ASMFC Stock Assessment Overview: Atlantic Sturgeon

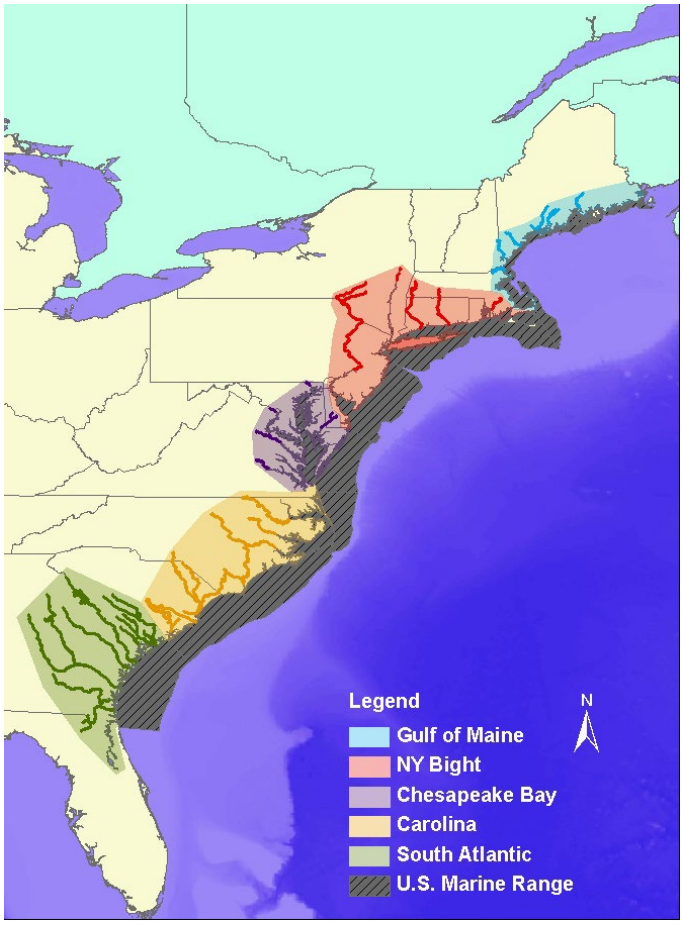
Introduction

The 2024 Atlantic Sturgeon Stock Assessment Update is an update to the 2017 Atlantic Sturgeon Benchmark Stock Assessment that was peer-reviewed by an independent panel of scientific experts through the Commission's Peer Review process. The assessment is the latest and best information available on the status of US Atlantic sturgeon populations for use in fisheries management.

Management Overview

Atlantic sturgeon are broadly distributed along the Atlantic coast of the US and Canada. The Commission manages Atlantic sturgeon as a single, coastwide stock from Maine through Florida. Individual states managed Atlantic sturgeon with their own size limits, closed seasons, and gear restrictions until 1990, when the Commission implemented a Fishery Management Plan (FMP) with the goal of restoring Atlantic sturgeon populations. By 1996, 10 states/jurisdictions had closed their fisheries, and Amendment 1 to the FMP (1998) instituted a coastwide harvest ban. In 2012, NOAA Fisheries listed five distinct population segments (DPS) of Atlantic sturgeon as either threatened (Gulf of Maine DPS) or endangered (New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs) under the Endangered Species Act (ESA). The ESA listing separated the coastwide stock into DPSs after determining that the five individual populations were genetically distinct, differed in when and where they spawned, and that the loss of any one DPS would result in a significant gap in the range of the species coastwide.

Figure 1. Map of Atlantic Sturgeon's Five Distinct Population Segments (DPS)



What Data Were Used?

The assessment used both fishery-dependent and -independent data as well as biological and life history information. Fishery-dependent data are from commercial fisheries that targeted Atlantic sturgeon prior to the moratorium or catch sturgeon incidentally, while fishery-independent data are collected through scientific research and survey programs.

Life History

Like salmon, Atlantic sturgeon are anadromous, meaning they live in the ocean and return to freshwater to spawn. After hatching, juvenile Atlantic sturgeon stay in the freshwater portions of their

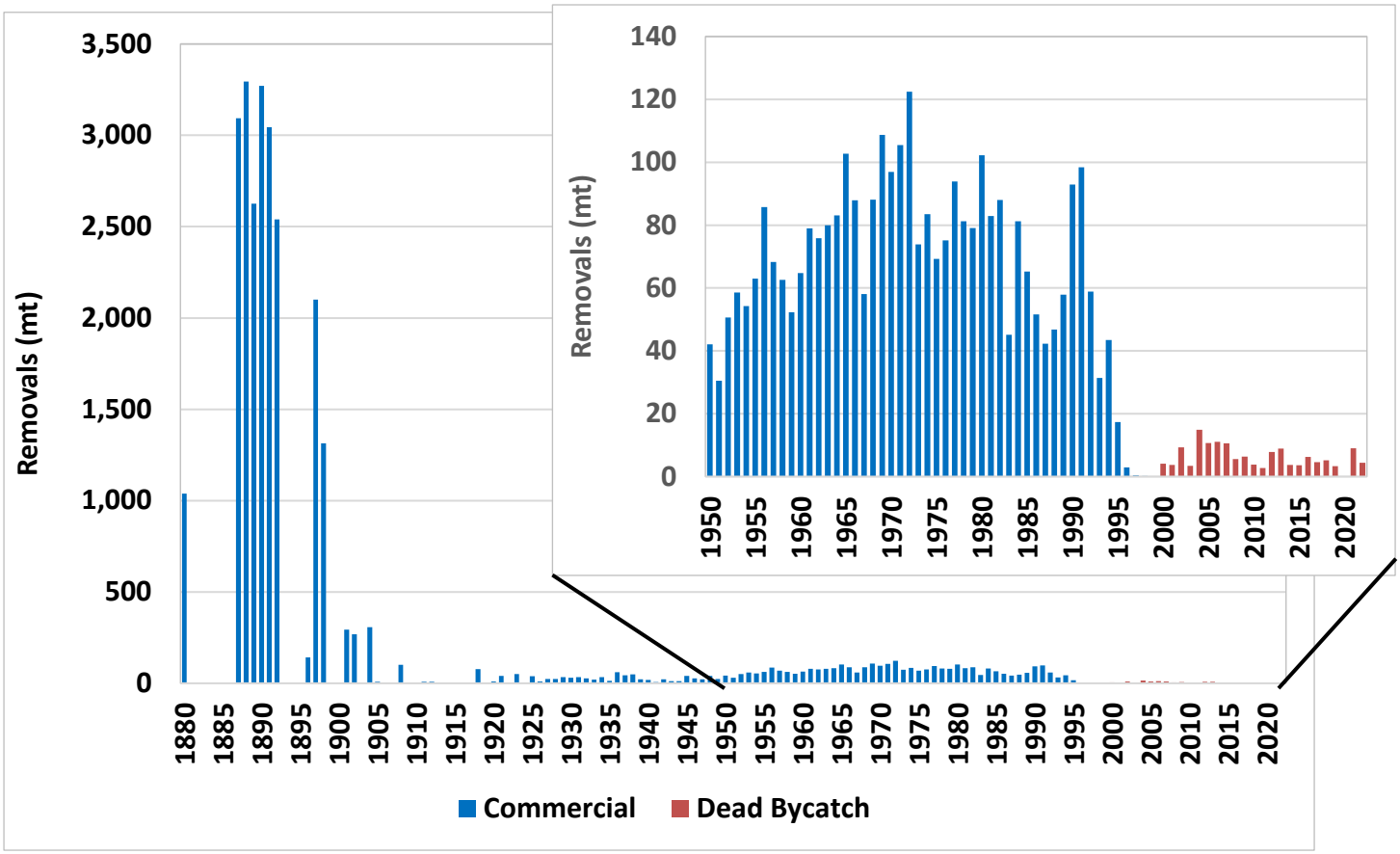
natal rivers for their first year or two before moving into estuaries and then to nearshore ocean waters. Atlantic sturgeon generally begin to mature around age 10 but may take up to 32 years to mature. Males mature earlier than females, and individuals in the southern extent of their range may mature sooner, at 5-10 years old. Unlike salmon, Atlantic sturgeon do not die after spawning and may return to spawn many times over the course of their lives, which may last as long as 60 years. Historically, Atlantic sturgeon reached maximum lengths of 14-18 feet, though individuals over 10-12 feet are now rarely encountered.

Fishery-Dependent Data

Atlantic sturgeon have a long history of exploitation on the Atlantic coast. Archeological evidence shows Native Americans harvested sturgeon in pre-colonial times, and there are colonial records going back to the 1600s of directed sturgeon fisheries in New England. In the late 1800s and early 1900s Atlantic sturgeon supported one of the largest fisheries by weight on the Atlantic coast, but landings have declined steadily since the beginning of the timeseries. Landings reached low points during World War I and II, and increased from the 1950s through the 1970s. By the late 1980s, landings were declining again, and concerns about the status of the stock led to a coastwide moratorium in 1998.

Despite there being no directed fisheries for Atlantic sturgeon for more than two decades, sturgeon are caught as bycatch in fisheries for other species, predominantly in gill nets, and to a lesser extent trawls and pound nets. Observer data from the federal Northeast Fishery Observer Program, North Carolina Independent Gillnet Observer Program, and South Carolina American shad fishery were used to estimate the number of

Figure 2. Coastwide Atlantic Sturgeon Commercial Landings and Dead Bycatch, 1880 – 2022
Inserted graph provides snapshot of a more recent timeframe, 1950 – 2022

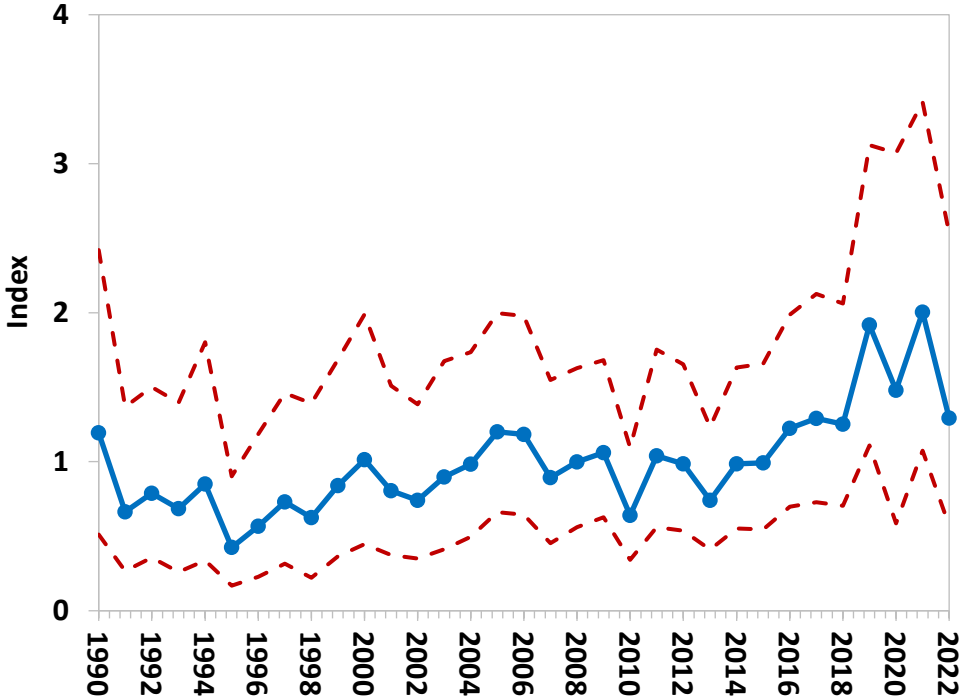


Atlantic sturgeon caught and killed as bycatch (Figure 2).

Fishery-Independent Data

Nine surveys were developed into indices of relative abundance and were analyzed individually to evaluate population trends at the DPS level. The indices were also combined statistically to create a composite index that represents the coastwide metapopulation of Atlantic sturgeon. These surveys ranged from Maine to South Carolina and mostly caught juveniles and small adults. Most indices either had no trend over the time series or were increasing. The coastwide index is variable from 1990-2022 but has been steadily increasing since 2013 (Figure 3).

Figure 3. Relative Abundance of Coastwide Juvenile and Adult Atlantic Sturgeon with 95% Confidence Intervals



The assessment also used acoustic tagging data to calculate survival and mortality rates. Unlike conventional fish tags that attach to the outside of a fish, acoustic tags are implanted internally and emit an acoustic signal that can be detected by receiver arrays stationed along the coast. Using this method, researchers do not have to wait until a tagged fish is caught again to know where it went or whether it was still alive. Total mortality (Z) was low for the coastwide population. For individual DPSs, the Gulf of Maine had the highest Z estimates whereas the Chesapeake Bay had the lowest Z estimates.

What Models Were Used?

Stock status was based on the results of autoregressive integrated moving average (ARIMA) trend models and the tagging models. The ARIMA model is a statistical technique that removes noise from the abundance index trends and calculates the probability that the relative abundance in the last year of the timeseries is greater than the relative abundance in the reference year. The assessment used 1998 as the reference year, the first year of the coastwide moratorium, in order to determine whether Atlantic sturgeon abundance is higher or lower than it was at the start of the moratorium. If an index started after 1998, the first year of the survey was used as the reference year. The tagging model estimated the total mortality rate (Z) of Atlantic sturgeon at the coastwide and DPS levels. An egg-per-recruit (EPR) model was used to develop a total mortality reference point ($Z_{50\%EPR}$), which is the total mortality rate that that would result in 50% of the egg production of an unexploited population. This reference point was also used in the 1998 and 2017 benchmark assessments as an appropriate target to aid in stock recovery. The total mortality estimate from the tagging model was compared to $Z_{50\%EPR}$ to determine if total mortality was too high.

What is the Status of the Stock?

Atlantic sturgeon were designated as a federally endangered species in 2012. However, there remains no estimates of unexploited biomass or abundance at the coastwide or DPS-level against which to evaluate

Atlantic sturgeon status, and estimates of current abundance are limited to a few rivers. Also, for a species that has been under a moratorium for nearly 20 years, the traditional "overfished" and "overfishing" status designations are not as meaningful.

For this assessment, quantitative stock status for total mortality was determined by the probability that the estimate of total mortality from the tagging model exceeded the $Z_{50\%EPR}$ reference point. Quantitative stock status for abundance was determined by the average probability that the most recent year of the indices for each DPS was greater than the reference year for each index. The assessment used the probability of being above or below a reference point to describe stock status to better show the uncertainty about the results. Because the available indices only cover the most recent time period, long after the height of exploitation, metrics like trends in landings and consideration of anecdotal reports of historical distribution and abundance were used to determine a qualitative biomass or abundance status relative to historical levels.

At the coastwide level, while Atlantic sturgeon remain depleted relative to historic levels, the population has shown signs of improvement with a significant positive trend over the time series and a high probability that abundance in 2022 was greater than abundance in 1998 at the start of the moratorium. Total mortality was low and had a low probability of exceeding the $Z_{50\%SPR}$ reference point (see Table 1). The "depleted" status was used instead of "overfished" because many factors (such as bycatch, habitat loss and ship strikes), not just directed historical fishing, have contributed to the continued low abundance of Atlantic sturgeon.

At the individual DPS level, results were more mixed. Most indices showed either a positive trend or no significant trend over the time series. The average probability that the New York Bight and Carolina DPSs indices were greater than the reference year was high, meaning it was likely that abundance in 2022 was higher than it was at the start of the mortarium. For the Gulf of Maine, Chesapeake Bay, and South Atlantic DPSs, the average probability was lower – less than 50% for all three DPSs – meaning that it was unlikely that

Table 1. Stock status determination for the coastwide stock and DPSs based on mortality estimates and biomass/abundance status relative to historic levels, and the terminal year (i.e., the last year of available data) of indices relative to the start of the moratorium.

Population	Mortality Status	Biomass/Abundance Status		
	Probability that Z is greater than the Z Reference Point	***Relative to Historical Levels***	***NOAA Designation***	***Average probability that relative abundance in 2022 was greater than relative abundance in the reference year****
Coastwide	2%	Depleted		100%
Gulf of Maine	56%	Depleted	Threatened	45%
New York Bight	20%	Depleted	Endangered	59%
Chesapeake Bay	14%	Depleted	Endangered	27%
Carolina	18%	Depleted	Endangered	77%
South Atlantic	27%	Depleted	Endangered	31%

**Reference year is 1998, or the first year of the survey for indices that started after 1998*

abundance in 2022 was greater than it was at the start of the moratorium. Total mortality estimates for each DPS were higher than for the full coastwide population and the probability of exceeding the $Z_{50\%SPR}$ reference point was higher, partly due to the smaller sample size and higher uncertainty in the tagging model at the DPS

level than at the coastwide level. There was a greater than 50% chance that total mortality for the Gulf of Maine DPS exceeded the $Z_{50\%SPR}$ reference point, but total mortality on the other DPSs was lower and had a less than 50% chance of exceeding the reference point.

Overall, stock status was similar to stock status from the 2017 benchmark assessment.

Data and Research Needs

By far, the greatest challenge in assessing the status of Atlantic sturgeon is the lack of data. While progress was made in numerous recommendations from the 2017 benchmark assessment, the assessment update identified a number of new research needs.

Better information on population trends, especially at the DPS level, is a high priority. More work is needed to identify key areas where sturgeon are found along the coast throughout the year, including the use of offshore habitat, particularly in areas where offshore energy development and mineral removal are planned or occurring. Observer programs should be expanded to include more estuarine waters and increase the number of trips and gears covered to improve bycatch estimates. In addition, ship strikes may be a significant source of mortality for some DPSs. More data are needed to quantify the degree to which vessel strikes in specific rivers and estuaries may be impacting populations which spawn in other locations and evaluate strategies to reduce or mitigate mortalities from ship strikes.

The tagging data provide important information on current mortality rates. It is critical to maintain and support current networks of acoustic receivers and acoustic tagging programs, and expand the programs in underrepresented DPSs to improve the estimates of total mortality.

Glossary

Distinct population segment (DPS): the smallest division of a taxonomic species permitted to be protected under the Endangered Species Act.

Egg-per-recruit (EPR): the expected egg production from an individual female fish in her lifetime, typically represented as a percentage of the egg production that would otherwise occur in an unfished stock

Fishing mortality (*F*): the rate at which fish die because of fishing

Metapopulation: a group of populations that are separated by space but consist of the same species. These spatially separated populations interact as individual members move from one population to another.

Natural mortality (*M*): the rate at which fish die from all causes other than fishing (predation, disease, starvation, etc.)

Terminal year: The last year of available data in a survey index or assessment.

Total mortality (*Z*): the rate of removal of fish from a population due to both fishing and natural causes

References

ASMFC. 2024. Atlantic Sturgeon Stock Assessment Update, Arlington, VA. 80p.

ASMFC. 2017. Atlantic Sturgeon Benchmark Stock Assessment and Peer Review Report, Arlington, VA. 456p.

ASMFC. 2009. Guide to Fisheries Science and Stock Assessments. Arlington, VA.