



## Introduction

The 2017 Atlantic sturgeon benchmark stock assessment 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 U.S. Atlantic sturgeon populations for use in fisheries management. The last Atlantic sturgeon stock assessment was completed in 1998.

## Management Overview

Atlantic sturgeon are broadly distributed along the Atlantic coast from Maine to Florida and into the Canadian Maritimes. The Commission manages Atlantic sturgeon as a single, coastwide stock from Maine through Florida. Prior to 1990, individual states managed Atlantic sturgeon with their own size limits, closed seasons, and gear restrictions. The Commission implemented a Fishery Management Plan (FMP) in 1990 with 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).

## What Data Were Used?

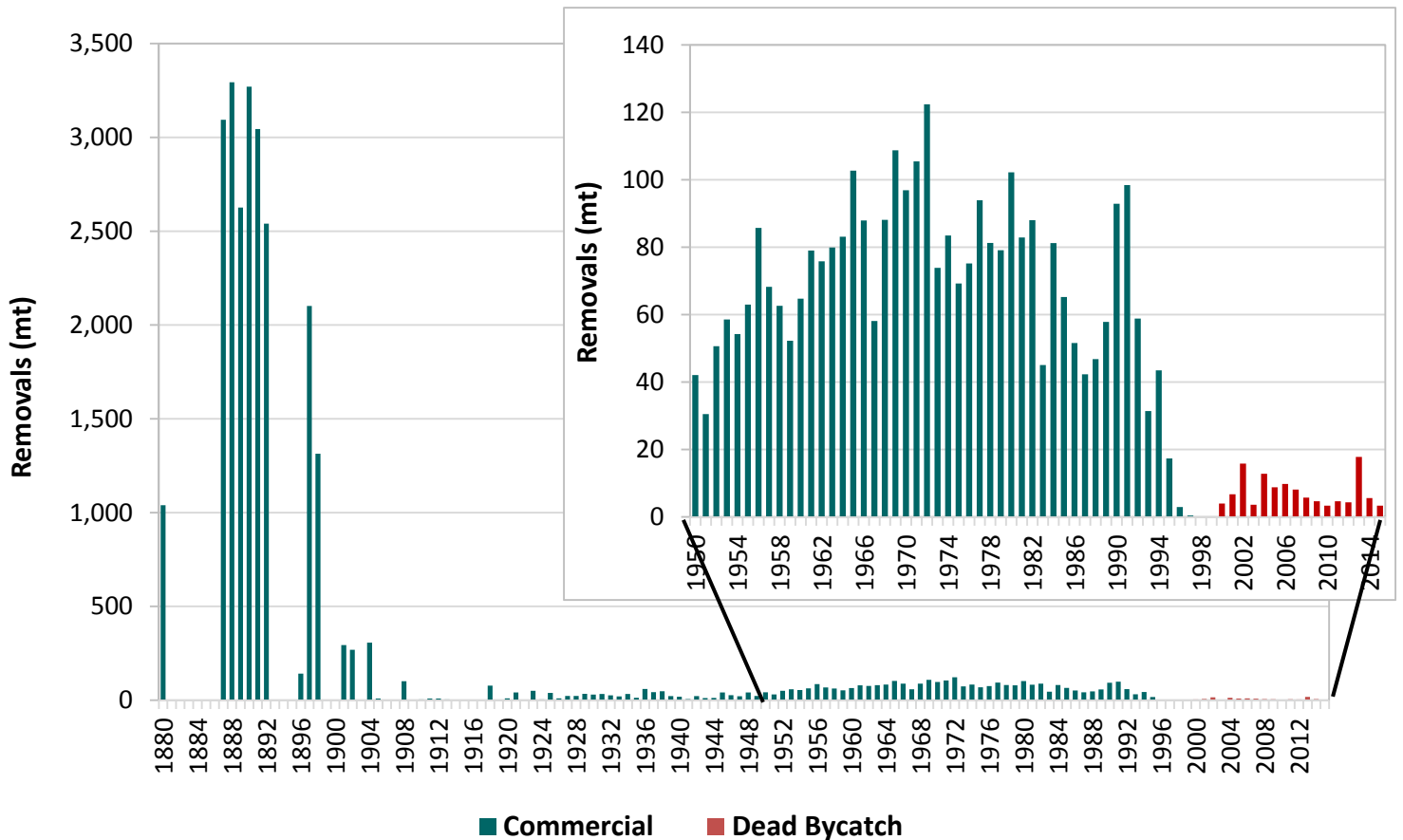
The assessment used both fishery-dependent and fishery-independent data as well as biological and life history information. Fishery-dependent data are from commercial fisheries that targeted Atlantic sturgeon prior to the moratorium or catch sturgeon incidentally, while fishery-independent data are collected 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 start 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 time-series. Landings reached low points during World War I and II, and increased from the 1950s through the 1970s.



**Figure 1. Coastwide Atlantic sturgeon commercial landings and dead bycatch, 1880 – 2014. Inserted graph provides same information but for a more recent timeframe, 1950 – 2014.**

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 nearly two decades, sturgeon are caught as bycatch in fisheries for other species, predominantly in gillnets, and to a lesser extent trawls and pound nets. Observer data from the federal Northeast Fishery Observer Program and the North Carolina Independent Gillnet Observer Program were used to estimate the number of Atlantic sturgeon caught and killed as bycatch.

### ***Fishery-Independent Data***

Atlantic sturgeon are not often encountered by fishery-independent surveys. The Atlantic Sturgeon Stock Assessment Subcommittee (SAS) evaluated 50 fishery-independent surveys conducted by the states, NOAA Fisheries, and academic institutions. Nine of the surveys were accepted and developed into indices of relative abundance for use in the assessment. These surveys ranged from Maine to South Carolina and mostly caught juveniles and small adults. The other surveys were not used because they rarely encountered sturgeon (in <1% of the samples), or because their methods were inconsistent. The fishery-independent surveys were analyzed individually to evaluate population trends at the DPS level, and in combination to represent the coastwide metapopulation of Atlantic sturgeon.

The assessment also used acoustic tagging data, which can be used to calculate survival and mortality rates, and provide insight about movements and migratory patterns. Twelve different researchers from all five DPSs

contributed data from more than 1,300 acoustically tagged Atlantic sturgeon. 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. Researchers don't have to wait until a tagged fish is caught again to know where it went or whether it was still alive.

### What Models Were Used?

The SAS explored a number of different models and analyses to evaluate the status of Atlantic sturgeon, including trend analysis, data poor methods, genetic methods, per recruit models, and a tagging model to estimate mortality.

Stock status was based on the results of the ARIMA trend models and the tagging models.

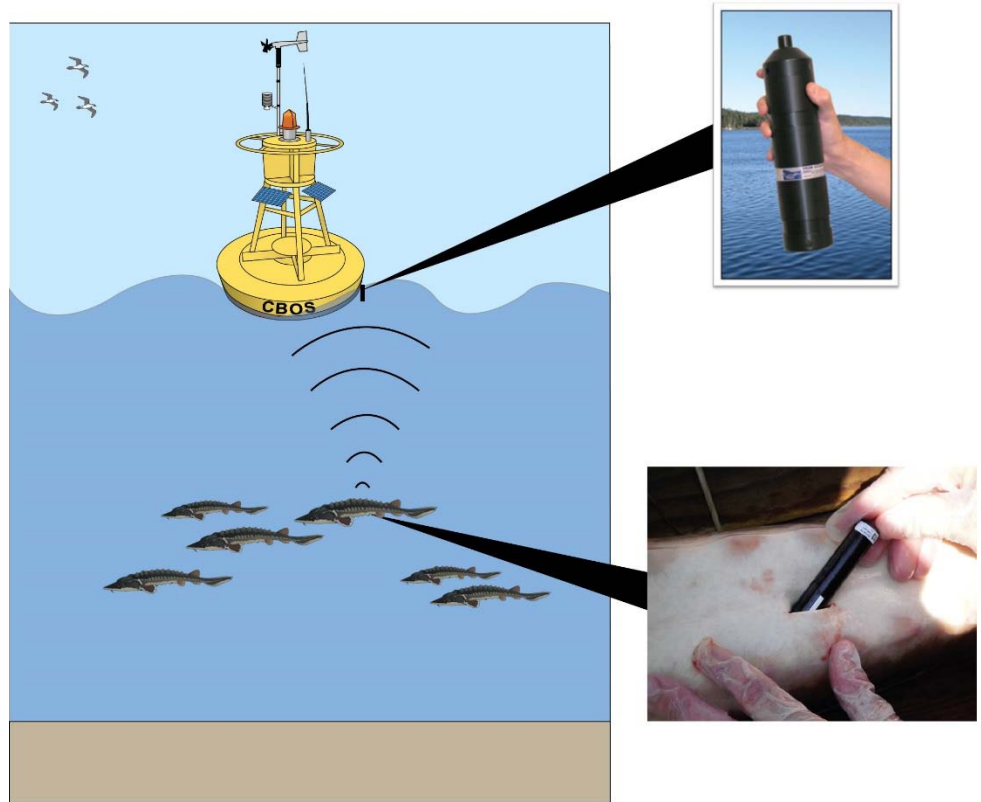
The ARIMA (Auto-Regressive

Integrated Moving Average) model uses fishery-independent indices of abundance to estimate how likely an index value is above or below a reference value. The tagging model estimated the survival rate of Atlantic sturgeon at the coast-wide and DPS levels. An egg-per-recruit (EPR) model was used to compare recent total mortality ( $Z$ ) with a total mortality reference point ( $Z_{50\%EPR}$ ) that would result in 50% of the egg production of an unexploited population. This reference point was used in the 1998 benchmark assessment and continued in the 2017 assessment as an appropriate target to aid in stock recovery. The survival 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?

At the coastwide and DPS levels, Atlantic sturgeon are depleted relative to historical levels. The 'depleted' status was used instead of 'overfished' because many factors, not just directed historical fishing, contributed to the low abundance of Atlantic sturgeon, including bycatch, habitat loss and ship strikes.

However, there are signs the populations have started a slow recovery relative to 1998 levels. There is a high probability that the coastwide index is above the 1998 value. Indices from the Gulf of Maine DPS, New York Bight DPS, and Carolina DPS all had a greater than 50% chance of being above their 1998 value. The index from the Chesapeake Bay DPS only had a 36% chance of being above the 1998 value. There were no representative indices from the South Atlantic DPS, therefore, its abundance status is unknown.



**Figure 2. An Atlantic sturgeon implanted with an acoustic tag being detected by a VEMCO VR2 receiver affixed to a Chesapeake Bay Observing System Buoy. Photos courtesy of VEMCO and Dave Secor, University of Maryland Center for Environmental Science.**

At the coastwide level, the estimate of total mortality from the tagging model was very low. There was only a 7% chance that total mortality of the coastwide population was higher than the  $Z_{50\%EPR}$  threshold. The estimates of total mortality for each DPS were more uncertain because of lower sample sizes. The New York Bight, Chesapeake Bay, and South Atlantic DPSs all had a less than 50% chance of having a mortality rate higher than the threshold. The Gulf of Maine and Carolina DPSs had 74-75% probability of being above the mortality threshold.

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

**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 as determined by the ARIMA analysis.**

\*For indices that started after 1998, the first year of the index was used as the reference value.

## Data and Research Needs

Efforts to assess the status of Atlantic sturgeon are hampered by a lack of data. The stock assessment identified a number of high priority research needs.

Better information on population trends, especially at the DPS level, is a high priority. More work is needed to establish reliable indices of abundance for spawning populations and juveniles. Observer programs which monitor bycatch should be expanded to include more estuarine waters and increase the number of trips and gears covered to improve our estimates of bycatch. In addition, ship strikes may be a significant source of mortality for some DPSs. More data are needed to quantify the numbers of Atlantic sturgeon killed by strikes each year.

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.

## Whom Do I Contact For More Information?

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## Glossary

**Age class:** all of the individuals in a stock that were spawned or hatched in the same year. This is also known as the year class or cohort.

**Catch-at-age:** the number of fish of each age that are removed in a year by fishing activity.

**Distinct population segment:** 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 expressed as a percentage of the egg production that would otherwise occur in an unfished stock

**Fishing mortality (F):** the instantaneous (not annual) 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 instantaneous (not annual) 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 instantaneous (not annual) rate of removal of fish from a population due to both fishing and natural causes

## References

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