

**FISHERY MANAGEMENT PLAN UPDATE
ATLANTIC STRIPED BASS
AUGUST 2020**

STATUS OF THE FISHERY MANAGEMENT PLAN

Fishery Management Plan History

Original FMP Adoption:	October 1981
Amendments:	Amendment 1 – 1984 Amendment 2 – 1984 Amendment 3 – October 1985 Amendment 4 – 1989 October Addendum I – 1991 Addendum II – 1992 Addendum III – 1993 Addendum IV – 1994 Amendment 5 – March 1995 Addendum I – January 1997 Addendum II – October 1997 Source Document to Amendment 5 January 1998 Addendum III – October 1998 Addendum IV – October 1999 Addendum V – January 2001 Amendment 6 – February 2003 Addendum I – November 2007 Addendum II – November 2010 Addendum III – August 2012 Addendum IV – October 2014
Revisions:	None
Supplements:	None
Information Updates:	None
Schedule Changes:	None
Next Benchmark Review:	A benchmark assessment and peer review was completed in 2018. The next benchmark has not been scheduled.

The Atlantic States Marine Fisheries Commission (ASMFC) developed a fisheries management plan (FMP) for Atlantic Striped Bass in 1981 in response to declining juvenile recruitment and landings. The FMP recommended increased restrictions on commercial and recreational fisheries, such as minimum size limits and harvest closures on spawning grounds. Two amendments were passed in 1984 recommending additional management measures to reduce fishing mortality. To strengthen the management response and improve compliance and enforcement, the Atlantic Striped Bass Conservation Act (P.L. 98-613) was passed in late 1984, which mandated the implementation of striped bass regulations passed by the ASMFC, and gave the ASMFC authority to recommend to the Secretaries of Commerce and Interior that states be found out of compliance when they failed to implement management measures consistent with the FMP.

The first enforceable plan, Amendment 3, was approved in 1985, and required size regulations to protect the 1982 year-class, which was the first modest size cohort since the previous decade. The objective was to increase size limits to allow at least 95 percent of the females in the cohort to spawn at least once. Smaller size limits were permitted in producer areas (Albemarle Sound, Chesapeake Bay, Delaware River, and Hudson River) compared to coastal areas, due to socio-economic and/or biological reasons. Several states, beginning with Maryland in 1985, opted for a more conservative approach and imposed a total moratorium on striped bass landings for several years. The amendment contained a trigger mechanism to reopen the fisheries when the three-year moving average of the Maryland juvenile abundance index (JAI) exceeded an arithmetic mean of 8.0. That level was attained with the recruitment of the 1989-year class.

Consequently, Amendment 4 was adopted to allow state fisheries to reopen in 1990 under a target fishing mortality (F) of 0.25, which was half the estimated F needed to achieve maximum sustainable yield (MSY). The amendment allowed an increase in the target F once spawning stock biomass (SSB) was restored to levels estimated during the late 1960s and early 1970s. The dual size limit concept was maintained, and a recreational trip limit and commercial season implemented to reduce the harvest to 20 percent of that in the period of 1972-1979. The amendment and its four addenda aimed to rebuild the resource, rather than maximize yield.

In 1995, coastal striped bass were declared restored by the ASMFC, and Amendment 5 was adopted to increase the target F to 0.33, midway between the existing F target (0.25) and FMSY, which was revised to 0.40. Regulations were developed to allow 70 percent of the historic harvest and achieve the target F, although states could submit proposals for alternative regulations that were conservationally equivalent. From 1997 to 2000, a series of five addenda were implemented to respond to the latest stock status information.

Striped bass stocks in North Carolina also experienced harvest declines and juvenile recruitment failures in the 1970s and 1980s. The North Carolina Marine Fisheries Commission (NCMFC) and the North Carolina Wildlife Resources Commission (NCWRC) implemented a Memorandum of Agreement in 1990 to address management of striped bass in the Albemarle Sound and Roanoke River. The seriousness of the situation resulted in implementation of harvest restrictions and Congressionally-mandated studies (N.C. Striped Bass Study Management Board 1991, U.S. Fish and Wildlife Service 1992). Studies funded by Congress and resource management agencies indicated that rates of harvest during the 1980s were likely too high to

allow stock recovery. Studies commissioned by the N.C. Striped Bass Study Management Board (Dorazio 1993) and by independent investigators (Hightower 1994, Richkus et al. 1991) all determined that rates of harvest mortality exceeded those which will allow recovery as recommended for other Atlantic Coast stocks. The original Estuarine Striped Bass FMP was approved by the NCMFC in 1994 and was targeted at the continued recovery of the A-R stock, which at the time was at historically low levels of abundance and was experiencing chronic spawning failures (Laney et. al. 1993). The comprehensive plan addressed the management of all estuarine stocks of striped bass in the state, satisfying the recommendation contained in the Report to Congress for the North Carolina Striped Bass Study (U.S. Fish and Wildlife Service 1992) that such a plan be prepared. The Albemarle-Roanoke stock of striped bass was declared restored in 1997, and is currently assessed by an independent stock assessment by the State of North Carolina using catch and abundance data specific to the A-R stock. The stock is managed with ASMFC Striped Bass Management Board approval through a separate, state produced North Carolina Estuarine Striped Bass FMP (ASMFC 2014; NCDMF 2014).

In 2003, Amendment 6 was adopted to address five limitations within the management program: 1) potential inability to prevent the Amendment 5 exploitation target from being exceeded; 2) perceived decrease in availability or abundance of large striped bass in the coastal migratory population; 3) a lack of management direction with respect to target and threshold biomass levels; 4) inequitable effects of regulations on the recreational and commercial fisheries, and coastal and producer area sectors; 5) and excessively frequent changes to the management program. Amendment 6 was fully implemented by January 1, 2004, and completely replaced all previous plans for Atlantic striped bass (ASMFC 2003).

Amendment 6 modified the F targets and thresholds, and introduced a new set of biological reference points (BRPs) based on a threshold level of female spawning stock biomass (SSB) set at the level of abundance in 1995, and a target of 125% the 195 level, as well as a list of management triggers based on the BRPs. The coastal commercial quotas for striped bass were restored to 100 percent of the states' average landings during the 1972-1979 period, except for Delaware's coastal commercial quota, which remained at the level allocated in 2002. In the recreational fisheries, all states were required to implement a two-fish bag limit with a minimum size limit of 28-inches total length, except for the Chesapeake Bay fisheries, fisheries that operate in the Albemarle Sound and Roanoke River, and states with approved alternative regulations. The Chesapeake Bay and Albemarle-Roanoke regulatory programs were predicated on a more conservative F target than the coastal migratory stock, which allowed these jurisdictions to implement separate seasons, harvest caps, and size and bag limits if they remain under that F target. No minimum size limit can be less than 18-inches total length under Amendment 6. The same minimum size standards regulate the commercial fisheries as the recreational fisheries, except for a minimum 20-inches total length size limit in the Delaware Bay spring gillnet fishery.

States are permitted the flexibility to deviate from these standards by submitting proposals for review by the striped bass Technical Committee, Advisory Panel, and Plan Review Team and contingent upon the approval of the Management Board. A state may request a change only if it can demonstrate that the action is "conservationally equivalent" to the management standards or will not contribute to the overfishing of the resource. This practice has resulted in a variety of regulations among states.

In 2007, Addendum I was implemented to establish a bycatch monitoring and research program to increase the accuracy of data on striped bass discards and recommend development of a web-based angler education program.

In May 2009, the Management Board initiated the development of an addendum to consider options to roll over unused coastal commercial quota up to 50 percent, and approved sending the draft addendum out for public comment in August 2009. In November 2009, the Board voted for status quo management in regards to unused quota rollover.

In February 2010, the Management Board initiated the development of an addendum to consider options to increase the coastal commercial quota. The Board approved the draft addendum for public comment in May 2010, with the addition of an option to consider adopting a Technical Committee recommendation to revise the JAI management trigger. Adopting the Technical Committee recommendation would modify the definition of recruitment failure, such that each index would have a fixed numerical value indicating failure, rather than one that changes from year to year. The Board approved Addendum II, and the revised JAI management triggers, in November 2010 but did not take any action to increase the coastal commercial quota. The new definition of recruitment failure is a value that is below 75 percent of all values in a fixed time series appropriate to each juvenile abundance index.

In 2012, Addendum III was approved by the Board. The addendum was initiated in response to significant poaching events in the Chesapeake Bay and aims to limit illegal commercial harvest of striped bass. An investigation revealed that some of the control measures in place for regulating the harvest of striped bass were ineffective or inadequately designed to maximize compliance. The investigation also found that greater accountability of wholesalers would be difficult to achieve without uniform tags (colors, design) and tagging requirements, valid year and size limits inscribed on tags, and increased dealer compliance education. This addendum required all states and jurisdictions with a commercial fishery to make their commercial harvest tagging programs more consistent and comply with the recommendations by the Interstate Watershed Task Force (IWTF) and ASMFC Law Enforcement Committee (LEC) on reducing illegal harvest of striped bass.

The Board approved Addendum IV in 2014 in response to the 2013 benchmark assessment which indicated a steady decline in spawning stock biomass since the mid-2000s. The Addendum established new fishing mortality reference points (F target and threshold) still based on the level of SSB in 1995, and required coastal states to reduce removals and decrease F to a level at or below the new target (i.e., 25 percent reduction from 2013 removals for the coastal fishery and 20.5 percent reduction from 2012 removals for Chesapeake Bay fishery). Additionally, since current analysis of tag return data indicates the Albemarle-Roanoke stock contributes minimally to the coastwide complex, Addendum IV defers management of the Albemarle-Roanoke stock to the State of North Carolina using stock-specific BRPs approved by the Management Board. The 18-inch total length minimum size limit still applies.

The Exclusive Economic Zone (EEZ) has been closed to the harvest and possession of striped bass since 1990, except for a defined route to and from Block Island in Rhode Island. A

recommendation was made in Amendment 6, and submitted to the Secretary of Commerce, to re-open federal waters to commercial and recreational fisheries. Starting in July 2003 and continuing for several years, the National Oceanic and Atmospheric Administration (NOAA) Fisheries took steps in the rulemaking process to consider the proposal. In September 2006, NOAA Fisheries concluded that it would be imprudent to open the EEZ to striped bass fishing and chose not to proceed further in its rulemaking. Specifically, NOAA Fisheries concluded that: 1) it could not be certain, especially after taking into account the overwhelming public perception that large trophy sized fish congregate in the EEZ, that opening the EEZ would not increase effort and lead to an increase in mortality that would exceed the threshold, and 2) both the ASMFC's and NOAA Fisheries' ability to immediately respond to an overfishing and/or overfished situation is a potential issue, particularly given the timeframe within which Amendment 6 was created, and given the lag time in which a given year's data is available to management (71 FR 54261-54262). Additionally, in October 2007, President George W. Bush issued an Executive Order (E.O. 13449) prohibiting the sale of striped bass (and red drum) caught within the EEZ. The Order also requires the Secretary of Commerce to encourage management for conservation of the resources, including State designation as gamefish where the State determines appropriate under applicable law, and to periodically review the status of the populations within US jurisdictional waters.

To ensure compliance with interstate requirements, North Carolina also includes Atlantic Striped Bass under the North Carolina Fishery Management Plan for Interjurisdictional Fisheries (IJ FMP). The goal of the IJ FMP is to adopt fishery management plans, consistent with N.C. law, approved by the Mid-Atlantic Fishery Management Council, South Atlantic Fishery Management Council, or the ASMFC by reference and implement corresponding fishery regulations in North Carolina to provide compliance or compatibility with approved fishery management plans and amendments, now and in the future. The goal of these plans, established under the Magnuson-Stevens Fishery Conservation and Management Act (federal council plans) and the Atlantic Coastal Fisheries Cooperative Management Act (ASMFC plans) are like the goals of the Fisheries Reform Act of 1997 to “ensure long-term viability” of these fisheries (NCDMF 2015).

Management Unit

Migratory stocks of Atlantic striped bass from Maine through North Carolina. In North Carolina the striped bass stocks in the Tar-Pamlico, Neuse, and Cape Fear rivers are considered estuarine and non-anadromous, and are not managed through the ASMFC FMP, rather they are managed under the NC Estuarine Striped Bass FMP (NCDMF 2013).

Goal and Objectives

The goal of Amendment 6 is to perpetuate, through cooperative interstate management, migratory stocks of Striped bass; to allow commercial and recreational fisheries consistent with the long-term maintenance of a broad age structure, a self-sustaining spawning stock; and also to provide for the restoration and maintenance of their essential habitat. In support of this goal, the following objectives are included:

1. Manage Striped bass fisheries under a control rule designed to maintain stock size at or above the target female spawning stock biomass level and a level of fishing mortality at or below the target exploitation rate.
2. Manage fishing mortality to maintain an age structure that provides adequate spawning potential to sustain long-term abundance of Striped bass populations.
3. Provide a management plan that strives, to the extent practical, to maintain coastwide consistency of implemented measures, while allowing the States defined flexibility to implement alternative strategies that accomplish the objectives of the FMP.
4. Foster quality and economically viable recreational, for-hire, and commercial fisheries.
5. Maximize cost effectiveness of current information gathering and prioritize state obligations in order to minimize costs of monitoring and management.
6. Adopt a long-term management regime that minimizes or eliminates the need to make annual changes or modifications to management measures.
7. Establish a fishing mortality target that will result in a net increase in the abundance (pounds) of age 15 and older striped bass in the population, relative to the 2000 estimate.

STATUS OF THE STOCK

Life History

Striped bass are the largest member of the Moronidae family, the temperate basses, which also includes white perch, white bass and yellow bass. Striped bass are a riverine and estuarine dependent species native from the St. Lawrence River in Canada down to the St. Johns River in Florida, and through the Gulf of Mexico, although the striped bass found in the Gulf of Mexico is a genetically distinct species. The migratory striped bass stocks from Maine through the A-R stock in North Carolina are managed under the jurisdiction of the ASMFC. Stocks south of the Albemarle sound are considered estuarine and non-migratory and are not under ASMFC jurisdiction.

Atlantic striped bass under ASMFC jurisdiction 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 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. There are two, distinct life history strategies for striped bass from the Chesapeake Bay, Delaware, Hudson, and A-R stocks. One group consists of mostly females and participate in extensive coastal migrations. Fish travel north as far as Maine and Canada in the spring after spawning takes place, then as water temperatures drop they move south in the winter where they overwinter off the VA/NC coast before going to their natal rivers to spawn again in the spring. The other group is mostly resident fish and the majority are males, inhabiting the estuaries and near-shore ocean within their natal systems.

Based on sampling efforts from the Chesapeake Bay, 45% of female striped bass mature at age 6 and 100% mature by age 9. The latest maturity study for the A-R stock determined 29% of female striped bass are mature at age 3, 97% are mature at age 4, and 100% are mature at age 5 (Boyd 2011). The oldest striped bass on record is 31 years old, but they would likely live longer than that in the absence of fishing pressure. The oldest fish observed in the Albemarle-Roanoke stock is 24 years old.

Stock Status

On a regular basis, female spawning stock biomass (SSB) and fishing mortality rate (F) are estimated and compared to target and threshold levels (i.e., biological reference points) in order to assess the status of the stock. The 1995 estimate of female SSB is currently used as the SSB threshold because many stock characteristics, such as an expanded age structure, were reached by this year, and this is also the year the stock was declared recovered. The female SSB target is equal to 125% female SSB threshold. The associated F threshold and target are calculated to achieve the respective SSB reference points in the long term.

In May 2019, the Board accepted the 2018 Benchmark Stock Assessment and Peer Review Report for management use. The accepted model is a forward projecting statistical catch-at-age model, which uses catch-at-age data and fishery-dependent data and fishery-independent survey indices to estimate annual population size, fishing mortality, and recruitment. The assessment indicated the resource is overfished and experiencing overfishing relative to the updated reference points. Female SSB in the terminal year (2017) was estimated at 151 million pounds, which is below the SSB threshold of 202 million pounds. F in 2017 was estimated at 0.31, which is above the F threshold of 0.24.

The assessment also indicated a period of strong recruitment (numbers of age-1 fish entering the population) from 1994-2004, following by a period of low recruitment from 2005-2011 which likely contributed to the decline in SSB in recent years. Recruitment was high in 2012, 2015, and 2016. In 2017, estimated at 108.8 million age-1 fish in 2017 which is below the time series average of 140.9 million fish.

Stock Assessment

As shown in Figure 1, 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.

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 $SSB_{Threshold} = \text{female } SSB_{1995} = 127$ million pounds and $SSB_{Target} = 125\% \text{ female } SSB_{1995} = 159$ 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 $SSB_{Target} = F_{Target} = 0.18$.

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. 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 2018 updated fishing mortality threshold was estimated at 0.24, and the target was estimated at 0.20 (Figure 2).

STATUS OF THE FISHERY

Current Regulations

Striped bass regulations in the North Carolina coastal waters (0-3 miles) of the Atlantic Ocean are under the jurisdiction of ASMFC, while striped bass regulations in North Carolina's inshore coastal (i.e. estuarine), joint, and inland waters are under the jurisdiction of the North Carolina Division of Marine Fisheries and Wildlife Resources Commission. Striped bass regulations in the EEZ are under the jurisdiction of the NOAA Fisheries. Commercial and recreational harvest of striped bass is not allowed in the EEZ, which is from three to 200 miles offshore. Striped bass cannot even be targeted for recreational catch-and-release fishing in the EEZ.

In North Carolina, commercial harvest is currently constrained by a 360,360 pound annual quota and a 28-inch total length minimum length size limit. The quota is split evenly between three gears: ocean beach seine, ocean gill net, and ocean trawl. Usually only one gear is open at a time and any quota overages in a gear are taken away from the offending gear during the next year. Atlantic striped bass overwinter in North Carolina ocean waters during the winter months, from December through February, therefore the quota year is set from December 1 through November 30 each year.

Recreational harvest is constrained by a one fish per person daily possession limit and a 28 to 35 inch total length slot limit. When striped bass are inside state coastal waters they form large schools that are easily accessed by anglers, and harvest can be significant with releases even larger.

The Atlantic Ocean waters from about Oregon Inlet to the N.C./V.A. state line are the southernmost extension of the overwintering grounds for Atlantic striped bass. Therefore, annual landings are dependent on how far down and offshore striped bass stocks migrate each winter. Since 2011 striped bass have been farther north and offshore than normal. In recent years large

schools of striped bass have been up to 30 miles offshore. Since 2012 there has been no commercial or recreational harvest of overwintering migratory striped bass in North Carolina's coastal ocean waters during the winter months.

Commercial Landings

Commercial landings of striped bass in the Atlantic Ocean have been controlled by a quota since 1991. Due to the relatively small individual gear quota and the ability to harvest tens of thousands of pounds in just a single day, specific gear overages were common, but the overall quota was rarely exceeded. Landings reached the quota in most years and averaged 361,555 pound a year from 1995/1996-2006/2007. Starting in 2008/2009 shifting migratory patterns and decreasing stock abundance led to less availability of fish inside three miles. Since 2012/2013 no striped bass have been landed from the Atlantic Ocean because striped bass have stayed outside of three miles and in southern Virginia waters while overwintering (Tables 1 and 2, Figure 3).

Recreational Landings

Recreational landings were low through the early 2000s. As the Atlantic striped bass stock recovered and abundance increased, recreational landings increased as well, with peak landings of 6.6 million pounds in 2004 (Table 1; Figure 3). When striped bass are inside state coastal waters they form large schools that are easily accessed by anglers, and harvest can be significant and releases even larger. Landings have fluctuated since, often due to winter weather conditions and the migratory behavior in the near shore ocean during January and February. From 2001 to 2011 landings averaged about 2.3 million pounds. Due to the stocks being outside of three miles and not migrating down into North Carolina state waters in recent years, no recreational landings have occurred since 2012 (Table 1 Figure 3.).

The NCDMF offers award citations for exceptional catches of striped bass. Most citations are from fish caught in the Atlantic Ocean. Striped bass that measure greater than 45 inches total length or 35 pounds are eligible for an award citation. Citations peaked in 2004 at over 700 but have declined to near zero since 2011 due to shifting overwintering patterns (Figure 4).

MONITORING PROGRAM DATA

Fishery-Dependent Monitoring

The length, weight, sex, and age composition of the commercial harvest has been consistently monitored through sampling at fish houses conducted by the division since 1982. The annual harvest quota is split equally between three gear types, beach seine, gill net, and trawl. Any overages from one year are deducted from next year's quota (Table 2). Because of the 28-inch total length minimum size limit and gear regulations, most fish harvested average about 38-inches total length (Table 3; Figure 5). North Carolina also augments NOAA Fisheries Marine Recreational Information Program (MRIP) by providing additional funding for increased samplers, which estimates the annual harvest and releases of marine recreational fisheries. Mean total length is usually around 36-inches, with fish as large as 51-inches measured. Total number

of fish measured for 2006-2011 ranged from 67 to 609. There has been no estimated harvest (and therefore no fish measured) since 2012 (Table 4; Figure 6).

Fishery-Independent Monitoring

North Carolina has no fishery independent sampling indices of abundance for Atlantic striped bass. However, we do participate in the coastwide striped bass tagging program administered through the United States Fish and Wildlife Service (USFWS). In 2011, the DMF started contracting charter trips to collect striped bass using hook-and-line gear to tag striped bass on their overwintering grounds, usually in the vicinity of the VA/NC border. Tagging takes place in January and/or February. Dates and actual location of tagging are dependent on striped bass annual migration patterns. Tags used are USFWS tags and all tagging information is housed in the USFWS tagging database. The striped bass Winter Cooperative Tagging Program is a critical component of overall coastwide striped bass management, as it is the only tagging program that tags the mixed, migratory stock on their overwintering grounds (off the VA/NC coast, from the mouth of the Chesapeake Bay down to Oregon Inlet). This means that fish from all producer areas, including Chesapeake Bay, Delaware River, Hudson River, and A-R stocks are available for tagging. Tag returns provide managers with an estimate of the percent contribution of the individual producer areas to the migratory portion of the stock and fishing mortality on the stock. Length frequencies average about 37-inches total length, and about 1,000 fish are collected each year (Table 5). Nearly all of these fish are large, mature females that are staging on their overwintering grounds in preparation for the spring spawning run to their respective spawning grounds.

In order to describe the age structure of harvest and indices, striped bass age structures are collected from various fishery independent (scientific surveys) and dependent (fisheries) sources throughout the year. The length at age data for striped bass display an increasing length at age for striped bass up to about 40 inches in length, although the length at age overlaps between similar ages (Table 6; Figure 7).

MANAGEMENT STRATEGY

Atlantic striped bass are managed under Amendment 6 (and subsequent addenda) to ASMFC's Interstate FMP for Atlantic Striped Bass. The plan identifies spawning stock biomass and fishing mortality reference points to maintain adequate stock size and age structure, and to prevent overfishing. Stock status is determined by a formal, peer reviewed statistical catch-at-age stock assessment. The FMP requires several independent and dependent monitoring programs to be in place in each state, although these programs vary by state. States have the flexibility to implement different size limits, bag limits, and commercial quotas, if they are deemed to meet conservation equivalency by the Technical Committee and are approved by the Management Board.

RESEARCH NEEDS

The following management issues and research needs are identified in Amendment 6 and from the peer reviewed stock assessment.

Fishery Dependent Priorities

High

- Continue collection of paired scale and otolith samples, particularly from larger striped bass, to facilitate the development of otolith-based age-length keys for scale-otolith conversion matrices.

Moderate

- Develop studies to provide information on gear specific discard mortality rates and to determine the magnitude of bycatch mortality.
- Improve estimates of striped bass harvest removals in coastal areas during wave 1 and in inland waters of all jurisdictions year round.
- Evaluate the percentage of fishermen using circle hooks.

Fishery Independent Priorities

Moderate

- Develop a refined and cost-efficient, fisheries-independent coastal population index for striped bass stocks.
 - The PRT recommends the SBTC be tasked with exploring whether the Cooperative Winter Tagging Cruise, NEAMAP, and/or NOAA Fisheries Trawl Survey datasets would prove useful in this respect.

Modeling/Quantitative Priorities

High

- Develop a method to integrate catch-at-age and tagging models to produce a single estimate of F and stock status.
- Develop a spatially and temporally explicit catch-at-age model incorporating tag based movement information.
 - The PRT recommends that the SAS be tasked with reviewing recent published literature examining tag-based movement information to see if they would contribute to the development of such a model (e.g., Callihan et al., 2014).
- Review model averaging approach to estimate annual fishing mortality with tag based models. Review validity and sensitivity to year groupings.
- Develop methods for combining tag results from programs releasing fish from different areas on different dates.
- Examine potential biases associated with the number of tagged individuals, such as gear specific mortality (associated with trawls, pound nets, gill nets, and electrofishing), tag induced mortality, and tag loss.
- Develop field or modeling studies to aid in estimation of natural mortality or other factors affecting the tag return rate.

Moderate

- Develop maturity ogives applicable to coastal migratory stocks.
- Examine methods to estimate annual variation in natural mortality.
- Develop reliable estimates of poaching loss from striped bass fisheries.

- Improve methods for determining population sex ratio for use in estimates of SSB and biological reference points.
- Evaluate truncated matrices and covariate based tagging models.

Low

- Examine issues with time saturated tagging models for the 18-inch length group.
- Develop tag based reference points

Life History, Biological, and Habitat Priorities

High

- Continue in-depth analysis of migrations, stock compositions, etc. using mark-recapture data.
- Continue evaluation of striped bass dietary needs in relation to health condition.
- Continue analysis to determine linkages between the mycobacteriosis outbreak in Chesapeake Bay and sex ration of Chesapeake spawning stock, Chesapeake juvenile production, and recruitment success into coastal fisheries.

Moderate

- Examine causes of different tag based survival estimates among programs estimating similar segments of the population.
- Continue to conduct research to determine limiting factors affecting recruitment and possible density implications.
- Conduct study to calculate the emigration rates from producer areas now that population levels are high and conduct multi-year study to determine inter-annual variation in emigration rates.

Low

- Determine inherent viability of eggs and larvae.
- Conduct additional research to determine the pathogenicity of the IPN virus isolated from striped bass to other warm water marine species, such as flounder, menhaden, shad, and largemouth bass.

Management, Law Enforcement, and Socioeconomic Priorities

Moderate

- Examine the potential public health trade-offs between the continued reliance on the use of high minimum size limits (28-inches) on coastal recreational anglers and its long-term effects on enhanced PCB contamination among recreational stakeholders.
- Evaluate striped bass angler preferences for size of harvested fish and trade-offs with bag limits.

Habitat Recommendations

- Passage facilities should be designed specifically for passing striped bass for optimum efficiency at passing this species.
- Conduct studies to determine whether passing migrating adults upstream earlier in the year in some rivers would increase striped bass production and larval survival, and opening

downstream bypass facilities sooner would reduce mortality of early emigrants (both adult and early-hatched juveniles).

- All state and federal agencies responsible for reviewing impact statements and permit applications for projects or facilities proposed for striped bass spawning and nursery areas shall ensure that those projects will have no or only minimal impact on local stocks, especially natal rivers of stocks considered depressed or undergoing restoration.
- Federal and state fishery management agencies should take steps to limit the introduction of compounds which are known to be accumulated in “striped bass tissues and which pose a threat to human health or striped bass health.
- Water quality criteria for striped bass spawning and nursery areas should be established, or existing criteria should be upgraded to levels that are sufficient to ensure successful striped bass reproduction.
- Each state should implement protection for the striped bass habitat within its jurisdiction to ensure the sustainability of that portion of the migratory stock. Such a program should include inventory of historical habitats. Identification of habitats presently used, specification areas targeted for restoration, and imposition or encouragement of measures to retain or increase the quantity and quality of striped bass essential habitats.
- States in which striped bass spawning occurs should make every effort to declare striped bass spawning and nursery areas to be in need of special protection, such as declaration should be accompanied by requirements of non-degradation of habitat quality, including minimization of non-point source runoff, prevention of significant increases in contaminant loadings, and prevention of the introduction of any new categories of contaminants into an area. For those agencies without water quality regulatory authority, protocols and schedules for providing input on water quality needs of striped bass stocks are met.
- ASMFC should designate important habitats for striped bass spawning and nursery areas as HAPC.
- Each state should survey existing literature and data to determine the historical extent of striped bass occurrence and use within its jurisdiction. An assessment should be conducted of those areas not presently used for which restoration is feasible.

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TABLES

Table 1. Striped bass recreational harvest and number released (Marine Recreational Information Program) and commercial harvest (North Carolina Trip Ticket Program) from the Atlantic Ocean, North Carolina, for calendar year 1982-2019. All weights are in pounds.

Year	Recreational			Commercial	
	Numbers		Weight (lb)	Numbers	
	Landed	Released		Landed	Weight (lb)
1982	0	0	0	3,200	92,462
1983	0	0	0	1,405	52,796
1984	0	0	0	532	14,501
1985	0	0	0	0	0
1986	0	0	0	0	0
1987	0	0	0	0	0
1988	510	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	803	9,797
1991	1,032	0	10,240	413	6,186
1992	2,680	928	0	1,745	27,702
1993	531	2,115	6,084	3,414	36,463
1994	6,543	6,340	89,819	7,956	139,672
1995	16,479	28,169	232,043	23,387	344,627
1996	31,709	98,285	391,588	3,289	58,217
1997	60,074	102,395	865,306	25,820	463,144
1998	41,236	130,531	636,090	14,213	272,969
1999	26,388	50,032	339,092	21,119	391,482
2000	18,108	41,812	276,814	6,465	162,369
2001	60,700	23,264	1,081,940	24,955	381,115
2002	56,330	47,328	997,649	23,242	441,018
2003	50,418	19,006	965,671	5,769	201,199
2004	323,239	246,671	6,655,565	31,041	605,356
2005	194,854	179,323	3,947,042	27,288	604,464
2006	134,184	37,204	2,975,348	2,718	74,189
2007	81,777	22,486	1,965,111	16,798	379,467
2008	36,877	26,405	749,673	13,369	288,410
2009	6,548	1,001	186,729	9,030	189,963
2010	67,144	51,400	1,197,988	13,664	276,435
2011	207,610	245,287	4,467,159	10,867	246,366
2012	0	0	0	333	7,281
2013	0	0	0	0	0
2014	0	0	0	0	0
2015	0	0	0	0	0
2016	0	39,248	0	0	0
2017	0	5,149	0	0	0
2018	0	3,490	0	0	0
2019	0	0	0	0	0
Average	38,513	38,051	757,755	7,914	155,882

ASMFC AND FEDERALLY-MANAGED SPECIES WITH N.C. INDICES – ATLANTIC STRIPED BASS

Table 2. Striped bass commercial harvest (pounds) by gear (North Carolina Trip Ticket Program) from the Atlantic Ocean, North Carolina, based on a fishing year beginning December 1 and ending November 30. The fishing year management strategy began with the implementation of a coastwide (states from Maine to North Carolina) commercial quota in 1991.

Fishing Year	Beach Seine	Gill Net	Trawl	Total Landings	Fishing Year Quota
1991/1992				6,186	96,000
1992/1993				27,702	96,000
1993/1994				75,671	96,000
1994/1995	64,077	54,576	4,531	123,184	96,000
1995/1996	163,519	130,280	36,250	330,049	334,000
1996/1997	76,558	95,337	184,192	356,187	334,000
1997/1998	155,633	104,551	92,316	352,500	*312,827
1998/1999	68,920	330,784	0	399,727	*299,954
1999/2000	61,149	2,055	100,910	164,114	*218,000
2000/2001	62,969	117,457	168,456	348,882	336,000
2001/2002	100,718	113,515	84,795	299,028	*326,787
2002/2003	226,023	93,346	108,141	427,510	480,480
2003/2004	0	201,025	220,166	421,191	480,480
2004/2005	181,552	233,772	37,598	452,922	480,480
2005/2006	330,429	981	17,797	349,207	480,480
2006/2007	0	326,328	98,373	424,701	480,480
2007/2008	86,150	138,894	74,118	299,162	480,480
2008/2009	4,888	51,677	133,430	189,995	480,480
2009/2010	4,097	71,664	196,657	272,418	480,480
2010/2011	6,646	139,377	104,360	250,383	480,480
2011/2012	0	5,101	2,181	7,282	480,480
2012/2013	0	0	0	0	480,480
2013/2014	0	0	0	0	480,480
2014/2015	0	0	0	0	360,360
2015/2016	0	0	0	0	360,360
2016/2017	0	0	0	0	360,360
2017/2018	0	0	0	0	360,360
2018/2019	0	0	0	0	360,360

*Fishing year quotas adjusted for previous year's overage.

ASMFC AND FEDERALLY-MANAGED SPECIES WITH N.C. INDICES – ATLANTIC STRIPED BASS

Table 3. Summary of striped bass total length (inches) samples collected from commercial fisheries from the Atlantic Ocean, North Carolina, 1981/1982-2018/2019.

Year	Mean Total Length	Minimum Total Length	Maximum Total Length	Total Number Measured
1981/1982	43	38	48	53
1982/1983	43	35	50	221
1983/1984	44	29	52	7
1990/1991	31	27	38	203
1991/1992	33	28	51	241
1992/1993	31	24	46	135
1993/1994	33	26	51	351
1994/1995	35	30	39	51
1995/1996	35	22	43	211
1996/1997	35	28	45	358
1997/1998	33	28	40	183
1998/1999	36	29	42	191
1999/2000	37	30	44	290
2000/2001	35	28	43	256
2001/2002	38	29	47	249
2002/2003	36	23	43	573
2003/2004	37	29	47	400
2004/2005	38	29	46	717
2006/2007	38	28	48	843
2007/2008	39	29	49	317
2008/2009	39	30	49	175
2009/2010	37	28	50	456
2010/2011	36	28	48	388
2011/2012	38	34	47	21
2012/2013				0
2013/2014				0
2014/2015				0
2015/2016				0
2016/2017				0
2017/2018				0
2018/2019				0

ASMFC AND FEDERALLY-MANAGED SPECIES WITH N.C. INDICES – ATLANTIC STRIPED BASS

Table 4. Striped bass total length (inches) data from Marine Recreational Information Program recreational fishery samples, Atlantic Ocean, North Carolina, 1991-2019.

Year	Mean Fork Length	Minimum Fork Length	Maximum Fork Length	Total Number Measured
1991	685	685	685	1
1992	848	848	848	1
1993	802	802	802	1
1994	733	501	892	19
1995	817	720	1,058	69
1996	782	293	990	135
1997	788	483	1,018	229
1998	807	458	1,083	272
1999	770	488	1,076	182
2000	792	482	1,091	113
2001	830	471	1,091	267
2002	828	473	1,098	318
2003	905	584	1,152	614
2004	907	536	1,279	1,800
2005	914	706	1,168	1,106
2006	920	708	1,145	372
2007	965	722	1,178	375
2008	902	722	1,204	303
2009	1,005	725	1,253	67
2010	858	708	1,302	95
2011	913	683	1,244	609
2012				0
2013				0
2014				0
2015				0
2016				0
2017				0
2018				0
2019				0

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Table 5. Striped bass total length (inches) and tagging data from the Cooperative Winter Tagging Program, trawl and hook-and-line gear, 1988-2019.

Year	Number tagged		Mean Total Length		Minimum Total Length		Maximum Total Length	
	H&L	Trawl	H&L	Trawl	H&L	Trawl	H&L	Trawl
1988		1,338		25		17		53
1989		1,156		27		20		46
1990		2,010		25		14		48
1991		1,780		28		20		40
1992		1,016		28		17		39
1993		530		26		17		39
1994		4,631		23		14		49
1995		644		29		15		42
1996		698		30		11		44
1997		1,356		29		16		45
1998		462		25		18		49
1999		277		30		3		43
2000		6,236		20		13		42
2001		2,447		25		15		44
2002		4,087		23		15		47
2003		1,908		31		11		48
2004		2,708		25		14		47
2005		4,263		23		12		44
2006		4,462		28		12		48
2007		370		32		19		48
2008		1,033		34		21		47
2009		146		32		22		45
2010		567		30		12		43
2011	*108	**	32		26		43	
2012	*6	**	36		25		46	
2013	1,114	893	37	33	26	24	49	47
2014	921	**	37		27		53	
2015	1,042	333	38	35	29	22	52	42
2016	1,241	110	39	38	23	24	48	43
2017	881	**	40		21		50	
2018	667	**	41		29		52	
2019	44		40		31		45	

* Only one hook-and-line sampling trip was taken due to a lack of funding. 2011 was the first year charter boats were used as the sampling platform and hook-and-line was used as the sampling gear.

** No trips using the traditional research vessel sampling platform and trawl gear were taken due to a lack of funding.

ASMFC AND FEDERALLY-MANAGED SPECIES WITH N.C. INDICES – ATLANTIC STRIPED BASS

Table 6. Summary of striped bass age samples collected from the Atlantic Ocean from both dependent (commercial and recreational fisheries) and independent (surveys) sources 1982 to 2019.

Year	Modal Age	Minimum Age	Maximum Age	Total Number Aged
1981	10	4	17	43
1982	12	5	18	98
1983	11	9	18	214
1984	6, 12	4	17	197
1985				0
1986				0
1987				0
1988				0
1989				0
1990	7	5	11	133
1991	9	6	13	90
1992	8	4	19	320
1993	8	3	17	638
1994	8	3	23	367
1995	7	3	13	475
1996	8	2	14	467
1997	9	3	15	787
1998	5	4	16	623
1999	9	5	12	449
2000	9	3	13	807
2001	8	2	14	536
2002	10	3	16	782
2003	8	4	18	401
2004	9	3	17	589
2005	10	2	17	614
2006	11	2	17	552
2007	9	4	16	627
2008	10	4	17	411
2009	11	7	17	179
2010	9	6	18	292
2011	8	6	17	226
2012	9	8	15	21
2013				
2014				
2015				
2016				
2017				
2018				
2019				

FIGURES

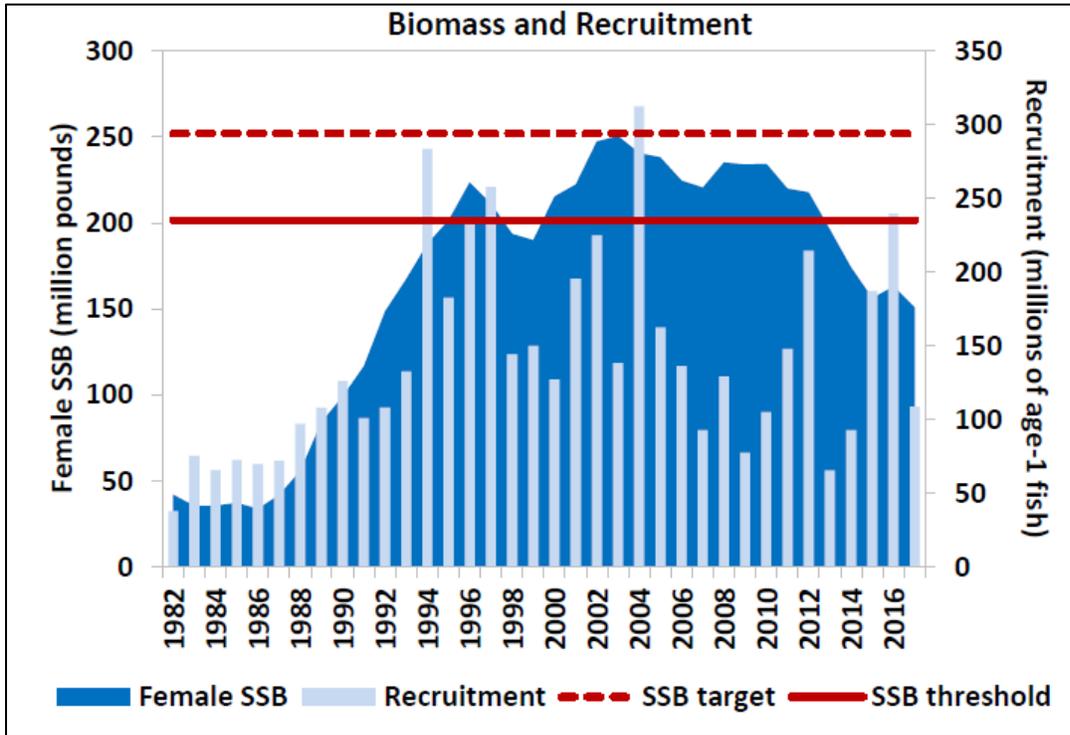


Figure 1. Atlantic striped bass female spawning stock biomass and recruitment (abundance of age-1). Source: ASMFC Atlantic Striped Bass Stock Assessment 2018.

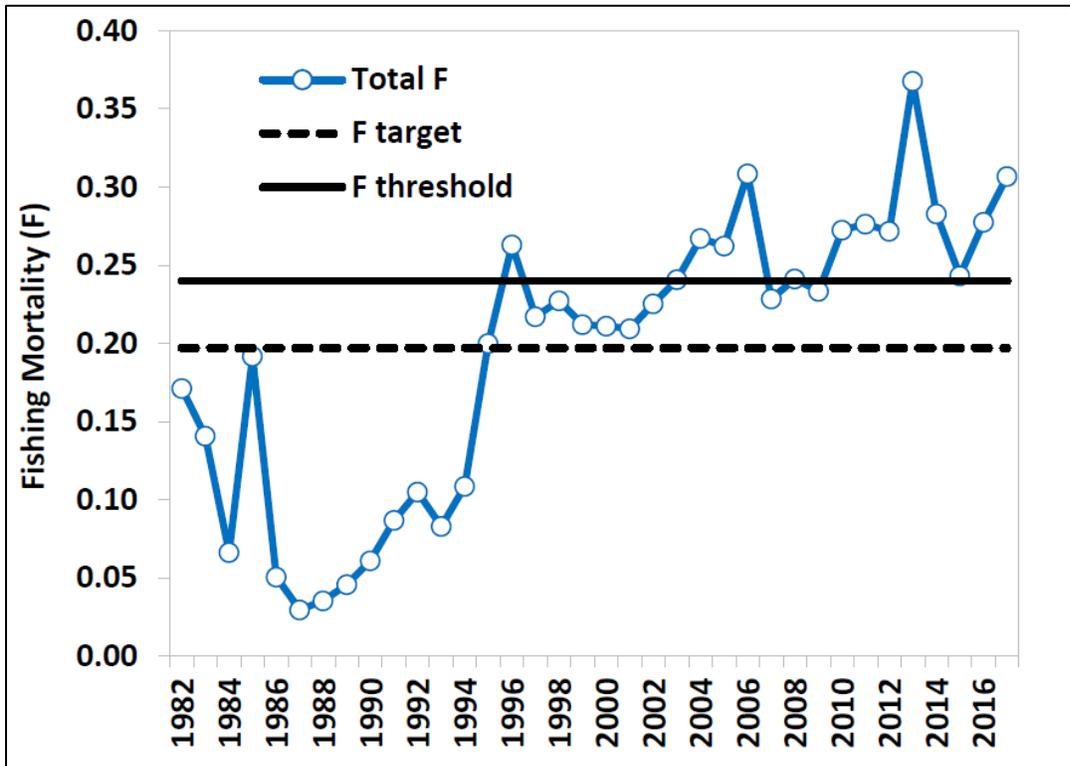


Figure 2. Atlantic striped bass estimates of fishing mortality and the fishing mortality target and threshold reference points. Source: ASMFC Atlantic Striped Bass Stock Assessment 2018.

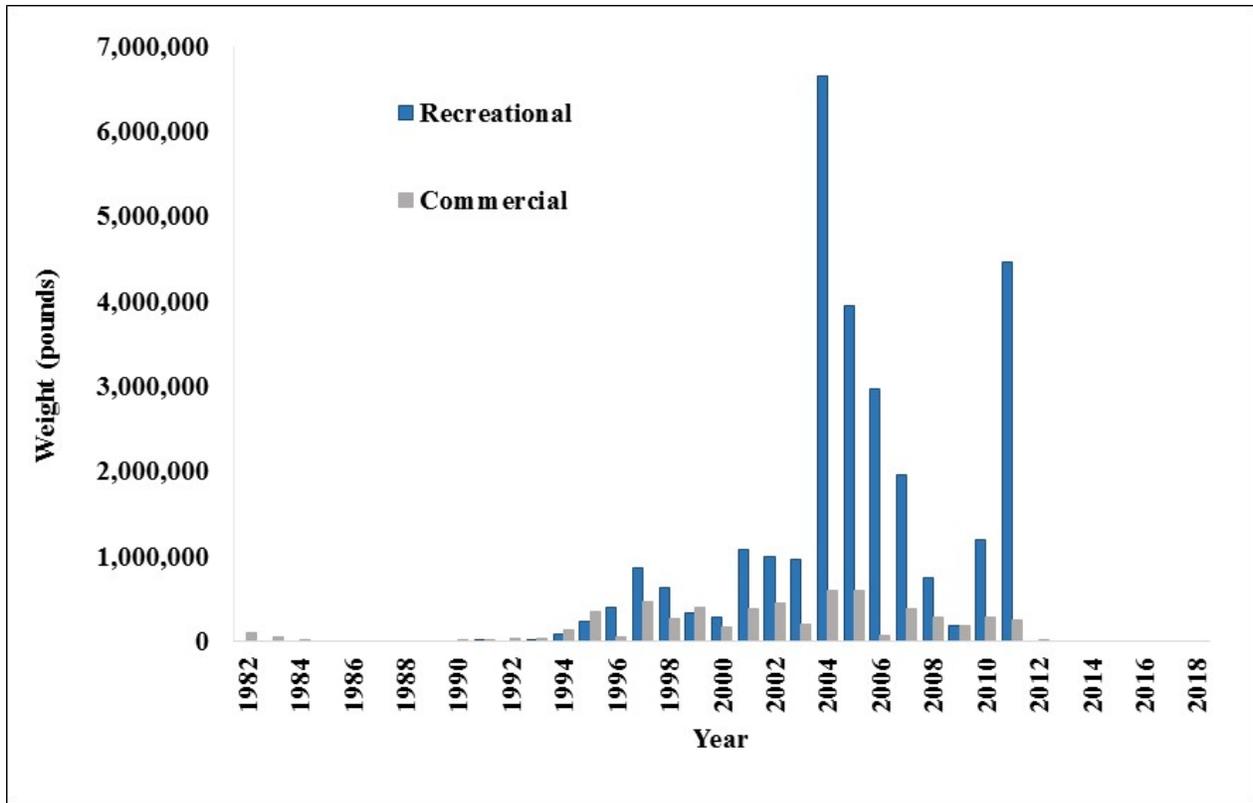


Figure 3. North Carolina’s annual commercial and recreational striped bass landings in pounds from the Atlantic Ocean by calendar year, 1982-2019.

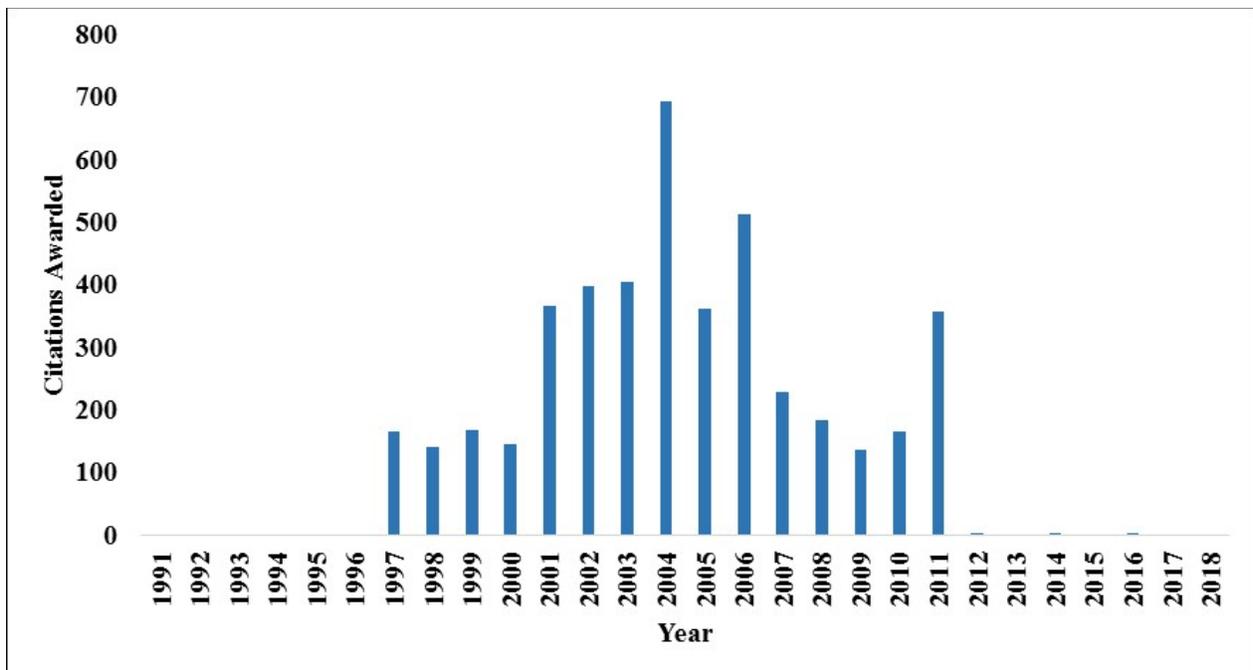


Figure 4. North Carolina Saltwater Fishing Tournament citations awarded for striped bass from the Atlantic Ocean from 1991 to 2019. Citations are awarded for striped bass greater than 35 pounds or 45 inches total length.

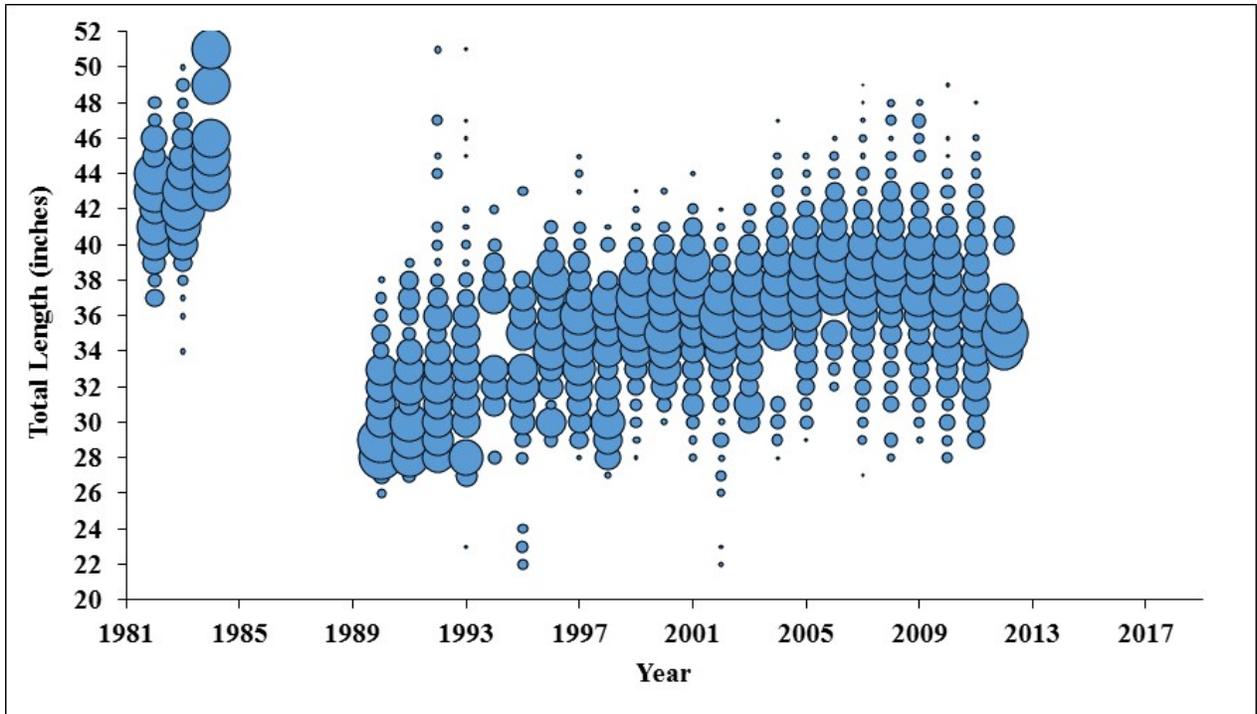


Figure 5. Commercial length frequency (total length, inches) of striped bass harvested from 1982 to 2019. Bubbles represent fish harvested at length and the size of the bubble is equal to the proportion of fish at that length.

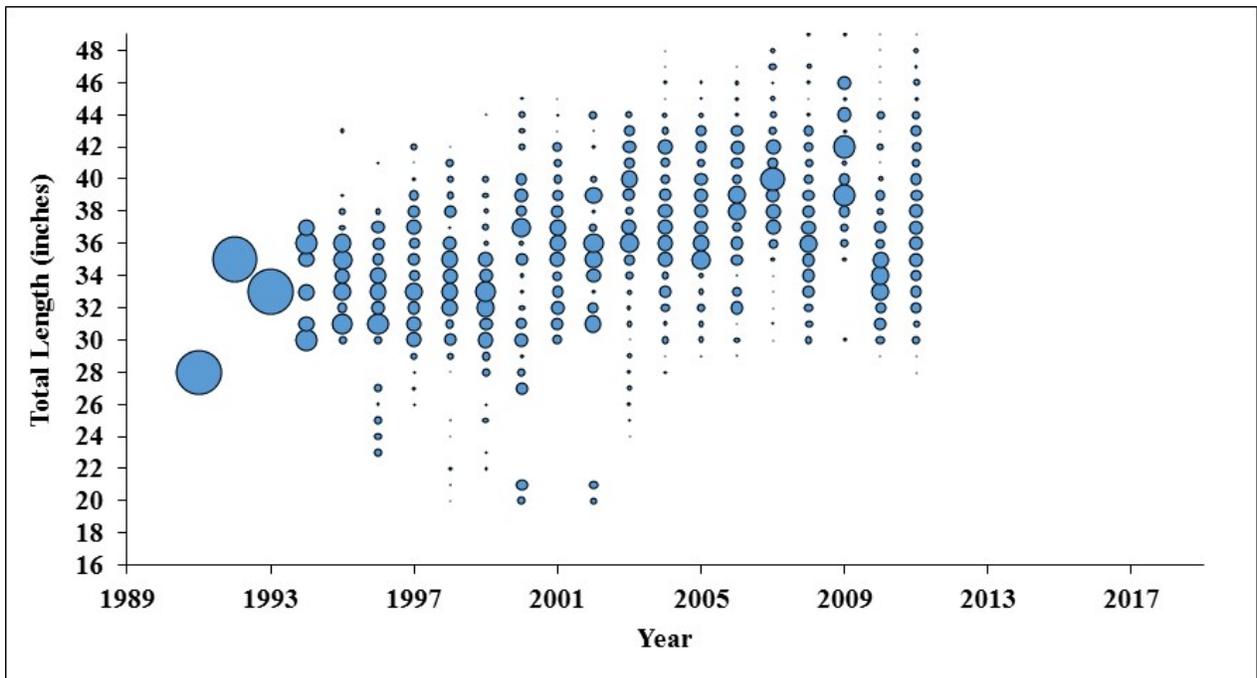


Figure 6. Recreational length frequency (total length, inches) of striped bass harvested from 1988 to 2019. Bubbles represent fish harvested at length and the size of the bubble is equal to the proportion of fish at that length.

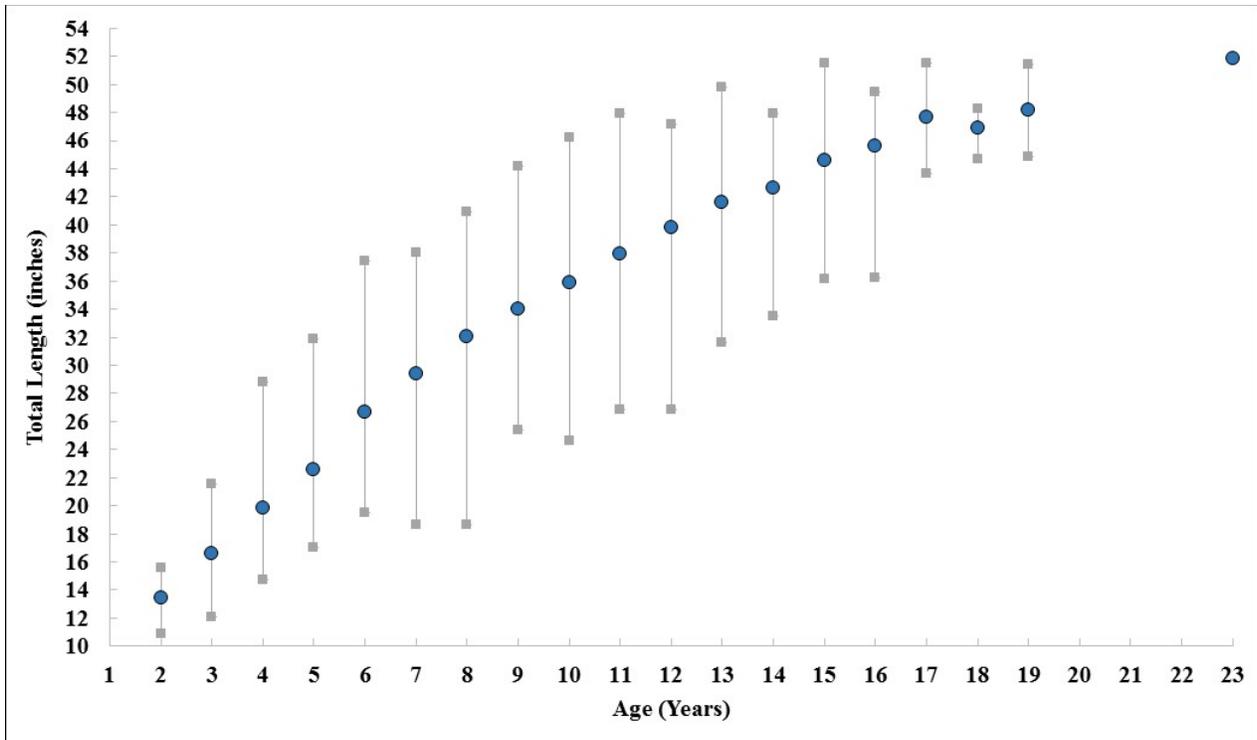


Figure 7. Striped bass length at age samples collected from both dependent (commercial and recreational fisheries) and independent (surveys) sources from 1982 to 2019. Blue circles represent the mean size at a given age while the grey squares represent the minimum and maximum observed size for each age.