



Introduction

This document presents a summary of the 2013 benchmark stock assessment for Atlantic striped bass. The assessment was peer-reviewed by an independent panel of scientific experts at the 57th Northeast Regional Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC57) meeting in July 2013 and updated in August 2013 to incorporate final 2012 landings. 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 that stocks which 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 coastal striped bass management unit includes the coastal and estuarine areas of all states and jurisdictions from Maine through North Carolina. The stock assessment includes data from both state (0 – 3 miles from shore) and federal waters (3 – 200 miles from shore). Striped bass are managed by the Atlantic States Marine Fisheries Commission (ASMFC) through Amendment 6 to the Interstate Fishery Management Plan and its addenda. Amendment 6 implements a separate management program for the Chesapeake Bay due to the size availability of striped bass in this area.

The Albemarle-Roanoke stock is managed as a non-coastal migratory stock by the state of North Carolina under the auspices of the Commission. The Albemarle-Roanoke management unit is defined as the striped bass inhabiting the Albemarle, Currituck, Croatan, and Roanoke Sounds and their tributaries, including the Roanoke River.

What Data Were Used?

The Atlantic striped bass assessment used both fishery-dependent and -independent data collected through state, federal, and academic research programs. Final catch data were not available for 2012 at the time of the peer review, so preliminary numbers were used. The assessment was updated after the review workshop with the final 2012 catch data, and this report reflects the updated assessment results.

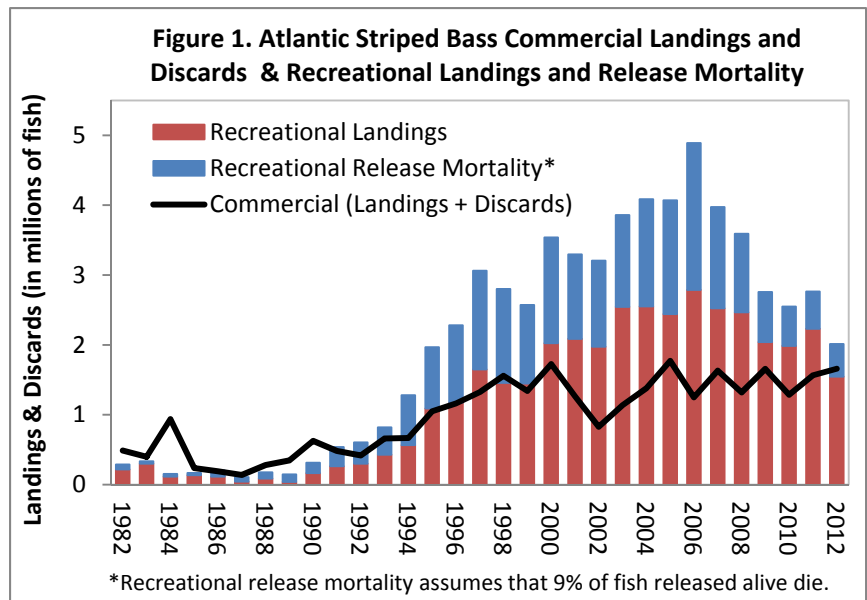
Life History

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. Males mature at around age 2 and females at around age 4, and they can live for up to 30 years.

Commercial and Recreational Data

The stock assessment used total catch (harvest, commercial discards, and dead recreational discards) and catch-at-age split into three components: Chesapeake Bay, coastal harvest, and commercial discards.

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. Commercial landings increased from 800,000 pounds in 1990 to 7.3 million pounds in 2004 following liberalization of fishery regulations. Since 2005, landings have fluctuated around an average of 6.97 million pounds. The assessment estimates unreported commercial discards using tag return data from commercial and recreational fisheries.



Recreational catch, effort, and length frequency data were obtained from the Marine Recreational Fisheries Statistics Survey/Marine Recreational Information Program (MRFSS/MRIP) for 1982-2012. Recreational harvest increased from 2.2 million pounds (163,000 fish) in 1990 to 31 million pounds (2.8 million fish) in 2006. Following the peak in 2006, harvest declined through 2012 to 19 million pounds (1.5 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 23.3 million fish, 2.1 million of which were assumed to have died. Total numbers of releases have declined since then, with 5.2 million fish released in 2012, 467,000 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).

Two fishery-dependent indices of abundance were used in the assessment: the MRFSS/MRIP catch per unit effort and the Virginia pound net index.

Fishery-Independent Surveys

The assessment used several fishery-independent indices of abundance for adults (Connecticut trawl survey, NOAA Fisheries Northeast Fisheries Science Center bottom trawl, 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 YOY and yearling survey, New Jersey YOY survey, Virginia YOY survey, and Maryland YOY and yearling 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 the 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 the waters off of Massachusetts, New York, New Jersey, and North Carolina. USFWS maintains the tag release/recovery database and provides rewards to fishermen who report the

recaptures of tagged fish. From 1985 through January 2013, a total of 507,097 striped bass have been tagged and released, with 91,440 recaptures reported and recorded in the USFWS database.

How Were the Data Analyzed?

Statistical catch-at-age (SCA) model

The accepted model for use in striped bass assessments is a forward projecting statistical catch-at-age model (SCA), 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

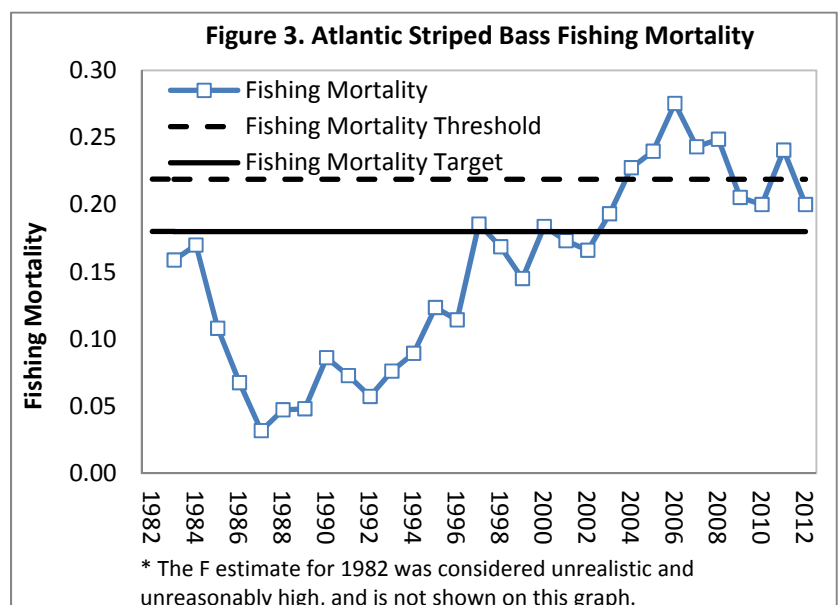
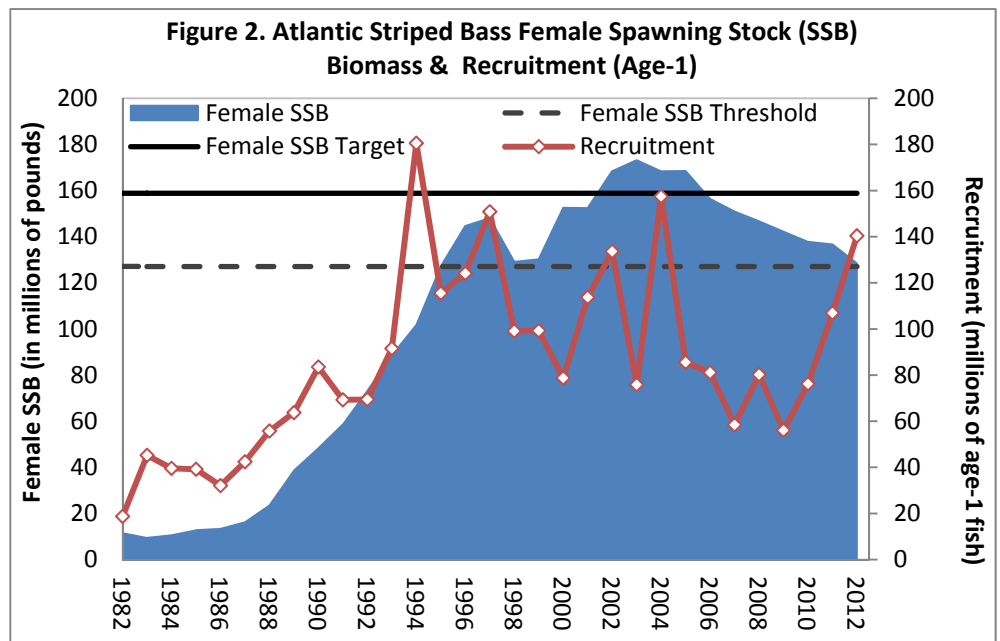
As a complement to the SCA, a tagging model (IRCR) was run on data from the USFWS coastwide striped bass tagging program through the 2011 tagging year. The IRCR model compares the numbers of tagged fish that have been recaptured to the numbers of fish that were originally tagged over time to estimate the survival rate of striped bass from year-to-year, fishing mortality rates, and natural mortality.

What is the Status of the Stock?

In 2012, the Atlantic striped bass stock was not overfished or experiencing overfishing relative to the new reference points defined in the 2013 assessment (see below). Female spawning stock biomass (SSB) was estimated at 128 million pounds (58,200 mt) just above the SSB threshold of 127 million pounds (57,626 mt), but below the SSB target of 159 million pounds (72,032 mt). Total fishing mortality was estimated at 0.20, below the fishing mortality threshold of 0.219 but above the fishing mortality target of 0.180.

Recruitment

Striped bass experienced a period of strong recruitment (age-1 fish) from 1993-2003,



followed by a period of lower recruitment from 2004-2009 (although not as low as the early 1980s, when the stock was overfished). The 2011 year-class was strong (i.e., abundant), but early observations from several states' juvenile indices indicate the 2012 year class was very weak (i.e., low abundance).

Projections

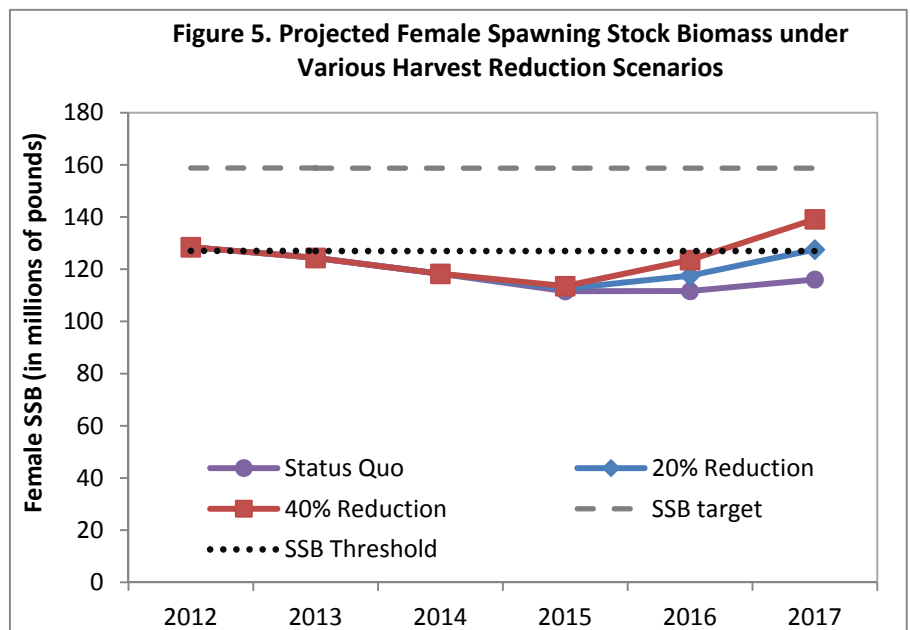
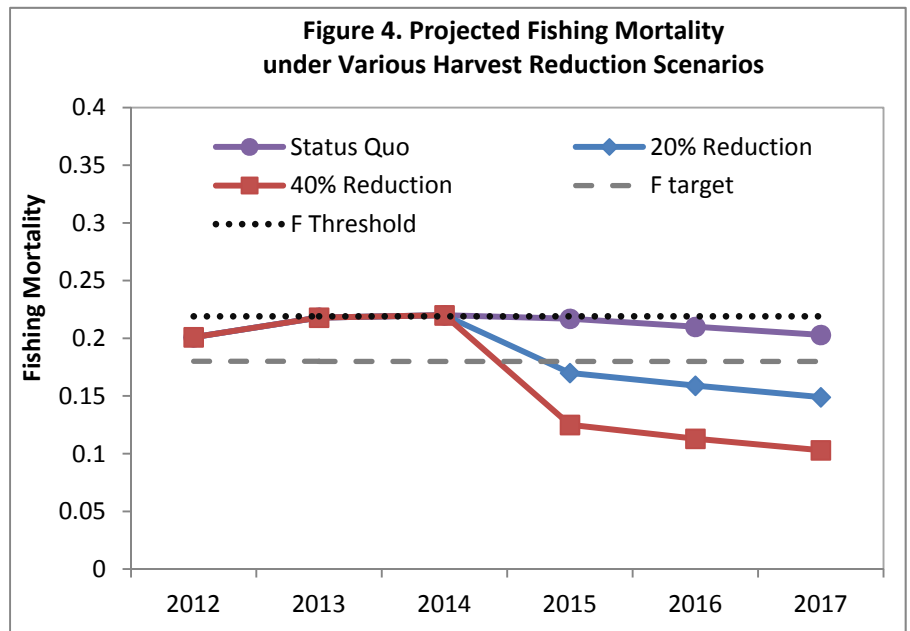
Five-year projections of female SSB and fishing mortality were made by using a standard forward projection methodology. Under this scenario, if the current fishing mortality rate of 0.20 is maintained during 2013-2017, the probability of the stock being overfished (SSB less than the SSB threshold) is high and increases until 2015-2016, but declines thereafter. If total harvest is reduced in 2015-2017, the pattern is the same – the probability of being overfished increases, peaking in 2015, but declines after that. In addition, the probability of overfishing (fishing mortality greater than the threshold) would be near zero.

This trend is driven by the lack of strong year classes currently in the fishery, and the emergence of the strong 2011 year class that matures into the spawning stock in three to four years. Despite recent declines in SSB, the stock is still well above the SSB during the moratorium that was in place in the mid-1980s.

Biological Reference Points

The biological reference points for striped bass used in the previous assessment and by the Commission for management use are based on fishing mortality at maximum sustainable yield ($F_{MSY} = 0.34$) and an SSB proxy which is equivalent to the 1995 SSB level. The SSB target was calculated as 125% of the 1995 SSB, and the fishing mortality target was defined as an exploitation rate of 24% or $F=0.3$.

For the 2013 assessment, the basis for deriving the SSB target and threshold remain the same, but the values have been updated. However, the method of estimating the fishing mortality reference points was changed so that the fishing mortality reference points are calculated to be consistent with the SSB reference points. In prior years, fishing mortality reference points were calculated independently of SSB reference points and led to inconsistencies. This new method resulted in a fishing mortality target of 0.180, corresponding to the SSB



target of 159 million pounds (72,032 mt), and a fishing mortality threshold of 0.219, corresponding to the SSB threshold of 127 million pounds (57,626 mt).

Data and Research Priorities

The Commission's Atlantic Striped Bass Technical Committee identified several research priorities that would improve the management advice offered by striped bass stock assessments. Currently, most striped bass are aged using scales; however, scales tend to under age fish at older ages compared to otoliths (ear bones). Collection of paired scale and otolith samples from individual fish, particularly from larger striped bass, should continue, in order to develop otolith-based age-length keys and scale-otolith conversion matrices. In addition, the model currently treats the migratory striped bass population as a single stock. Incorporating more accurate spatial dynamics and movement patterns of striped bass could improve the accuracy of the model. It would allow for the tracking of population dynamics of regional sub-stocks, which may have different patterns of recruitment and abundance over time.

Other research priorities the Technical Committee identified include additional work on mycobacteriosis (a lethal infection) and its effects on Chesapeake juvenile production and recruitment success, improved estimates of discard mortality and poaching rates, and development of a coastwide fishery-independent index for adult striped bass.

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

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