswered questions (e.g., how do different life stages of Atlantic sturgeon use different habitats?) that need to be considered to adequately quantify and address the threats to each DPS. Continued funding is needed to support the activities and research that are providing insights on these unanswered questions. These activities include improved understanding of genetic differentiation, maintenance of receiver arrays that detect and store data from the tagged sturgeon, as well as greater and more accurate population estimates. Continued funding is also needed to analyze and apply the findings of these activities and research so the information can be used to address recovery of each Atlantic sturgeon DPS.

SUMMARY ASSESSMENT

Overall, clear, robust population estimates and indications of population trends of the five DPSs of Atlantic sturgeon have proven to be difficult to obtain. Abundance across all five DPSs is very low relative to historical populations, albeit the data available for estimating population abundance is often limited. Atlantic sturgeon face human-caused threats like interactions with fishing gear, vessel strikes, and habitat loss or modification. Recovery will depend on successful reproduction and reducing mortality of extant populations. Many of the activities causing harm to the Atlantic sturgeon DPSs have occurred for years, even decades. Similarly, some conservation actions have been in place for years (e.g., prohibition on catch and retention of Atlantic sturgeon). The past impacts of human activity on the Atlantic sturgeon DPSs cannot be particularized in their entirety. Similarly, the benefits to Atlantic sturgeon DPSs as a result of conservation activities already implemented may not be evident for years, given the relatively late age to maturity for Atlantic sturgeon and depending on the age class(es) affected.

PRELIMINARY RECOVERY STRATEGY

RECOVERY PRIORITY NUMBER WITH RATIONALE

Based on the 1990 recovery priority ranking guidelines, the recovery priority number for each of the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs is 5 (55 FR 24296; June 15, 1990). This number is based on three criteria: magnitude of threat, recovery potential, and conflict. These DPSs face a moderate threat of extinction if recovery is temporarily held off, although there continue to be threats to their habitat. Recovery potential is high for these DPSs because the major threats affecting these DPS (i.e., water quality/quantity alterations, bycatch in state/commercial fisheries, and impeded access to historical habitats) are relatively well understood and necessary management actions are known. These DPSs also conflict with construction or other developmental projects or other forms of economic activity.

RECOVERY VISION STATEMENT

Subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future.

INITIAL ACTION PLAN

The initial focus will be to protect extant subpopulations and the species' habitat through reduction of threats. Further, we must gather information through research and monitoring on current distribution and abundance; vessel strikes; effects of climate change; and bycatch. We will also be seeking fish passage designs that are effective in safely moving sturgeon upstream and downstream of barriers to migration (i.e., dams) where access to historical habitats is blocked.

Specific actions that will be undertaken early in the process may include the following:

- Improve understanding of population dynamics, population distribution, abundance, trends, and structure through research, monitoring, and modeling.
- Continue researching fish passage designs that allow Atlantic sturgeon access to historical spawning grounds currently blocked by dams.
- Continue research and monitoring of human-caused sources of injury or mortality such as fisheries bycatch and vessel strikes with the goal of minimizing those impacts.
- Develop standardized methods to create reliable abundance indices.

Recovery actions needed in the longer term may also include:

- Work with dam owners/operators to implement fish passage once designs that successfully pass fish are identified.
- Implement region-wide initiatives to improve water quality in sturgeon spawning rivers, with specific focus on eliminating or minimizing human-caused anoxic zones.
- Implement regional initiatives to improve access to historical habitats and ensure water withdrawals have minimal impact on Atlantic sturgeon.

PREPLANNING DECISIONS

PLANNING APPROACH

A Recovery Plan will be prepared for all five DPSs of Atlantic sturgeon pursuant to Section 4(f) of the ESA. We are also considering expanding the scope of the plan to include shortnose sturgeon (*Acipenser brevirostrum*), which co-occur with Atlantic sturgeon in most rivers. A joint plan would afford the opportunity to address threats that affect multiple DPSs as well as shortnose sturgeon.

A recovery team consisting of key stakeholders and sturgeon experts is expected to be assembled to develop the Recovery Plan. Recovery planning efforts will be coordinated across the Greater Atlantic and Southeast Regional Offices, as well as the Northeast Fisheries Science Center.

INFORMATION MANAGEMENT

All information relevant to recovery management of the Atlantic sturgeon DPSs will be housed in NOAA Fisheries Southeast Regional Office's and Greater Atlantic Regional Fisheries Office's administrative files.

STAKEHOLDER INVOLVEMENT

Key stakeholders:
Federal, state, territorial, and local agencies
Domestic and foreign universities and research organizations
Domestic and foreign conservation organizations

Stakeholder involvement strategy:
Representatives of key stakeholder groups are expected to be invited to participate in the recovery planning process. As needed, meetings and/or conference calls will be held to discuss particular issues, and stakeholders will be invited to participate as warranted. All stakeholders will be afforded an opportunity to review and comment on a draft of the Recovery Plan in conformance with the ESA. Stakeholders may also be asked to contribute directly in the development of implementation strategies for planned actions.

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