



Introduction

This document presents a summary of the 2019 stock assessment update for weakfish. This assessment update used the new, calibrated estimates of recreational catch from the Marine Recreational Information Program (MRIP) and added three more years of data to the benchmark assessment model. This assessment is the latest and best information available on the status of the weakfish stock for use in fisheries management.

Management Overview

Weakfish are managed under Amendment 4 to the Interstate Fishery Management Plan for Weakfish and its subsequent addenda (Addendum I-IV). Addendum IV requires states to implement a one fish recreational creel limit, 100 pound commercial trip limit, 100 pound commercial bycatch limit, and 100 undersized fish per trip allowance for the finfish trawl fishery. The Addendum's measures are intended to reduce the level of harvest without creating a large amount of discards and poise the stock for recovery should natural mortality decrease in the future.

What Data Were Used?

The weakfish stock assessment uses both fisheries-dependent and fisheries-independent data, including information on weakfish biology and life history, to determine the current stock condition. Fisheries-dependent data come from recreational and commercial fisheries, while fisheries-independent data are collected through scientific research and surveys.

Life History

Weakfish (*Cynoscion regalis*) occur along the Atlantic coast of North America from Nova Scotia to southeastern Florida, but are more common from New York to North Carolina. Warming of coastal waters in the spring prompts an inshore and northerly migration of adults from their offshore wintering grounds between Chesapeake Bay and Cape Lookout, North Carolina to nearshore sounds, bays, and estuaries. Spawning occurs shortly after, peaking from April to June, with some geographical variation in timing. Females continuously produce eggs during the spawning season and release them over a period of time. In the fall, adults migrate offshore and south as water temperatures get cooler.

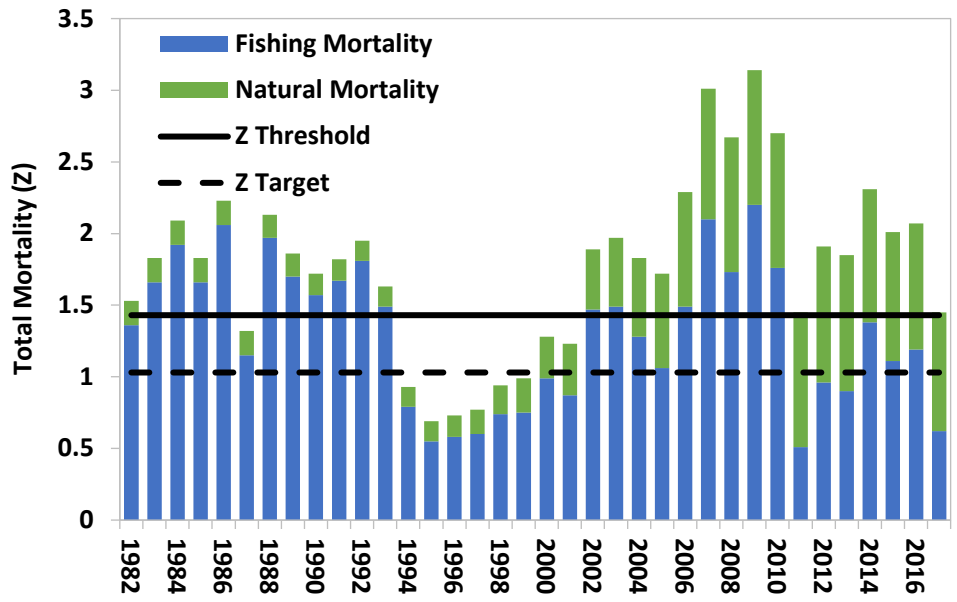
Feeding on microscopic animals, larval weakfish journey from spawning areas to nursery areas, located in deeper portions of coastal rivers, bays, sounds, and estuaries. They remain in these areas from October to December of their first year, after which the juveniles migrate to the coast. Growth in weakfish is especially rapid in the first year and they mature at a young age. Size at age-1 varies but most fish are 10 to 11 inches long. As adults, weakfish are often found near the edges of eelgrass beds, perhaps because weakfish feed primarily on shrimp, other crustaceans, and small fish that are found near these grass beds.

Natural Mortality

Since the early 2000s, the weakfish fishery has experienced decreased catch rates, while the population has experienced a shrinking age structure. Young-of-year (YOY) indices remained relatively steady, but even with very low levels of harvest, the population showed no signs of recovery. This suggested that natural mortality (M) had increased for the stock. The 2009 assessment included several analyses to investigate time-varying M (or changes in M over time) and concluded that, while there was evidence to support an

increase in M, it was not possible to identify a driving factor (e.g. predation, environmental conditions, etc.). The 2016 assessment revisited this issue by looking at several methods to estimate time-varying M, including the relationship between catch and the Atlantic Multidecadal Oscillation and using data on harvest, relative abundance, and catchability to model changes in M. Overall, the different analyses support the hypothesis that M has increased since the mid-1990s, but the underlying cause or causes remain unclear.

Figure 1. Contribution of Natural Mortality to Total Weakfish Mortality

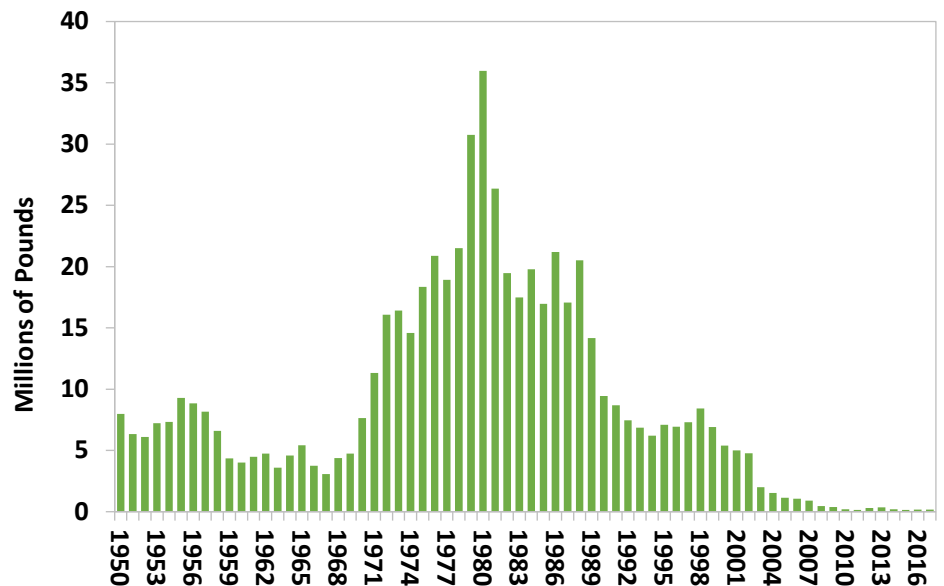


Commercial Data

Weakfish fishery data were evaluated between 1982 and 2017 from four fishery sectors: commercial harvest, commercial discards, recreational harvest, and recreational discards. Commercial harvest data were obtained from state and federal harvest reporting systems through NOAA Fisheries, while recreational harvest statistics were available from MRIP.

Weakfish commercial landings have dramatically declined since the early 1980s, dropping from over 36 million pounds landed in 1980 to roughly 180,560 pounds landed in 2017. The majority of landings occur in North Carolina and Virginia and, since the early 1990s, the primary gear used has been gillnets. Discarding of weakfish by commercial fishermen is known to occur, especially in the northern trawl fishery, and the discard mortality is assumed to be 100%. Discards peaked in the 1990s but have since declined as the result of management measures and a decline in stock abundance.

Figure 2. Weakfish Commercial Landings



Recreational Data

The assessment update used the new, calibrated estimates of recreational catch from MRIP. 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 higher for weakfish.

Calibrated estimates of weakfish recreational landings were 72% higher overall, and calibrated estimates of recreational live releases were 96% higher overall. The percent difference between calibrated and uncalibrated estimates increased over the time series, so that in recent years, calibrated harvest estimates were 152% - 267% higher. Calibrated live release estimates were 130% - 314% higher than uncalibrated live release estimates. Those differences are less pronounced when looking at total recreational removals (landings and release mortality) as shown in Figure 3. Despite the increase in percent difference, the overall trend in landings and live releases was the same between the calibrated and uncalibrated time series.

Like the commercial catch, recreational landings and live releases have declined over time. It is assumed that 10% of weakfish released alive die, so the total recreational removals are equal to the number of weakfish landed plus 10% of the weakfish released alive. Total recreational removals peaked in 1987 at 20.4 million pounds and have since declined, to slightly less than 500,000 pounds in 2017. The proportion of fish alive has increased over time; over the last 10 years, 88% of weakfish were released alive. Most of the recreational catch occurs in the five Mid-Atlantic States between North Carolina and New Jersey.

Figure 3. Total Recreational Removals of Weakfish

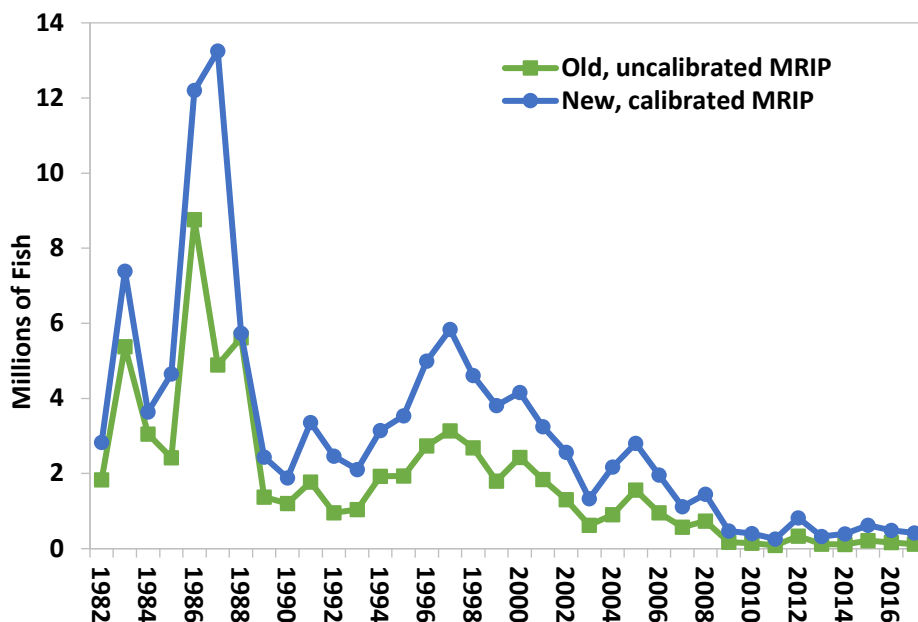
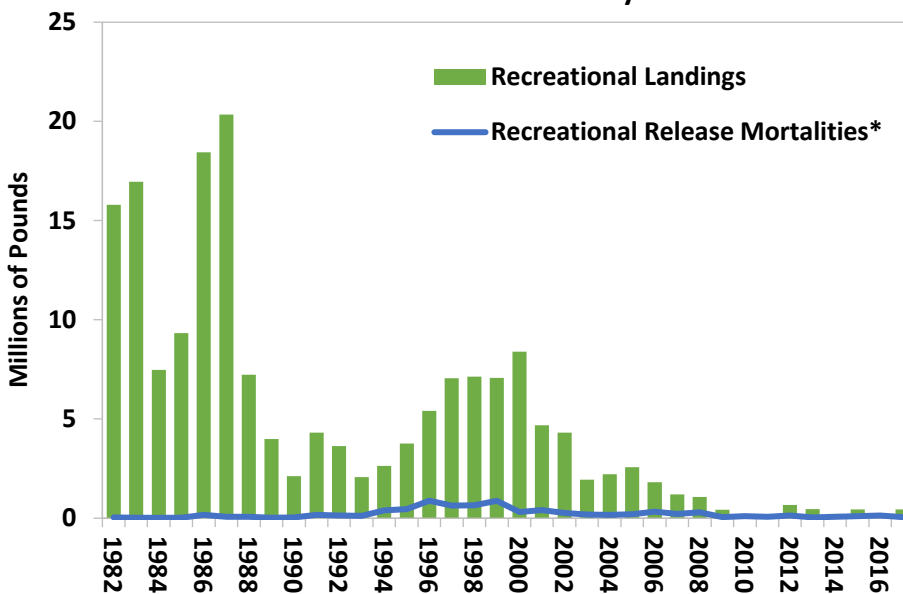


Figure 4. Weakfish Recreational Landings and Release Mortality



* The stock assessment assumes 10% of the released fish died as a result of being caught and released.

A recreational harvest-per-unit effort (HPUE) index was developed from the recreational estimates and used as a fishery-dependent index of abundance. This index showed a peak in the mid-1980s followed by a decline that was reversed in the early to mid-1990s, corresponding to an expansion of the age-structure in the catch. However, the index has declined steadily since 1998 and remains low.

Fishery-independent Data

Out of 45 fishery-independent surveys considered by the Technical Committee during the benchmark stock assessment, 14 were considered suitable for the assessment based on criteria including survey length, geographic range, and sampling methodology.

Seven YOY fishery independent surveys were incorporated into the stock assessment. These include the trawl surveys for juvenile finfish conducted by the states of Rhode Island through North Carolina. A composite index of these surveys showed that YOY has generally varied without trend but was below average at the beginning and the end of the time series.

Seven fishery-independent surveys were used to characterize the abundance of weakfish older than 1 year, including the North Carolina Gill Net Survey, the Delaware Bay Trawl Survey, the New Jersey Ocean Trawl Survey, the Northeast Fisheries Science Center Bottom Trawl Survey, the Southeast Area Monitoring and Assessment Program (SEAMAP), the Chesapeake Bay Multispecies Monitoring and Assessment Program, and the Northeast Area Monitoring and Assessment Program. All of the adult indices showed declines in abundance and a collapse of the age-structure since the early 2000s, with the exception of SEAMAP and the New Jersey Ocean Trawl Survey, which have been more variable and have not shown a strong trend.

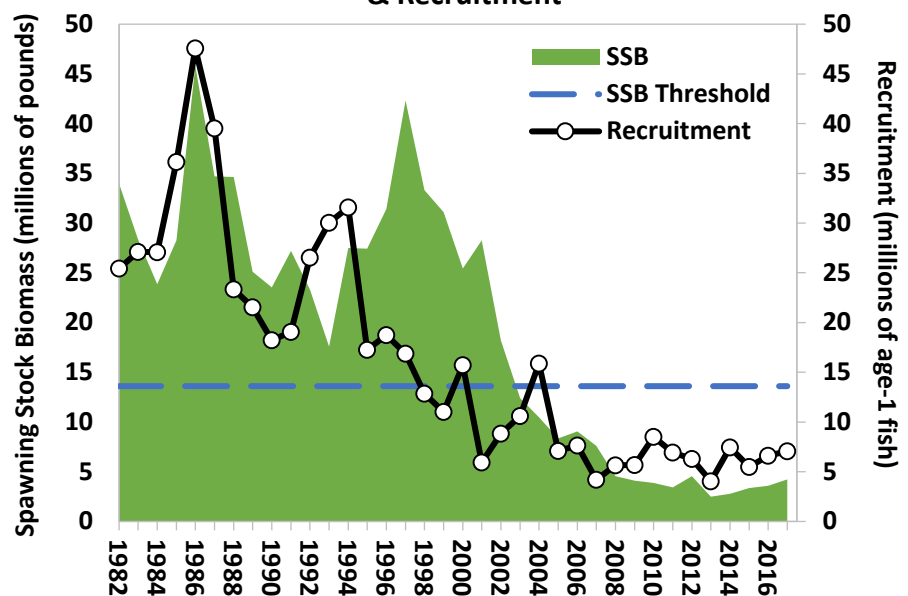
What Models Were Used?

In collaboration with researchers at Virginia Tech, a sophisticated new model was developed to assess weakfish for the 2016 benchmark assessment. This model is similar to the forward-projecting statistical catch-at-age models used to assess other Commission managed species, but uses Bayesian techniques that allowed the Technical Committee to estimate natural mortality, along with recruitment and fishing mortality. The model also incorporates variations in the spatial distribution of the weakfish population by assuming that the population trend being sampled by the various surveys differs based on survey location.

What is the Status of the Stock?

Results of the assessment show that the weakfish stock is depleted and has been since 2003. Under the new reference points proposed in the assessment, the stock is considered depleted when it is below a spawning stock biomass (SSB) threshold of 30% (13.6 million pounds). The threshold is equivalent to 30% of the projected

Figure 5. Weakfish Spawning Stock Biomass (SSB) & Recruitment



total weight of fish in a stock that are old enough to spawn under average natural mortality and no fishing pressure. In 2017, SSB was 4.24 million pounds. The model does indicate some positive signs in the weakfish stock in the most recent years, with a slight increase in SSB and total abundance; however, the stock is still well below the SSB threshold.

The Technical Committee recommends the use of total mortality (Z) benchmarks, which includes fishing mortality and natural mortality, to prevent an increase in fishing pressure when M is high. The assessment proposes a total mortality target of 1.03 and threshold of 1.43. Total mortality in 2014 was 1.45, which is above both the target and the threshold, indicating that total mortality is too high. Natural mortality has been increasing since the early 2000s, but fishing mortality was also high during the mid-to-late 2000s.

Overall, the new MRIP numbers did not cause a significant change between the results of the 2016 benchmark assessment and this assessment update. Estimates of SSB and recruitment were slightly higher while estimates of total mortality were lower for most of the time series with the new MRIP numbers; the pattern was reversed in the most recent years.

Data and Research Needs

The Technical Committee compiled a list of prioritized research needs to improve understanding of weakfish life history and population dynamics as well as aid in the development of future stock assessments. High priority needs include increased observer coverage to identify the magnitude of discards in the commercial fishery and research to identify potential sub-stocks, such as tagging or genetic work. In addition, the Technical Committee recommended developing ecosystem models to look at predation as a potential cause of increasing natural mortality.

Whom Do I Contact For More Information?

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Glossary

Atlantic Multidecadal Oscillation: an ocean current which produces cyclical patterns in sea surface temperature in the North Atlantic over a 65-70 year period.

Bayesian: a branch of logical that uses knowledge of prior events to predict future events.

Bycatch: fish from one species that are caught while fishing for a different species.

Depleted: a stock which has reached critically low biomass or abundance.

Discards: fish returned to the sea dead or alive.

Fishery-Dependent Data: information collected from fishermen and dealers on catch, landings, and effort.

Fishery-Independent Data: information collected by scientists via a long-term research survey or other.

Fishing mortality (F): the instantaneous (not annual) rate at which fish are killed by fishing.

Natural mortality (M): the instantaneous (not annual) rate at which fish die because of natural causes (predation, disease, starvation, etc.).

Overfishing: harvesting from a stock at a rate greater than the stocks reproductive capacity to replace fish removed through harvest.

Spawning stock biomass: the total weight of fishing in a stock that are old enough to spawn.

Statistical catch-at-age (SCAA) model: an age-structured stock assessment model that works forward in time to estimate population size and fishing mortality in each year. It assumes some of the catch-at-age data have a known level of error.

Total mortality (Z): the sum of fishing and natural mortality ($Z=F+M$)

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

References

ASMFC. 2019. Weakfish Stock Assessment Update Report. Atlantic States Marine Fisheries Commission, Stock Assessment Report, 92 p.

<http://www.asmfc.org/uploads/file/5de7fc7c2019WeakfishAssessmentUpdate.pdf>

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

<http://www.asmfc.org/publications/GuideToFisheriesScienceAndStockAssessments.pdf>