## Introduction

This document presents a summary of the 2022 stock assessment update for Atlantic striped bass. This is an update of the assessment model that was peer-reviewed by an independent panel of scientific experts at the 66th Northeast Regional Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC66) meeting in November 2018 and includes data through 2021. The assessment is the latest and best information available on the status of the coastwide Atlantic striped bass stock for use in fisheries management.

## Management Overview

Atlantic coast migratory striped bass live along the eastern coast of North America from the St. Lawrence River in Canada to the Roanoke River and other tributaries of Albemarle Sound in North Carolina. Historical tagging data suggest stocks that occupy coastal rivers from the Tar-Pamlico River in North Carolina south to the St. Johns River in Florida do not undertake extensive Atlantic Ocean migrations when compared with stocks from the Roanoke River north.

The Atlantic States Marine Fisheries Commission (ASMFC) manages the coastal migratory striped bass stock, which inhabits all coastal and estuarine areas from Maine through Virginia, and the coastal areas of North Carolina. Estuarine striped bass stocks in North Carolina, which contribute minimally to the coastal migratory stock, are managed separately by the State of North Carolina under the auspices of the Commission. The North Carolina estuarine striped bass management unit is defined as the striped bass inhabiting the Albemarle Sound and Roanoke River and their tributaries.

The stock assessment includes data from both state (0 – 3 miles from shore) and federal waters (3 – 200 miles from shore). Amendment 7 to the Interstate Fishery Management Plan, approved in May 2022, sets the management program for striped bass. Amendment 7 implements a number of changes to improve management of the species and rebuild the stock, including establishing a more conservative recruitment trigger and requiring the 2022 stock assessment's rebuilding projections to conservatively account for the possibility of future low recruitment. Amendment 7 also builds on the mandatory circle hook provision by implementing additional measures intended to increase the chance of survival after a striped bass is released alive in the recreational fishery.

## What Data Were Used?

The stock assessment used both fishery-dependent and -independent data collected through state, federal, and academic research programs. The assessment includes final catch and index data through 2021.

### *Life History*

Atlantic striped bass are anadromous, meaning they spend most of their adult life in ocean waters, but return to their natal rivers to spawn in the spring. The rivers that feed into the Chesapeake Bay and the Delaware and Hudson Rivers are the major spawning grounds for the coastal migratory population. Female striped bass typically grow larger and heavier than males. Based on sampling efforts, 45% of female striped bass mature at age 6 and 100% mature by age 9. Striped bass can live to a maximum of 31 years.

### *Commercial and Recreational Data*

The stock assessment used total catch (harvest, commercial discards, and dead recreational discards) and catch-at-age split into two components: Chesapeake Bay removals and ocean removals. Removals include harvest and dead discards from both fishing sectors. Ocean removals include removals from inland areas like the Delaware Bay, Long Island Sound and the Hudson River.

Strict commercial quota monitoring is conducted by states through various state and federal dealer and fishermen reporting systems; landings are compiled annually from those sources by state biologists. Following the stock's collapse in the late 1970s/early 1980s, commercial landings dropped to 151,000 pounds (under 50,000 fish) in 1986. As fishery regulations were liberalized during the 1990s, landings increased, reaching over 7.3 million pounds (about 880,000 fish) in 2004. From 2004-2014, landings were relatively stable due to the commercial quota system with average landings of 6.8 million pounds per year (about 943,000 fish). The commercial quota was reduced in 2015 and again in 2020 in response to stock assessment findings that overfishing was occurring. Commercial harvest averaged 3.95 million pounds per year (about 595,000 fish) from 2020-2021. The assessment estimates unreported commercial discards using tag return data from commercial and recreational fisheries. Commercial discards were estimated to be about 12% of total commercial removals in recent years, and 1.5% of total removals.

Recreational catch, effort, and length frequency data were obtained from the Marine Recreational Information Program (MRIP) for 1982-2021. MRIP uses surveys to estimate how many fishing trips recreational anglers take every year and how many fish per trip they catch. In 2020, the angler intercept survey used to estimate catch per trip was suspended in several states for varying lengths of time due to COVID-19. The effort survey continued uninterrupted, and MRIP used data from 2018 and 2019 to fill the gaps in the angler intercept survey to estimate catch for 2020.



**Figure 1. Atlantic Striped Bass Commercial Landings and Discards & Recreational Landings and Release Mortality**
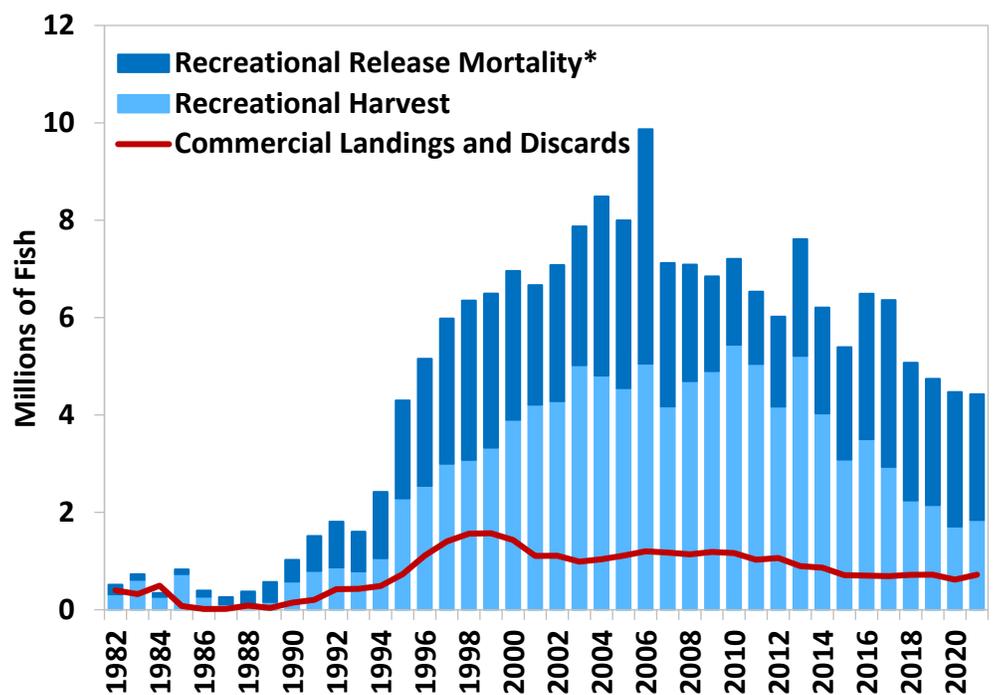
* 9% of fish released alive are assumed to die because of being caught.

This assessment used the new MRIP estimates of recreational harvest and releases. Recreational harvest increased from 2.4 million pounds (264,000 fish) in 1984 to 61.5 million pounds (5.4 million fish) in 2010. Between 2004 and 2014, harvest remained steady, averaging 54.8 million pounds (4.6 million fish) per year. Following stock declines and implementation of size and bag limit changes in the recreational fisheries through Addendum IV, harvest decreased to an average of 33.6 million pounds (2.7 million fish) for 2015-2019. Recreational harvest for 2020-2021 averaged 15.2 million pounds (1.76 million fish). The vast majority (85-90%) of the annual catch in most years is released alive, and the assessment assumes, based on previous studies, that 9% of the fish that are released alive die as a result of being caught. The number of released fish peaked in 2006 at 53.5 million fish, 4.8 million of which were assumed to have died. Total numbers of releases have declined to a low of 16.4 million releases (1.5 million of which died) in 2011 after a series of weak year classes. Live releases have rebounded somewhat since then, with 28.7 million fish released in 2021, 2.6 million of which were assumed to have died. From 2018-2021, about 50% of total removals were release mortalities. Figure 1 shows commercial and recreational landings and discards (release mortality in the case of the recreational fishery) in numbers of fish (not pounds or metric tons).

MRIP catch per unit effort data was used as a fishery-dependent index of relative abundance.

### *Fishery-Independent Surveys*
The assessment used several fishery-independent indices of relative abundance for adults (Connecticut Trawl Survey, ChesMMAP Survey, New Jersey Bottom Trawl Survey, New York Ocean Haul Seine Survey, Maryland Spawning Stock Survey, and Delaware Spawning Stock Electrofishing Survey); and for young-of-year (YOY) and age-1 fish (New York and Maryland YOY and Yearling Surveys, and New Jersey and Virginia YOY Surveys). Several surveys were impacted by COVID-19 and other issues, with sampling interrupted or suspended in 2020 and 2021, resulting in missing data points or more uncertain data points for some surveys.

### *Tagging Data*
Eight tagging programs have traditionally participated in the U.S. Fish and Wildlife Service (USFWS) Atlantic coast striped bass tagging program and each have been in progress for at least 18 years. The tagging programs are divided into two categories, producer area programs and coastal programs. Producer area tagging programs primarily operate during spring spawning on spawning grounds in New York, Delaware/ Pennsylvania, Maryland, and Virginia. Coastal programs tag striped bass from mixed stocks during fall, winter, or early spring in waters off of Massachusetts, New York, New Jersey, and North Carolina. USFWS maintains the tag release and recapture database and provides rewards to anglers who report the recaptures of tagged fish.

## How Were the Data Analyzed?

### *Statistical catch-at-age (SCA) model*
The accepted model for use in striped bass stock assessments is a forward projecting statistical catch-at-age (SCA) model, which uses catch-at-age data and fishery-dependent and -independent survey indices to estimate annual population size and fishing mortality. Indices of abundance track relative changes in the population over time while catch data provide information on the scale of the population size. Age structure data (numbers of fish by age) provide additional information on recruitment (number of age-1 fish entering the population) and trends in mortality.

## What is the Status of the Stock?

In 2021, the Atlantic striped bass stock was overfished but not experiencing overfishing relative to the updated reference points defined in the 2022 assessment (see below). Female spawning stock biomass (SSB) was estimated at 143 million pounds, below the updated SSB threshold of 188 million pounds. Total fishing mortality was estimated at 0.14, below both the updated fishing mortality threshold of 0.20 and the updated fishing mortality target of 0.17.

Despite recent declines in SSB, the stock is still above the SSB levels observed during the moratorium that was in place in the mid-late 1980s.

**Figure 2. Atlantic Striped Bass Female Spawning Stock Biomass and Recruitment**



### *Recruitment*

As shown in Figure 2, striped bass experienced a period of strong recruitment (age-1 fish entering the population) from 1994-2004, followed by a period of lower recruitment from 2005-2011 (although not as low as the early 1980s, when the stock was considered collapsed). This period of low recruitment contributed to the decline in SSB that the stock has experienced since 2010. Recruitment of age-1 fish was high in 2012, 2015, 2016, and 2019 (corresponding to strong 2011, 2014, 2015, and 2018 year classes), but estimates of age-1 striped bass were below the long-term average in 2018, 2020, and 2021. Recruitment in 2017 was estimated at 116 million age-1 fish, below the time series average of 135.7 million fish.

### *Biological Reference Points*

The reference points currently used for management are based on the 1995 estimate of female SSB. The 1995 female SSB is used as the SSB threshold because many stock characteristics (such as an expanded age structure) were reached by this year and the stock was declared recovered. To estimate the associated fishing mortality threshold and target, population projections were made by using a constant fishing mortality rate and changing the value until the SSB threshold or target value was achieved.
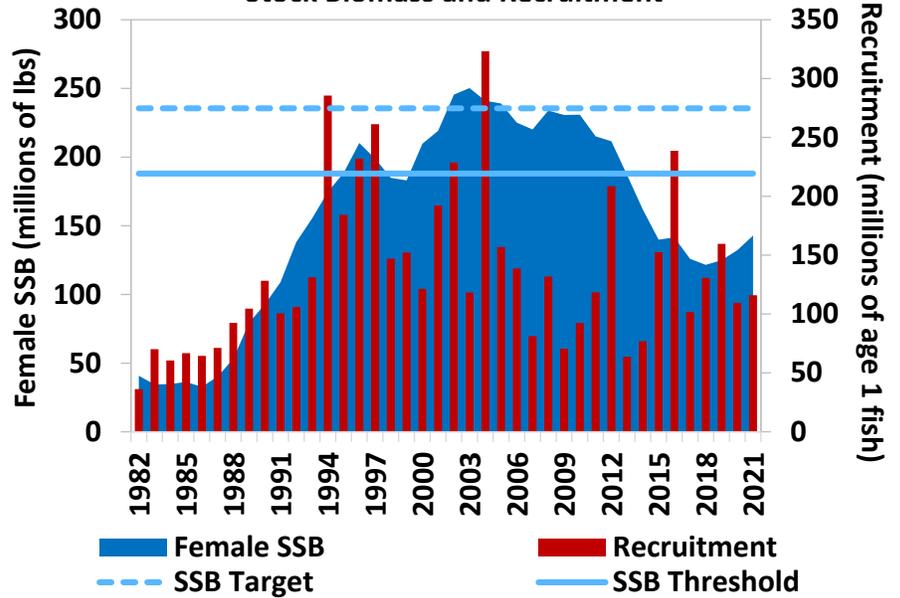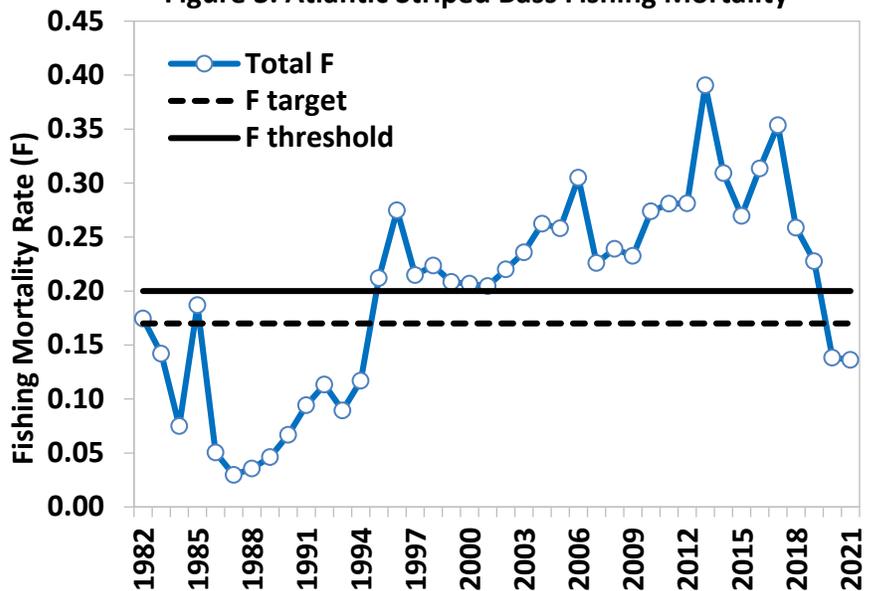
**Figure 3. Atlantic Striped Bass Fishing Mortality**

For the 2022 assessment, the definitions of the targets and thresholds remain the same, but the values have been updated. In addition, because the Amendment 7 recruitment trigger was tripped in 2022 and Maryland's juvenile abundance index being below the recruitment trigger for three consecutive years (2019-2021), the fishing mortality target and threshold were calculated using the low recruitment assumption, which means that the population was projected using the age-1 recruitment estimated from 2008-2021, which was lower than the long-term recruitment from 1993-2021. The updated fishing mortality target and threshold were also lower, due to the low recruitment assumption, with $F_{Threshold}$=0.20 and $F_{Target}$=0.17. The SSB threshold was estimated at 188 million pounds, with an SSB target of 235 million pounds. This was slightly lower than the SSB target and threshold from the latest benchmark assessment, as the updated model estimated SSB in 1995 slightly lower than the benchmark.

## Rebuilding Projections

The population was projected forward through 2030 using fishing mortality equal to the fishing mortality in 2021 and the low recruitment assumption. Under these conditions, there was a 78.6% chance that the stock would be at or above the SSB target in 2029, the rebuilding deadline. This means that no further reductions need to be taken at this time.

## Next steps

The Commission will closely monitor removals in 2022 and 2023, and conduct another stock assessment update in 2024 to evaluate rebuilding progress and ensure that the population remains on track to rebuild by 2029.

## Data and Research Priorities

The Technical Committee identified several high priority research recommendations to improve the assessment. These included continued development of a two-stock spatial assessment model; better characterization of commercial discards; expanded collection of sex ratio data and paired scale-otolith samples; development of an index of relative abundance for the Hudson River stock; better estimates of tag reporting rates; continued collection of mark-recapture data to better understand migration dynamics; and additional work on the impacts of *Mycobacteriosis* on striped bass population dynamics and productivity.

The Technical Committee recommends the next benchmark stock assessment be conducted in 2027, which will allow time to work on issues like state-specific scale-otolith conversion factors and directly incorporating tagging data into the two-stock assessment model. In the meantime, regular stock assessment updates should be conducted to monitor rebuilding progress.

## Glossary

**Age structure:** the separation of a fish population into distinct age groups

**Benchmark stock assessment:** A full analysis and review of stock condition, focusing on the consideration of new data sources and newer or improved assessment models. This assessment is generally conducted every 3-5 years and undergoes a formal peer review by a panel of independent scientists who evaluate whether the data and the methods used to produce the assessment are scientifically sound and appropriate for management use.

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

**Fishing mortality:** the instantaneous rate at which fish are killed by fishing

**Overfished:** Occurs when stock biomass falls below the threshold established by the FMP, impacting the stock's reproductive capacity to replace fish removed through harvest, and that decline is driven primarily by fishing mortality

**Overfishing:** Removing fish from a population at a rate that exceeds the threshold established in the FMP, impacting the stock's reproductive capacity to replace fish removed through harvest

**Spawning stock biomass**: the total weight of the mature females within a stock of fish; frequently used instead of total biomass as a better measure of the ability of a stock to replenish itself.

**Statistical catch-at-age (SCA) model:** an age-structured stock assessment model that works forward in time to estimate population size and fishing mortality in each year.

**Stock assessment update**: Incorporates data from the most recent years into a peer-reviewed assessment model to determine current stock status (abundance and overfishing levels)

**Recruitment:** a measure of the weight or number of fish that enter a defined portion of the stock, such as the spawning stock or fishable stock. For this stock assessment, recruitment refers to the number of age-1 fish entering the population.

**Year class:** All of the individuals in a given stock spawned or hatched in the same year; also known as an 'age class' or 'cohort'.

**Young-of the-year (YOY):** an individual fish in its first year of life; for most species, YOY are juveniles

## References

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