ASMFC Stock Assessment Overview: Atlantic Striped Bass

Introduction

This document presents a summary of the 2018 benchmark stock assessment for Atlantic striped bass. The assessment 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. 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 are managed as non-coastal migratory stocks 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 6 to the Interstate Fishery Management Plan and Addenda I-IV set the management program for striped bass. Amendment 6 implements a separate management program for the Chesapeake Bay due to the size availability of striped bass in this area.

What Data Were Used?

The stock assessment used both fishery-dependent and -independent data collected through state, federal, and academic research programs. The assessment included final catch data through 2017.

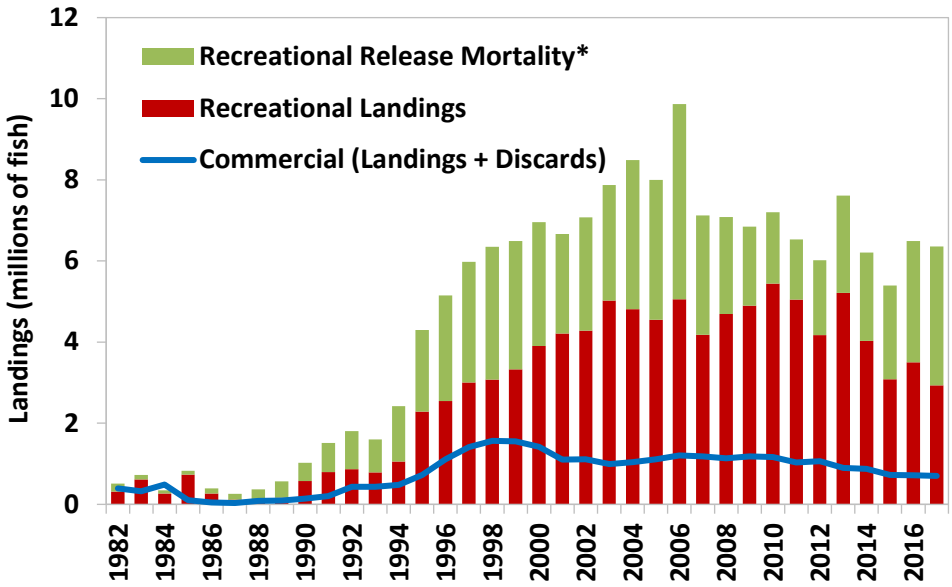
Life History

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.

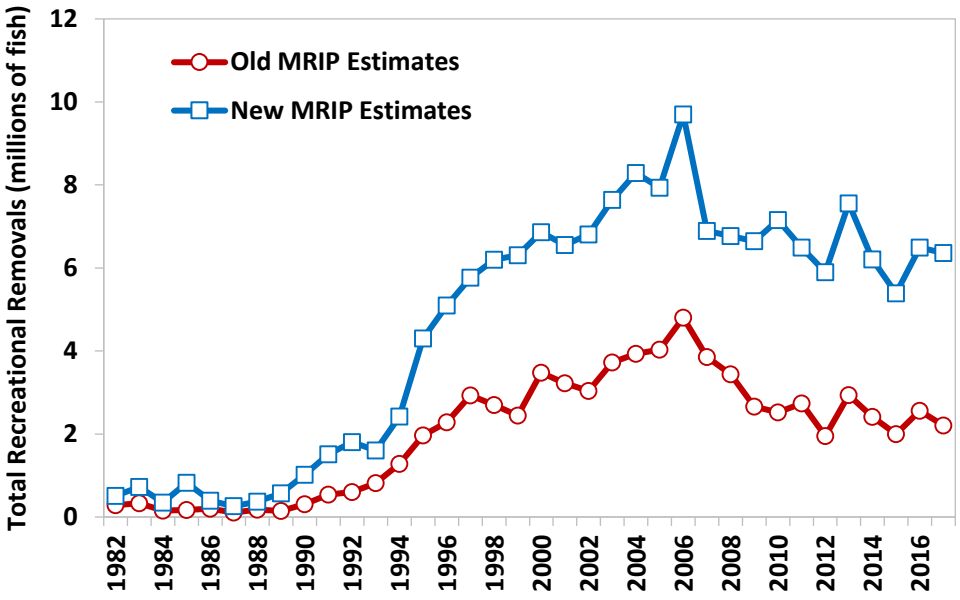
Figure 1. Atlantic Striped Bass Commercial Landings and Discards & Recreational Landings and Release Mortality



*Recreational release mortality assumes that 9% of fish released alive die.

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 (47,240 fish) in 1986. As fishery regulations were liberalized during the 1990s, landings increased, reaching 6.4 million pounds (1.04 million fish) in 2004. From 2004-2014, landings were relatively stable due to the commercial quota system with average landings of 6.5 million pounds per year. Since 2015, commercial landings have decreased to an average of 4.7 million pounds per year due to implementation of Addendum IV and a reduction in the commercial quota. The assessment estimates unreported commercial discards using tag return data from commercial and recreational fisheries. Commercial discards were estimated to be about 15% of total commercial removals in recent years.

Figure 2. Comparison of Old & New MRIP Estimates of Recreational Removals* of Atlantic Striped Bass



*Recreational removals include landed fish and the 9% of fish released alive that die.

Recreational catch, effort, and length frequency data were obtained from the Marine Recreational Information Program (MRIP) for 1982-2017. MRIP uses surveys to estimate how many fishing trips recreational anglers take every year and how many fish per trip they catch. In 2018, MRIP transitioned from a phone-based survey to a mail-based survey to estimate the number of angler trips. The new, improved survey showed the number of trips taken in recent years was much higher than had been previously estimated, and as a result, estimates of recreational

catch were much higher for striped bass (Figure 2). Overall, the estimates of recreational removals of striped bass (fish that were landed plus fish that died as a result of being released alive) were 2.3 times higher using the new method, with a greater difference in recent years.

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 54.9 million pounds (4.7 million fish) per year. Following implementation of size and bag limit changes in the recreational fisheries through Addendum IV, harvest decreased to an average of 40.5 million pounds (3.2 million fish) for 2015-2017. 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 slightly since then, with 38 million fish released in 2017, 3.4 million of which were assumed to have died. 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).

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 fishermen who report the recaptures of tagged fish. From 1985 through August 2018, there were 542,149 striped bass tagged and released, with 92,344 recaptures reported coastwide.

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.

Tagging model

As a complement to the SCA model, a tagging model (IRCR) was run on data from the USFWS coastwide striped bass tagging program through the 2017 tagging year. The IRCR model compares the numbers of tagged

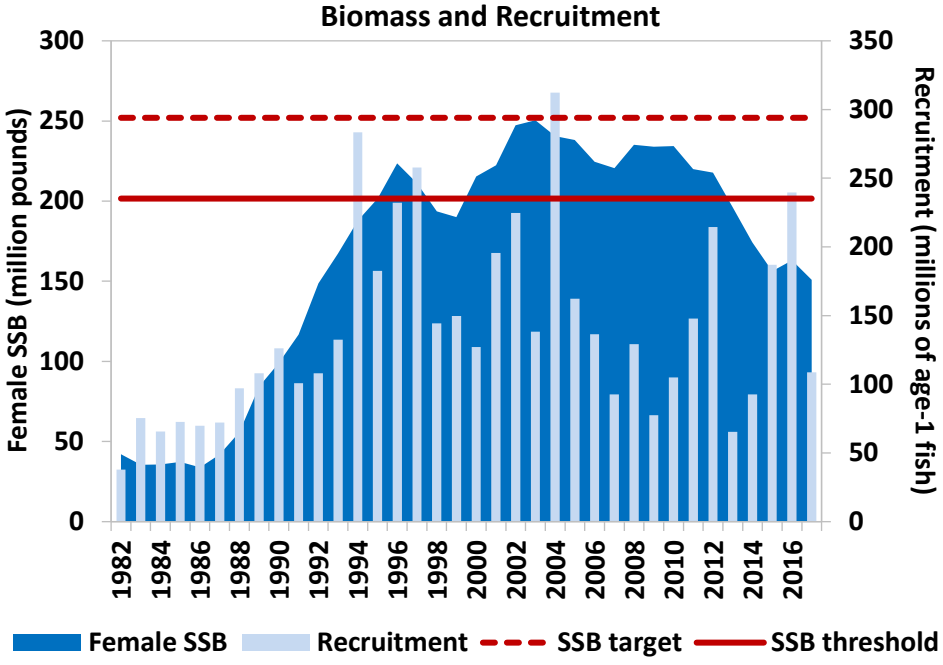
fish that have been recaptured to the numbers of fish that were originally tagged over time to estimate the survival rate of striped bass from year-to-year, fishing mortality rates and natural mortality rates.

What is the Status of the Stock?

In 2017, the Atlantic striped bass stock was overfished and experiencing overfishing relative to the updated reference points defined in the 2018 assessment (see below). Female spawning stock biomass (SSB) was estimated at 151 million pounds, below the SSB threshold of 202 million pounds. Total fishing mortality was estimated at 0.307, above the fishing mortality threshold of 0.240.

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.

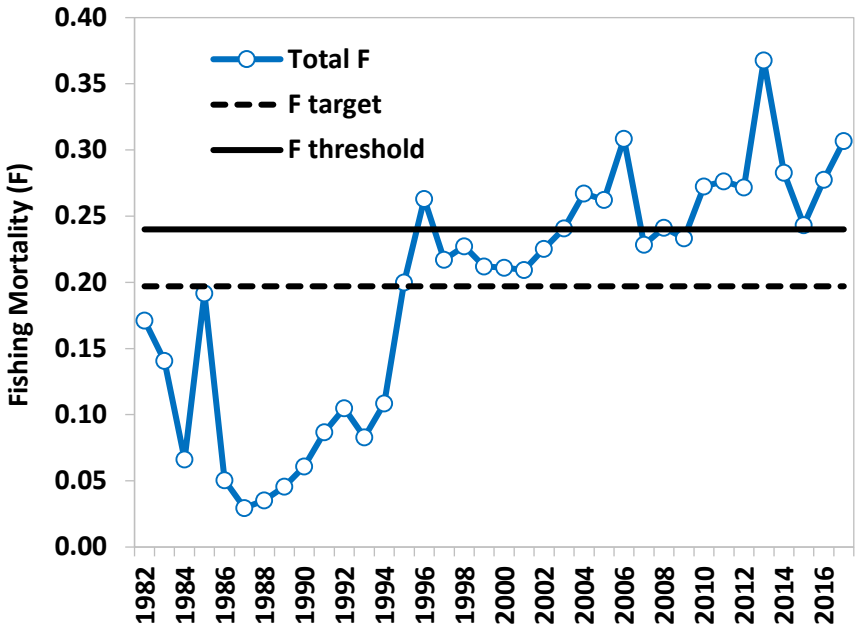
Figure 3. Atlantic Striped Bass Female Spawning Stock Biomass and Recruitment



Recruitment

As shown in Figure 3, 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, and 2016 (corresponding to strong 2011, 2014, and 2015 year classes), but estimates of age-1 striped bass were below the long-term average in 2013, 2014, and 2017. Recruitment in 2017 was estimated at 108.8 million age-1 fish, below the time series average of 140.9 million fish.

Figure 4. Atlantic Striped Bass Fishing Mortality

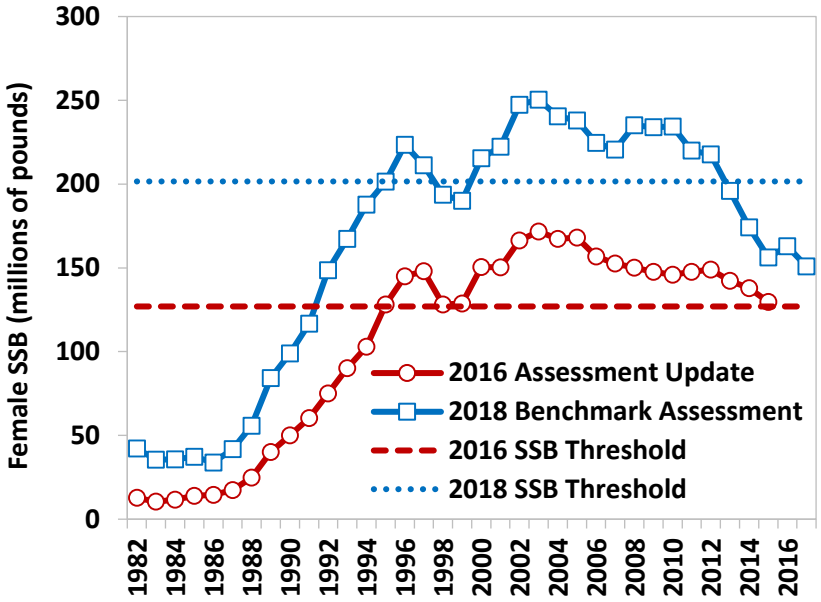


Biological Reference Points

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. The values estimated in the

2013 assessment are $SSB_{Threshold}$ = female SSB_{1995} = 127 million pounds and SSB_{Target} = 125% female SSB_{1995} = 159 million pounds. 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. The projected fishing mortality (F) to maintain $SSB_{Threshold}$ = $F_{Threshold}$ = 0.22, and the projected fishing mortality to maintain SSB_{Target} = F_{Target} = 0.18.

Figure 5. Comparison of SSB Estimates from the 2016 Update Using Old MRIP Numbers and the 2018 Benchmark Using New MRIP Numbers



For the 2018 assessment, the definitions of the targets and thresholds remain the same, but the values have been updated. The new MRIP estimates resulted in higher estimates of SSB, and therefore higher estimates for the SSB threshold and target (Figure 5). The SSB threshold was estimated at 202 million pounds, with an SSB target of 252 million pounds. The new MRIP estimates did not have a large effect on the estimates of fishing mortality, and the updated fishing mortality threshold and target values are very similar to the previous fishing mortality reference points. The fishing mortality threshold was estimated at 0.24, and the target was estimated at 0.20.

Data and Research Priorities

The Technical Committee (TC) addressed several of the recommendations from the 2013 benchmark assessment report, including developing new maturity-at-age estimates for the coastal migratory stock and evaluating stock status definitions relative to uncertainty in biological reference points. The TC also made progress on developing a spatially and temporally explicit catch-at-age model incorporating tag-based movement information. Although the Peer Review Panel did not accept the migration model for management use, it recommended continued work to improve the model for future assessments.

The TC identified several high priority research recommendations to improve the assessment. These included 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 TC recommends the next benchmark stock assessment be conducted in 2024, 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.

Glossary

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

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

IRCR: Jiang *et al.*'s (2007) instantaneous rates tagging model

Natural mortality (M): the instantaneous rate at which fish die because of natural causes (predation, disease, starvation, etc.)

Otoliths: the inner ear bones of a fish. They form rings as they grow which can be counted to assign an age to the fish.

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.

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.

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

References

ASMFC. 2009. Guide to Fisheries Science and Stock Assessments. Arlington, VA. http://www.asmfc.org/uploads/file/GuideToFisheriesScienceAndStockAssessments.pdf

Jiang H, Pollock KH, Brownie C, Hoenig JM, Latour RJ, Wells BK, Hightower JE. 2007. Tag return models allowing for harvest and catch and release: evidence of environmental and management impacts on striped bass fishing and natural mortality rates. North American Journal of Fisheries Management 27:387-396.

NEFSC. 2019. Summary Report of the 66th Northeast Regional Stock Assessment Review Committee (SARC 66), Northeast Fisheries Science Center, Woods Hole, Massachusetts. 40p.