FISHERY MANAGEMENT PLAN UPDATE
ESTUARINE STRIPED BASS
AUGUST 2021

STATUS OF THE FISHERY MANAGEMENT PLAN

Fishery Management Plan History

Original FMP Adoption:	January 1994 May 2004
Amendments:	Amendment 1 – May 2013 Amendment 2 – In Progress
Revisions:	November 2014 November 2020
Supplements:	Supplement A – February 2019
Information Updates:	None
Schedule Changes:	August 2016
Comprehensive Review:	Review started in 2017; Amendment 2 is currently in development

Estuarine striped bass *(Morone saxatilis)* in North Carolina are managed under Amendment 1 to the N. C. Estuarine Striped Bass FMP, its subsequent revisions and Supplement A. It is a joint plan between the North Carolina Marine Fisheries Commission (NCMFC) and the North Carolina Wildlife Resources Commission (NCWRC). The Striped Bass FMP, Revisions, Amendment, and Supplement (NCDMF 2004, 2013, 2014, 2019, and 2020) are available on the NCDMF website at: http://portal.ncdenr.org/web/mf/fmps-under-development

The NCMFC and the NCWRC implemented a Memorandum of Agreement in 1990 to address management of the striped bass stock in the Albemarle Sound and Roanoke River (A-R). 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 was at historically low levels of abundance and experiencing chronic spawning failures (Laney et. al. 1993). The comprehensive plan addressed the management of all estuarine striped bass stocks 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 North Carolina Estuarine Striped Bass FMP approved in May 2004 was the first FMP developed under the criteria and standards of the 1997 Fisheries Reform Act (NCDMF 2004). The plan focused on identifying water flow, water quality, and habitat issues throughout the

state, reducing discard mortality in the commercial anchored gill net fisheries, continued stocking of striped bass in the Central and Southern areas of the state, and developing creel surveys in the Tar-Pamlico, Neuse, and Cape Fear rivers to estimate recreational harvest in those systems.

Amendment 1, adopted in 2013, lays out separate management strategies for the A-R stock and the Central and Southern stocks in the Tar-Pamlico, Neuse, and Cape Fear rivers. Management programs in Amendment 1 consist of daily possession limits, open and closed harvest seasons, gill net mesh size and yardage restrictions, seasonal attendance requirements, barbless hook requirements in some areas, minimum size limits, and slot limits to maintain a sustainable harvest and reduce regulatory discard mortality in all sectors. Amendment 1 also maintains the stocking regime in the Central and Southern systems (Central Southern Management Area, CSMA) and the harvest moratorium on striped bass in the Cape Fear River and its tributaries (NCDMF 2013). Striped bass fisheries in the Atlantic Ocean of North Carolina are managed under the Atlantic States Marine Fisheries Commission's (ASMFC) Amendment 6 to the Interstate FMP for Atlantic Striped Bass and subsequent addenda.

In response to the 2013 benchmark A-R striped bass stock assessment that indicated fishing mortality was above the target, the NCMFC approved a Revision to Amendment 1 in November 2014 (NCDMF 2014). The revision reduced the total allowable landings (TAL) for the A-R stock from 550,000 pounds to 275,000 pounds, split evenly between the commercial and recreational sectors. Stock assessment projections indicated a TAL of 275,000 pounds would maintain fishing mortality and spawning stock at their respective targets, providing a sustainable harvest. The Revision maintained for the CSMA the 25,000 pound commercial TAL, daily possession limits and a closed summer season to control recreational harvest, and a total harvest moratorium in the Cape Fear River and its tributaries. The Revision utilizes total allowable landings (TAL) instead of total allowable catch (TAC). The term TAC does not accurately describe the existing management strategy, because the term "catch" refers to landings and discards. Since its inception the quota used to maintain striped bass harvest at sustainable levels in the A-R and the CSMA is for landings only, not landings and discards. Discards are accounted for in the stock assessment model but are not part of the TAL.

In August 2016, the NCMFC approved a change to the FMP review schedule so the comprehensive review of the Estuarine Striped Bass FMP would begin in July 2017 instead of July 2018 due to concerns about the high percentage of stock fish and minimal natural recruitment in the CSMA systems. Review of the plan began in 2017 and development of Amendment 2 is ongoing.

On June 1, 2018, a NCWRC rule change implementing a 26-inch total length minimum size limit in the Inland Fishing Waters of the Tar-Pamlico and Neuse rivers became effective. At the November 2018 NCMFC business meeting, the division recommended development of temporary management measures to supplement the FMP providing for a no-possession provision for striped bass in the internal coastal and joint waters of the CSMA to protect important year classes of striped bass while Amendment 2 to the N.C. Estuarine Striped Bass Fishery Management Plan is developed. Supplement A to the Estuarine Striped Bass FMP was

adopted by the NCMFC at their February 2019 business meeting and NCWRC in March 2019. Supplement actions in the FMP implemented March 29, 2019 consisted of the following:

- Commercial and recreational no possession measure for striped bass (including hybrids) in coastal and inland fishing waters of the CSMA (FF-6-2019). The NCWRC hook and line closure proclamation had the effect of suspending rules 15A NCAC 10C .0107 (l) and 10C .0314 (g). A no-possession requirement already exists for the Cape Fear River by rule.
- Additionally, consistent with Amendment 1, commercial set gill-net restrictions requiring tie-downs and distance from shore (DFS) measures will apply year-round (M-5-2019).

On March 13, 2019 the Marine Fisheries Commission held an emergency meeting that directed the division to issue a proclamation regarding gill nets, beyond what was contained in Supplement A. Proclamation (M-6-2019) implemented the following:

- Prohibits the use of ALL gill nets upstream of the ferry lines from the Bayview Ferry to Aurora Ferry on the Pamlico River and the Minnesott Beach Ferry to Cherry Branch Ferry on the Neuse River.
- Maintains tie-down (vertical net height restrictions) and distance from shore restrictions for gill nets with a stretched mesh length 5 inches and greater in the western Pamlico Sound and rivers (superseded M-5-2019).

An emergency meeting called under North Carolina General Statute section 113-221.1(d), authorizes the commission to review the desirability of directing the fisheries director to issue a proclamation. Once the commission votes under this provision to direct issuance of a proclamation, the fisheries director has no discretion to choose another management option and is bound by law to follow the commission decision. In these cases, under existing law, the decision of the commission to direct the director to issue a proclamation is final and can only be overruled by the courts.

The most recent A-R striped bass stock assessment (Lee et al. 2020) was completed and approved for management use in 2020. The assessment indicated the resource is overfished and is experiencing overfishing (Lee et al. 2020). In response to the overfished and overfishing stock status, the NCMFC approved a Revision to Amendment 1 in November 2020 (NCDMF 2020). The November 2020 Revision to Amendment 1 to the North Carolina Estuarine Striped Bass Fishery Management Plan reduced the striped bass TAL from 275,000 pounds to 51,216 pounds in the Albemarle Sound and Roanoke River Management Areas to remain in compliance with Amendment 1 to the North Carolina Estuarine Striped Bass Fishery Management Plan (FMP) and the Atlantic States Marine Fisheries Commission (ASMFC) Addendum IV to Amendment 6 to the Interstate FMP for Atlantic Striped Bass. The new TAL was effective January 1, 2021.

The CSMA Estuarine Striped Bass Stocks report (Mathes et al. 2020), completed in 2020, is a collection of (1) all data that have been collected, (2) all management effort, and (3) all major analyses that have been completed for CSMA stocks to serve as an aid in development of Amendment 2. No stock status determination was performed and no biological reference points were generated for CSMA striped bass stocks.

NCDMF and NCWRC staffs continue to work collaboratively in development of Amendment 2 to the N.C. Estuarine Striped Bass FMP.

Management Unit

There are two geographic management units and four striped bass stocks included in Amendment 1 to the North Carolina Estuarine Striped Bass FMP. The northern management unit is comprised of two harvest management areas; the Albemarle Sound Management Area (ASMA) and the Roanoke River Management Area (RRMA). The ASMA includes the Albemarle Sound and all its coastal, joint and inland water tributaries, (except for the Roanoke, Middle, Eastmost and Cashie rivers), Currituck, Roanoke and Croatan sounds and all their joint and inland water tributaries, including Oregon Inlet, north of a line from Roanoke Marshes Point across to the north point of Eagle Nest Bay in Dare county. The RRMA includes the Roanoke River and its joint and inland water tributaries, including Middle, Eastmost and Cashie rivers, up to the Roanoke Rapids Dam. The striped bass stock in these two harvest management areas is referred to as the A-R stock, and its spawning grounds are in the Roanoke River in the vicinity of Weldon, NC. Implementation of recreational and commercial striped bass regulations within the ASMA is the responsibility of the NCMFC. Within the RRMA, commercial regulations are the responsibility of the NCMFC while recreational regulations are the responsibility of the NCWRC. The A-R stock is also included in the management unit of Amendment 6 to the ASMFC Interstate FMP for Atlantic Striped Bass.

The southern geographic management unit is the CSMA and includes all internal coastal, joint and contiguous inland waters of North Carolina south of the ASMA to the South Carolina state line. There are spawning stocks in each of the major river systems within the CSMA; the Tar-Pamlico, the Neuse, and the Cape Fear. These stocks are collectively referred to as the CSMA stocks. Spawning grounds are not clearly defined in these systems as access to spawning areas is influenced by river flows as well as impediments to migration. Management of striped bass within the CSMA is the sole responsibility of the NCMFC and the NCWRC and is not subject to compliance with the ASMFC Interstate FMP for Atlantic Striped Bass.

To ensure compliance with interstate requirements, North Carolina also manages the A-R striped bass stock 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).

Goal and Objectives

The goal of Amendment 1 to the North Carolina Estuarine Striped Bass FMP is to achieve sustainable harvest through science based decision-making processes that conserve adequate spawning stock, provide and maintain a broad age structure, and protect the integrity of critical habitats. To achieve this goal, the following objectives must be met:

1. Identify and describe population attributes, including age structure, necessary to achieve sustainable harvest.
2. Restore, improve, and protect striped bass habitat and environmental quality consistent with the Coastal Habitat Protection Plan (CHPP) to increase growth, survival and reproduction.
3. Manage the fishery in a manner that considers biological, social, and economic factors.
4. Initiate, enhance, and/or continue programs to collect and analyze biological, social, economic, fishery, habitat, and environmental data needed to effectively monitor and manage the fishery.
5. Initiate, enhance, and/or continue information and education programs to elevate public awareness of the causes and nature of issues in the striped bass stocks, habitat, and fisheries, and explain management programs.
6. Develop management measures, including regulations that consider the needs of all user groups and provide sustainable harvest.
7. Promote practices that minimize bycatch and discard mortality in recreational and commercial fisheries.

DESCRIPTION OF THE STOCK

Biological Profile

Striped bass are an estuarine dependent species found from the lower St. Lawrence River in Canada to the west coast of Florida through the northern shore of the Gulf of Mexico to Texas. In North Carolina, the species is also known as striper, rockfish, or rock. The only stocks considered migratory are the stocks from Maine to the Albemarle Sound-Roanoke River in North Carolina. These migratory stocks are under the management authority of the ASMFC. Migratory striped bass are considered anadromous, meaning they spend most of their adult life in the waters of the estuaries and nearshore ocean, migrating to fresh water to spawn in the spring. For more southern stocks down through Florida, including the CSMA (Tar-Pamlico, Neuse, and Cape Fear stocks), striped bass are riverine, meaning they do not migrate to the ocean like northern striped bass stocks and, instead, spend their entire life in the upper estuary and riverine system.

Females in the A-R stock are 29% mature at age 3 and 97% mature at age 4, while females in the Tar-Pamlico and Neuse rivers are 50% mature at 2.7 years and 98% mature by age 3 (Knight 2015). The length at 50% maturity for striped bass in the A-R stock is 16.8 inches (Boyd 2011). Female striped bass in both systems produce large quantities of eggs which are broadcast into riverine spawning areas and fertilized by mature males, age 2 and older. In the Tar-Pamlico and Neuse rivers, fecundity ranged from 223,110 eggs for an Age-3 female to 3,273,206 eggs for an Age-10 female (Knight 2015). Fertilized eggs drift with downstream currents and need 1.5 to 3 days to hatch and then continue to develop through the larval stage for several more days,

eventually arriving in river mouths and the inland portions of coastal estuaries where they develop into juveniles. Striped bass require flowing, freshwater habitats to spawn successfully, allowing the eggs to remain suspended until they hatch, and to transport larvae to nursery areas. Environmental conditions including temperature, rainfall and river flows are important factors in determining the number of juveniles produced annually. Spawning in North Carolina takes place from late March until early June. Peak spawning activity for the A-R stock occurs when water temperature reaches 62 to 67 degrees Fahrenheit in the Roanoke River at Weldon. Spawning grounds are not clearly defined in CSMA systems as access to spawning areas is influenced by river flows as well as impediments to migration. Natural reproduction and successful juvenile recruitment occurs infrequently and at low levels in the Tar-Pamlico, Neuse and Cape Fear rivers. The CSMA stocks are supported by continuous stocking efforts as evidenced by stocked fish comprising nearly 100% of the striped bass on the spawning grounds and in internal coastal fishing waters of the Tar-Pamlico, Neuse, and Cape Fear rivers (O'Donnell and Farrae 2017).

Striped bass are relatively long-lived and capable of attaining moderately large sizes. Fish weighing 50 or 60 pounds are not exceptional. In general, females grow larger than males with reported maximum lengths of 60 inches and 45 inches. In recent years, the oldest observed striped bass in the A-R stock was 31 years. The oldest observed striped bass within the CSMA were; 7 years in the Cape Fear River and 12 years in the Tar-Pamlico and Neuse rivers. The largest striped bass on record are several females caught in the early 1900s in Albemarle Sound which weighed 125 pounds each. Large Roanoke River striped bass (>900 mm TL) rapidly emigrate (~ 59 km/d) after spawning to distant (>1,000 km) northern ocean waters (New Jersey to Massachusetts), where they spend their summers and migrate southward in the fall to overwintering habitats off Virginia and North Carolina and complete their migration circuit the following spring by returning to the Roanoke River to spawn. (Callihan et al. 2015). Estuarine striped bass from the A-R stock contribute minimally to the total coastal migratory stock when compared to the contributions from larger systems like the Chesapeake Bay, Delaware and Hudson rivers. Striped bass populations in the CSMA are considered to have a primarily endemic riverine life history, having limited or no adult oceanic migration (Setzler et al. 1980; Rulifson et al. 1982a; Callihan 2012).

Striped bass can form large schools feeding on whatever fishes are seasonally and geographically available. They also feed on a wide variety of invertebrates. In general, oily fish such as Atlantic menhaden, herrings and shads are very important prey items, but they will also readily eat spot, mullet, Atlantic croaker, American eel, and various invertebrates like blue crabs.

Stock Status

A-R Stock

The most recent assessment of the A-R striped bass stock was completed in 2020, utilizing data from 1991–2017. Results from the 2020 A-R striped bass benchmark stock assessment indicate the stock is overfished and overfishing is occurring (Lee et. al 2020). The estimate of F in the terminal year of the assessment (2017) was 0.27, above the $F_{35\%SPR\ Threshold}$ of 0.18 (AR_Figure 1) and the estimate of SSB was 78,576 lb, below the $SSB_{35\%SPR\ Threshold}$ of 267,390 lb (AR_Figure 2). Estimates of F have been above the $F_{35\%SPR\ Threshold}$ in 24 out of the 27 years of the time period of the assessment (AR_Figure 1). Female SSB has declined steadily from a high of

587,516 lb in 2000 to a low of 45,418 lb in 2013. Female SSB increased through 2015 to 167,053 lb and has declined since (AR_Figure 2). Results of the assessment also show a period of strong recruitment (as measured by the number of age-0 fish coming into the stock each year) from 1993 to 2000, then a period of much lower recruitment from 2001 to 2017, which has contributed to the decline in SSB since 2003. Average recruitment during 1993–2000 was 1,127,646 age-0 fish per year while average recruitment for years 2001–2017 was 428,796 age-0 fish per year (AR_Figure 2).

Several years of poor recruitment occurred from 2001–2004 at a time when SSB was at high levels, indicating factors other than abundance of SSB may be contributing to poor spawning success in some years. Appropriate river flow during the spawning period has long been recognized as an important factor in spawning success for A-R striped bass (Hassler et. al 1981; Rulifson and Manooch 1990). Low to moderate flows have been identified as favorable to strong year-class production while high flows (10,000 cubic feet per second or greater) are unfavorable to the formation of strong year classes. The peer reviewers of the 2020 benchmark assessment recognized the importance of river flow on recruitment and noted declining recruitment in the time series does not appear to result solely from reduced abundance due to harvest (Lee et. al 2020).

CSMA Stocks

There is no stock status determination for the CSMA stocks in the Tar-Pamlico, Neuse, and Cape Fear rivers. No formal peer-reviewed stock assessments have been conducted for CSMA striped bass. In 2013, an index-based method of catch curve analysis was used to assess the status of striped bass populations in the CSMA (NCDMF 2013); however; the large confidence intervals and lack of precision in the catch curve Z estimates (total instantaneous mortality rate) made them unsuitable for making a stock status determination.

In the 2020 CSMA stock assessment report, no stock status determination was performed for Tar-Pamlico, Neuse, and Cape Fear rivers stocks and biological reference points were not generated due to continuous stocking efforts and lack of understanding of the abiotic factors that may hinder successful natural recruitment given the large number of fish stocked every year (Mathes et al. 2020). A demographic matrix model was developed to evaluate different stocking and management measures for striped bass in all three CSMA river systems. Results from the matrix model indicate that striped bass populations in the CSMA are depressed to an extent that sustainability is unlikely at any level of fishing mortality, and it also provides evidence that natural recruitment is the primary limiting factor influencing Tar-Pamlico and Neuse river stocks and if stocking was stopped the populations would decline (Mathes et al. 2020). The demographic matrix model does not provide population abundance or mortality estimates. A tagging model was developed to estimate striped bass abundance in the Cape Fear River. Tagging model results showed a consistent decline in abundance estimates for striped bass (2012–2018), and that abundance in 2018 was reduced to less than 20% of the abundance in 2012, even with a total no-possession provision for striped bass in place in the Cape Fear River since 2008.

Stock Assessment

A-R Stock

Stock Synthesis text version 3.30 (Methot 2000, 2012; Methot and Wetzel 2013) was used to model the striped bass stock and also to calculate reference points (Lee et al. 2020). The Stock Synthesis model incorporates information from multiple fisheries and surveys and both length and age composition data. The structure of the model allows for a wide range of model complexity depending upon available data. The strength of the model is that it explicitly models both the dynamics of the population and the processes by which one observes the population and its fisheries. That is, the comparison between the model and the data is kept close to the natural basis of the observations, instead of manipulating the observations into the format of a simpler model. Another important advantage is the model allows for (and estimates) selectivity patterns for each fishing fleet and survey. The model was peer reviewed and approved for use in management by an outside panel of experts and the ASMFC Atlantic Striped Bass Management Board. The NCDMF also approved it for management use.

CSMA Stocks

After reviewing available data, life history information, and stock assessment techniques, the Estuarine Striped Bass FMP Plan Development Team determined traditional stock assessment models would not be appropriate for CSMA stocks because of the high hatchery contribution and lack of natural recruitment in these systems. A demographic matrix model was developed to evaluate different stocking and management measures for striped bass in the three river systems in the CSMA and a tagging model was developed to estimate striped bass abundance in the Cape Fear river. The CSMA Stock Report (Mathes et al. 2020) is a collective documentation of all the data collected, all management efforts, and all major analyses completed for these river stocks. The report also serves as a record of completed research efforts with implications for fishery management and as a guide for future research based on results and identified data gaps. It evaluates the likelihood of successful population rebuilding under various simulations of stocking and fishery management strategies such as different harvest levels and size limits.

DESCRIPTION OF THE FISHERY

Annual spawning success of striped bass, is largely dependent upon environmental conditions, both natural and manmade. Even when female spawning stock biomass is high, poor reproductive success can occur due to unfavorable environmental conditions. This fact is important to keep in mind when discussing trends in landings data and stock abundance. For species that have long term juvenile abundance surveys, this phenomenon is evident when we observe a year with above average spawning success (termed a “strong year class”) followed by a year when practically no eggs survive to the juvenile stage (a “weak year class”). This cycle of spawning success and failure results in annual harvests that increase and decrease depending on the abundance of the year classes available to the fishery.

Current Regulations

ASMA

Harvest in the commercial sector in 2020 was limited by an annual TAL of 137,500 pounds. There is also an 18-inch minimum total length (TL) size limit. The commercial fishery is prosecuted as a non-directed bycatch fishery, with most landings occurring in large mesh (≥ 5-inch stretched mesh) floating gill nets during the spring American shad fishery. Pound nets and flounder nets account for the remainder of the harvest. Daily trip limits are set by proclamation. Daily reporting of the number and pounds of striped bass landed from all licensed striped bass dealers ensure the TAL is not exceeded. Dependent on available quota, a fall harvest season can be opened from October 1 through December 31 and a spring harvest season can be opened from January 1 through April 30. The harvest season is closed from May 1 through September 30 each year. The seasons may be closed early by proclamation if the TAL is reached. There is mandatory attendance of all small mesh (< 5-inch stretched mesh) gill nets during May–November to reduce discard mortality in that fishery. There are areas within the ASMA that are closed to all gill netting to further reduce undersize discards and to protect females as they enter the mouth of the Roanoke River during their spring spawning migration.

Harvest by the ASMA recreational sector is limited by an annual TAL of 68,750 pounds. The recreational sector also has an 18-inch total length minimum size limit and a two fish per person daily possession limit. The harvest seasons are the same as the commercial sector. Harvest is estimated via a creel survey designed for striped bass in the ASMA. The daily possession limit may be changed and/or seasons closed early by proclamation to ensure the TAL is not exceeded.

Check with the NCDMF for the most recent proclamation on striped bass harvest limits including trip limits and bycatch requirements.

RRMA

Commercial harvest in the RRMA is prohibited. The RRMA recreational sector also has an annual TAL of 68,750 pounds. Typically, the harvest season is open from March 1 through April 30 each year. There is an 18-inch total length minimum size limit and a no possession slot where fish between 22 and 27 inches TL may not be possessed. There is a two fish per person daily possession limit and only one of those fish may be greater than 27 inches total length. Only a single barbless hook may be used in inland waters of the RRMA upstream of the U.S. Highway 258 Bridge April 1–June 30.

CSMA

Commercial and recreational harvest in the CSMA is prohibited. Supplement A to the Estuarine Striped Bass FMP was adopted by the NCMFC at their February 2019 business meeting and by the NCWRC in March 2019. The NCWRC hook and line closure proclamation had the effect of suspending rules 15A NCAC 10C .0107 (l) and 10C .0314 (g), and Supplement A actions consisted of the following:

- Commercial and recreational no possession measure for striped bass (including hybrids) in coastal and inland fishing waters of the CSMA (FF-6-2019). A no-possession requirement already exists for the Cape Fear River by rule.

- Additionally, consistent with Amendment 1, commercial set gill-net restrictions requiring tie-downs and distance from shore (DFS) measures will apply year-round (M-5-2019).

Commercial Fisheries

ASMA

Commercial landings in the ASMA have been controlled by an annual TAL since 1991 (AR_Table 1). Due to gill net mesh regulations and minimum size limits in place since 1993, most harvest consists of fish 4 to 6 years of age. From 1990 through 1997 the TAL was set at 98,000 pounds because the A-R stock was at historical low levels of abundance. The stock was declared recovered in 1997 and the TAL was gradually increased as stock abundance increased. The TAL reached its maximum level of 275,000 pounds in 2003 as the stock reached record levels of abundance.

Through 2004 the TAL was reached easily. As stock abundance declined, commercial landings no longer reached the annual TAL, even with increases in the number of harvest days and daily possession limits. From 2005 through 2009 landings steadily declined and averaged about 150,000 pounds, even though gill net trips remained steady during that period (AR_Figure 3).

The decline in landings during 2005-2009 was due to poor year classes produced from 2001 to 2004. An increase in landings in 2010 to over 200,000 pounds was due to the strong 2005-year class. Since 2013 landings have been reduced in part because of a shortened American shad season resulting from triggers being met in the American Shad Sustainable Fishery Plan. Most landings traditionally have come during the American shad season. Length frequency distribution in 2020 is presented in AR_Figure 4. Length at age for all commercial samples collected from 1972 through 2020 are presented in AR_Figure 5. Commercial length frequencies are represented in AR_Figure 6. Modal length increased in 1991 and has stayed steady due to the 18-inch minimum. A larger abundance of older fish was present in 2004 and a there was a decrease in modal length in 2018. Fish between 18 and 24 inches TL dominate the fishery.

CSMA

Due to the no possession measure approved in Supplement A, the commercial striped bass fishery was closed in 2019 while Amendment 2 is developed. From 1994 to 2018 commercial landings in the CSMA were constrained by an annual TAL of 25,000 pounds. Landings closely follow the annual TAL, except for 2008 when less than half of the TAL was landed. From 2004 through 2018 striped bass commercial landings in the CSMA averaged 24,179 pounds and ranged from a low of 10,115 pounds in 2008 to a high of 32,479 pounds in 2004 (CS_Figure 1). Most commercial landings come from the Tar-Pamlico and Pungo rivers and the Neuse and Bay rivers, with the remainder coming from the Pamlico Sound (CS_Figure 2). From 2004 to 2018, there was only a spring harvest season, opening March 1 each year and closing when the TAL was reached.

Recreational Fisheries

ASMA

The recreational sector's landings in the ASMA are dominated by fish age 3 to 5. Landings in the ASMA have been controlled by a TAL since 1991 (Table 1). Starting in 1998 the TAL was split evenly between the commercial and recreational sectors. The recreational TAL increased incrementally from 29,400 pounds in 1997 to 137,500 pounds in 2003. The recreational sector reached its TAL consistently until 2002, when landings started declining. Recreational landings peaked in 2001 at 118,506 pounds. (AR_Figure 3). The harvest season increased from four days a week to seven in the fall of 2005 and the daily recreational possession limit increased from two to three fish in the fall of 2006, but landings continued to decline. Several poor year classes produced since 2001 have accounted for the decline in stock abundance and recreational harvest since 2006. The recreational limit went back down to two fish per person per day in January 2016. Recreational harvest during 1991–2020 has averaged 44,889 pounds in the ASMA. Releases are usually greater than harvest and are dominated by fish less than the 18-inch minimum length limit. Undersized releases during the last 10 years have averaged 22,690 fish (Table 1). Length frequency distribution in 2020 is presented in AR_Figure 4. ASMA recreational length frequencies are presented in AR_Figure 7. Since 1996 the shift in abundance of younger fish is apparent with older fish still showing up in the fishery. Since 2014 the abundance of younger fish has increased likely due to the large 2014 and 2015 year classes with a slight uptick in landings for 2019 from the previous year. Landings in 2020 decreased from 2019 but were still higher than those in 2016–2018.

During 2020, sampling was impacted due to the COVID pandemic. Executive Order (EO) 116, issued on March 10, 2020, declared North Carolina under a State of Emergency and was soon followed by EO 120 which implemented a statewide Stay at Home Order for all non-essential State employees. The striped bass creel survey in the ASMA was halted on March 27, 2020, so the estimate produced covered only January 1–March 27, 2020.

RRMA

The recreational sector's landings in the RRMA are dominated by fish age 3 to 5 due to a no possession rule of fish 22–27 inches TL in the RRMA, a statewide rule that prohibits possession of river herring cut bait or whole river herring over six inches in length while engaged in fishing activities, and general angling techniques in the RRMA. Very few anglers use the large size artificial lures or natural bait required to catch striped bass over 28 inches, so very few fish over nine or 10 years old are observed in the creel survey. Plus, these older fish make up a relatively small portion of the total overall stock abundance. Harvest from 1991 through 2019 has averaged 54,103 pounds in the RRMA (Table 1). Many more striped bass are caught and released by recreational anglers each year than are harvested, especially in the RRMA where concentrations of fish on the spawning grounds can be dense. Annual releases from 2005 through 2019 in the RRMA have averaged 80,821 fish (Table 1).

Landings in the RRMA followed the TAL closely through 2002. From 2003 through 2016 landings averaged 64,389 pounds, with a few noticeable low years (2003, 2008, 2013 and 2014; AR_Figure 3). The total number of fish caught per angler during the spring fishery in the RRMA can be large; catches of 100 fish per day are not uncommon, but angler catch rates can be

impacted by spring water flows. The hydropower company operating the dams on the Roanoke River, along with the U.S. Army Corps of Engineers and biologists with the USFWS and NCWRC, coordinate releases to best mimic natural flow conditions during the spring spawn. However, droughts or heavy rainfall may still result in very low, i.e. 2,000–3,000 cubic feet per second (cfs) or very high, (≥20,000 cfs) flood stage flow conditions in some years. During these low or high flow years, angler success can be greatly diminished. Length frequency distribution in 2020 is presented in AR_Figure 4. RRMA recreational length frequencies are presented in AR_Figure 8. Since 2005 abundance of older fish in the recreational survey has decreased. Abundance of fish between 18 and 22 inches has stayed consistent from 2005 to 2020.

During 2020, sampling was impacted due to the COVID pandemic. Executive Order (EO) 116, issued on March 10, 2020, declared North Carolina under a State of Emergency and was soon followed by EO 120 which implemented a statewide Stay at Home Order for all non-essential State employees. The striped bass creel survey in the RRMA was halted on March 18, 2020 with angler reported lengths available until April 1 2020, so the estimate produced covered only March 2020.

CSMA

The NCDMF started collecting recreational striped bass data in the major rivers of the CSMA in 2004. In 2013, due to comparatively low recreational striped bass catch in the Cape Fear River, creel survey methodology was adjusted for American and hickory shad to become the target species. Due to the recreational no possession measure approved as part of Supplement A in February 2019, there was minimal recreational harvest in 2019 and no recreational harvest in 2020. In 2019, 959 pounds of striped bass were harvested in the CSMA. Recreational landings fluctuated between 2004–2018, ranging from lows in 2008 and 2009 to a high of 26,973 pounds in 2017 (Table 1).

Since 2011, harvest in the Tar-Pamlico and Neuse rivers has fluctuated little, ranging from 4,000 pounds to 9,000 pounds, however in 2016 and 2017 there was a sharp increase in recreational harvest (25,260 and 26,973 pounds, respectively). In 2018, recreational harvest dropped sharply by more than half of the 2016 and 2017 values (Table 1; CS_Figure 3). Harvest on the Pungo River has remained consistent at a relatively low level compared to fluctuations in the Tar-Pamlico and Neuse rivers. In 2016 and 2017 the number of trips and hours spent targeting striped bass in the CSMA increased although there was a moderate decline observed in 2018.

Although the recreational striped bass season in the CSMA was closed in 2019, data collection characterizing fishing effort and release dispositions have continued. Within the CSMA there is a significant catch-and-release fishery and releases during the last 10 years have averaged 47,309 fish (Table 1). Undersized discards peaked in 2017 mainly due to the large number of undersized striped bass available in the Tar-Pamlico River system. However, in 2020 there was a sizeable decline in under sized discards (10,439 fish). In 2020, discards of legal sized striped bass returned to more normal levels (n=7,575), after a high of 26,501 in 2017. Fish released that were within the slot limit, have fluctuated since 2004 and have ranged from a low in 2004, 2006, and 2007 of zero fish to a high of 6,779 fish in 2016 (Table 1). In 2020, there were approximately 1,406 discarded striped bass that were within the slot limit. CSMA recreational length frequencies are presented in CS_Figure 5. In 2018, the modal length of striped bass in the

recreational harvest from the Tar-Pamlico/Pungo rivers was 18 inches with few fish over 22 inches harvested, and the modal length from the Neuse River was 19 inches with few fish over 20 inches harvested (CS_ Figure 6).

MONITORING PROGRAM DATA

During 2020, sampling was impacted during March through June due to the COVID pandemic. Executive Order (EO) 116, issued on March 10, 2020, declared North Carolina under a State of Emergency and was soon followed by EO 120 which implemented a statewide Stay at Home Order for all non-essential State employees. During this time, limited sampling occurred.

Fishery-Dependent Monitoring

A-R Stock

The length, weight, sex, and age of the commercial harvest of striped bass has been consistently monitored through sampling at fish houses conducted by the division since 1972. Since 1994 anchored gill nets have accounted for 87.7 percent of the harvest in the ASMA (AR_Figure 9). Pound nets account for most of the remaining landings with minor catches coming from fyke nets, hoop nets, and pots. The mean total length from 2005 to 2020 was 21.6 inches (AR_Table 2).

The recreational harvest of striped bass in the ASMA and RRMA has been consistently monitored by the NCDMF since 1990 and the NCWRC since 1988 respectively. The mean total length from 2005 to 2020 was 20 inches total length for the ASMA and 19 inches total length for the RRMA from 2005 to 2019 (AR_Tables 3 and 4). Age data from the dependent and independent surveys in the ASMA are presented in AR_Table 5. The minimum and maximum age for the independent and dependent surveys are 1 and 17 years respectively with an average age of 5.

CSMA Stocks

Monitoring of the commercial fishery in the CSMA follows the same methodology as in the ASMA. There has been a commercial and recreational harvest moratorium in the Cape Fear River since 2008 and in the CSMA since March 2019. From 2004 to 2018, length data from the commercial harvest shows that on average striped bass harvested in the Neuse and Bay rivers are slightly larger than fish harvested in the Pamlico and Pungo rivers (CS_Table 1). Additionally, maximum lengths are generally larger in the Neuse and Bay rivers compared to the Pamlico and Pungo rivers.

In 2018, the modal length of CSMA striped bass in the commercial harvest from the Tar-Pamlico/Pungo rivers was 20 inches with few fish over 25 inches harvested and in the Neuse/Bay rivers striped bass modal length was 23 inches with few fish over 27 inches harvested (CS Figure 6). CSMA commercial length frequencies are represented in CS_Figure 7 and show that striped bass are routinely harvested up to 30 inches total length, and that few fish under the 18 inch total length minimum size limit are harvested.

In North Carolina, hybrid striped bass (a cross between a striped bass and white bass; *Morone chrysops*) are commercially harvested from both the Tar-Pamlico and Neuse river systems and are not distinguished from striped bass for management purposes. Data collected on hybrid striped bass at commercial fish houses showed a peak abundance in the commercial fishery in 2014, since then the number of hybrid striped bass have steadily declined (CS_Table 1, CS_Figure 8). It is hypothesized that most of the hybrid striped bass observed in these systems originated from aquaculture facilities and escaped during flooding events. The last major flooding events in the CSMA were during Hurricane Irene in 2011 and Hurricane Florence in 2018. During Hurricane Irene, river waters rose and flooded local aquaculture facilities. It was reported that tens of thousands of yearling hybrids were lost, presumably into the Pamlico River. While, it is likely the majority of hybrids within the CSMA river systems escaped from aquaculture facilities, it is also possible that hybridization occurs in the wild. Additional studies are needed to determine if this is occurring.

From 2004 to 2018, the CSMA recreational creel survey sampled on average 160 striped bass per year. In 2018, the creel survey measured 155 striped bass that averaged 19 inches and ranged in length from 16 to 29 inches, however, only 32 striped bass were measured in 2019 that averaged 20 inches and ranged in length from 16 to 26 inches due to the season closure in March 2019 (CS_Table 2).

Age data from fishery dependent surveys are presented in CS_Table 3 and CS_Figure 9; from 2016 to 2019, 65 otolith and 445 genetic samples were collected from commercial and recreational surveys that provided striped bass ages. Limited age data was collected in 2019 from the recreational creel survey (n=15) and no commercial samples were collected.

Fishery-Independent Monitoring

A-R Stock

A young-of-year (age-0) A-R striped bass juvenile abundance survey used to calculate a juvenile abundance index (JAI) was initiated by Dr. William Hassler of North Carolina State University in 1955. The NCDMF took over this critical long-term survey in 1987 at Dr. Hassler's retirement. Sampling occurs at seven fixed stations in the western Albemarle Sound from July through mid-October. Sampling gear is an 18-foot semi-balloon trawl towed for 15 minutes. Catch per unit effort is the number of striped bass captured per tow. The JAI provided by the survey is usually a reliable indicator of relative abundance and future harvest potential. Data from the survey reveal the highly variable inter-annual spawning success of striped bass. The long time-series of data also clearly shows the extended period of spawning failure that occurred when the stock was at historical levels of low abundance during the 1980s. Starting in 1993 the stock began producing successful spawns once again, due to improved water quality, agreements about water flow regimes on the Roanoke River during the spawning season, favorable environmental conditions during the spawning season, and severe management restrictions that allowed stock abundance to increase. Within an eight-year period spanning 1993-2000, the stock produced the four highest JAI values in the entire 46-year time series. The average JAI during 1993-2000 was 24.04, over three times higher than the average of the JAI prior to the stock crashing (1955-1977 JAI = 7.9; AR_Figure 10). However, from 2001 to 2010 the JAI was below average for most years, above average for only one year (2010), and several years including

some back to back (2003 and 2004), which were considered spawning failures. This cycle starting in 1993 led to overall stock abundance increasing steadily through the mid-2000s to all-time highs, followed by a period of stock decline. From 2010 to 2016 the stock has seen improved annual spawning success, with above average JAI values in 2011, 2014, and 2015, with one year (2013) below the spawning failure threshold. The JAI values for 2018, 2019, and 2020 were 0.4, 1.18, and 0.20 respectively and are below the spawning failure threshold of 1.33 (ASMFC 2010) (AR_Figure 10).

A fall/winter fishery independent gill net survey has been conducted by the NCDMF throughout the Albemarle and Croatan sounds since the fall of 1990 (Program 135). The survey utilizes a stratified random sampling design, employing mesh sizes from 2 ½-inch to 10-inch stretch mesh to characterize the resident and overwintering portion of the A-R stock. The survey is conducted from November through February. Catch per unit of effort is measured as the abundance of fish per 40-yard net soaked for 24 hours.

A spring survey employs the same methodology as the fall/winter survey but is conducted in the western Albemarle Sound only, near the mouth of the Roanoke River. The goal of the survey is to characterize the spawning portion of the A-R stock. The survey is conducted from March 1 through the end of May. Data from the surveys are used in the A-R stock assessment as an independent measure of stock abundance. During 2020 no index of abundance is available for striped bass from the spring survey. Sampling in 2020 was impacted by the COVID pandemic. Executive Order (EO) 116, issued on March 10, 2020, declared North Carolina under a State of Emergency and was soon followed by EO 120 which implemented a statewide Stay at Home Order for all non-essential State employees. During this time, fishery-independent projects were not able to take place, delaying future gillnet sampling.

The independent gill net surveys do a good job of tracking relative abundance, but the trend in total abundance is often masked by the highly variable and often very large number of two- and three-year-old fish captured in the survey, so trends in total abundance are often less informative than trends in 4 to 6-year-old abundance. The trend in abundance of 4 to 6-year olds show the stock increasing in abundance through the 1990s, to a high in 1999 of about 90 fish per 100 net days for the spring survey and 72 fish in the fall/winter survey. The 4 to 6-year-old abundance has fluctuated since 2000 but has been on a general downward trend with abundance for both surveys at about 20 fish per 100 net days in 2014 (AR_Figure 11). One weakness of the gill net surveys is they collect very few older fish and under-represent the expansion of fish in the 9+ age group that has occurred since 2000. They also don't capture the decline in abundance of age 9+ fish that has occurred since the period of poor spawning success from 2001 to 2010. In 2019 the abundance of 4 to 6-year-old fish was below average in the fall/winter portion of the survey and increased in the spring.

An electrofishing survey has been conducted by the NCWRC on the spawning grounds since the spring of 1990. The survey goals are the same as the spring gill net survey but takes place on the Roanoke River in the vicinity of Weldon, the location of the fall line and historical center of spawning activity for A-R striped bass. The survey uses a stratified random sampling design. Catch per unit of effort is measured as the number of fish captured per hour of electrofishing. The survey is used in the A-R stock assessment as an independent measure of stock abundance.

The trend in total abundance from the electrofishing survey is similar to the trends of age 4–6 fish in the gill net surveys, increasing from low levels of abundance in the early 1990s to a peak in the early 2000s of 380 fish per hour, then decreasing since to a low in 2013 of 150 fish per hour (AR_Figure 12). The abundance of fish in 2019 was slightly higher than 2018, but still lower than the peaks in 2001, 2006 and 2008. Both surveys exhibit a few years with high inter-annual variability, but this is common with fisheries surveys in which environmental conditions affect relative abundance in the survey area and the catch efficiency of the gear. The electrofishing survey does a better job at tracking the abundance of the age 9+ group, and clearly shows the emergence of the 1993 cohort into this age group in 2002. The age 9+ group has been on a downward trend since the 2006 peak of 14 fish per hour, with the lowest catch in 2014 of just over one fish per hour (AR_Figure 13). The strong year classes produced from 1993–2000 supported the increased abundance of fish in the 9+ age group, but since the below average spawning and several years of spawning failure during 2001-2011, the abundance of the 9+ age group is declining. The oldest fish seen recently in the population is a 31 year-old fish based on a tag returned by an angler in 2019 in the Roanoke River. When the survey started in 1990 fish older than seven were rarely observed in the survey. Age 9+ fish abundance has decreased in recent years and for years 2016–2019 is similar to the abundance levels seen in the early 90's.

CSMA Stocks

During 2020 no index of abundance is available for striped bass from the Fishery Independent Gill Net Survey (Program 915). Sampling in 2020 was impacted by the COVID pandemic. Executive Order (EO) 116, issued on March 10, 2020, declared North Carolina under a State of Emergency and was soon followed by EO 120 which implemented a statewide Stay at Home Order for all non-essential State employees. During this time, fishery-independent projects were not able to take place, delaying future gillnet sampling.

The gill net survey (P915) was initiated by the NCDMF in May of 2001 in Pamlico Sound. The survey was expanded to the Pamlico, Pungo, and Neuse rivers in 2003, expanded to the Cape Fear and New rivers in 2008, and expanded into Core Sound, Bogue Sound and the White Oak River in May 2018. Samples collected from P915 on the Tar-Pamlico, Pungo, and Neuse rivers show most striped bass were captured in the upper and middle portions of the rivers. Over the past twelve years (2004-2019), striped bass relative abundance has been higher in the Tar-Pamlico/Pungo, and Neuse rivers when compared to the Cape Fear River (CS_Table 4 and CS_Figure 10). Since 2004, striped bass relative abundance in the Tar-Pamlico/Pungo and Neuse rivers ranged from 2.04 to 9.00 fish per sample, whereas relative abundance in the Cape Fear River ranged from 0 to 0.14 fish per sample (CS_Table 4). In 2019, striped bass relative abundance in the Tar-Pamlico/Pungo and Neuse rivers was 5.06 and 4.21 fish per sample, respectively, compared to 0.03 fish per sample in the Cape Fear River (CS_Table 4; CS_Figure 10). Length frequencies from P915 are represented in CS_Figure 11. Length frequency distributions are variable between years but generally range from 10 to 25 inches TL, however in 2016-2017 in the Tar-Pamlico/Pungo and 2015-2017 in the Neuse rivers there was a higher percentage of small fish that could represent the two year classes of striped bass thought to be the result of successful natural reproduction in 2014 and 2015. In 2018 and 2019, there were larger fish in the Tar-Pamlico/Pungo and Neuse rivers that could represent growth and perpetuation of the two year classes of striped bass.

In 2017, the Juvenile Anadromous Survey (P100) which was developed in the Albemarle Sound to determine relative abundance, growth and distribution of juvenile alosines and striped bass was expanded to include the Tar-Pamlico, Neuse, Cape Fear, and Northeast Cape Fear rivers. The survey employs both seines (June-July) and trawls (July-October) to monitor the status of the striped bass stocks in North Carolina and to assess the effectiveness of management measures aimed at promoting natural reproduction within the CSMA. From 2017 to 2020 young-of-year sampling in the Central Southern Management Area (CSMA) did not capture any juvenile striped bass in the Tar-Pamlico, Neuse, and Cape Fear rivers, however 24 juvenile striped bass were captured in the Northeast Cape Fear River in 2018, four in 2019, and one in 2020.

Age data from fishery independent surveys are presented in CS_Table 3 and CS_Figure 9; from 2004 to 2019, 1,808 otolith samples were collected and from 2016 to 2019, 509 genetic samples were collected that provided striped bass ages from fishery independent surveys (CS_Table 3). Figure CS_Figure 9 shows an increasing trend of size at length with a maximum age of 12 years old.

RESEARCH NEEDS

The research recommendations listed below (in no particular order) are offered by the working group to improve future stock assessments of the A-R striped bass stock. The bulleted items outline the specific issue and are organized by priority ranking.

<u>High</u>

- Improve estimates of discard mortality rates and discard losses from the ASMA commercial gill-net fisheries (ongoing through observer program)
- Collect data to estimate catch-and-release discard losses in the ASMA recreational fishery during the closed harvest season
- Investigate relationship between river flow and striped bass recruitment for consideration of input into future stock assessment models

<u>Medium</u>

- Transition to an assessment that is based on ages derived from otoliths
- Improve estimates of catch-and-release discard losses in the RRMA recreational fishery during the closed harvest season
- Incorporate tagging data directly into the statistical catch-at-age model
- Improve the collection of length and age data to characterize commercial and recreational discards
- Explore the direct input of empirical weight-at-age data into the stock assessment model in lieu of depending on the estimated growth relationships

<u>Low</u>

- Re-evaluate catch-and-release mortality rates from the ASMA and RRMA recreational fisheries incorporating different hook types and angling methods at various water temperatures (e.g., live bait, artificial bait, and fly fishing)
- Investigate the potential impact of blue catfish on the A-R striped bass population (e.g., habitat, predation, forage)

The research recommendations listed below (in no particular order) are intended to improve future assessments of the CSMA striped bass stocks. The bulleted items outline the specific issue and are organized by priority ranking.

High

- Acquire life history information: maturity, fecundity, size and weight at age, egg and larval survival (ongoing through CRFL funded projects and NCDMF P930 data collection; see Knight, 2015, for recent work on maturation and fecundity in the Neuse and Tar-Pamlico rivers)
- Conduct delayed mortality studies for recreational and commercial gear during all seasons factoring in relationships between salinity, dissolved oxygen, and water temperature
- Develop better estimates of life-history parameters, especially growth and factors influencing rates of natural mortality for all striped bass life stages (growth is ongoing through NCDMF P930 data collection; for natural mortality, see recent publications Bradley 2016 and Bradley et al. 2018b)

Medium

- Determine factors impacting survivability of stocked fish in each system (Bradley et al. 2018b)
- Implement a random component to NCDMF program 100 juvenile sampling in the CSMA
- Conduct a power analysis to determine minimum sample sizes needed for determining the representative age structure

Low

- Determine if contaminants are present in striped bass habitats and identify those that are potentially detrimental to various life history stages (ongoing through N.C. Division of Water Quality but could be expanded; in 2017, NCSU was awarded a CRFL grant to conduct research on striped bass eggs, including evaluating for Gen X)
- Identify minimum flow requirements in the Tar-Pamlico, Neuse, and Cape Fear rivers necessary for successful spawning, egg development, and larval transport to nursery grounds
- Evaluate factors influencing catchability of striped bass, particularly larger striped bass, in electrofishing surveys conducted on the spawning grounds
- Obtain improved commercial discard estimates from the estuarine gill-net fisheries (i.e., anchored, runaround, and strike gill nets) in the CSMA systems to better characterize harvest and discards
- Investigate factors influencing mixing rates between A-R and CSMA striped bass stocks
- Identify water quality parameters that impact spawning, hatching, and survival of striped bass in CSMA systems
- Develop a consistent ageing approach across agency sampling programs
- Continue PIT tagging striped bass in the Cape Fear River and expand PIT tagging to the Tar-Pamlico and Neuse rivers to estimates of spawning population size
- Investigate factors influencing rates of natural mortality for all striped bass life stages in the CSMA systems

MANAGEMENT STRATEGY

A-R Stock

Estuarine striped bass in North Carolina are managed under Amendment 1 to the North Carolina Estuarine Striped Bass FMP and subsequent revisions (see AR_Table 6). Striped bass fisheries in the Atlantic Ocean of North Carolina are managed under ASMFC's Amendment 6 to the Interstate FMP for Atlantic Striped Bass and subsequent addenda. The A-R stock is managed using biological reference points for spawning stock biomass and fishing mortality that are aimed at maintaining a sustainable harvest and adequate spawning stock biomass. Stock status is determined through a formal, peer reviewed stock assessment process that evaluates annual estimates of fishing mortality and biomass against their target and threshold values. The 2020 A-R striped bass stock assessment indicated that the A-R striped bass stock is overfished with overfishing occurring in the terminal year (2017). Adaptive management measures within Amendment 1 to the Striped Bass FMP required a reduction in TAL to reduce fishing mortality (F) to the target level. This reduction was implemented through a revision to Amendment 1 which reduced the TAL from 275,000 to 51,216 pounds starting in January of 2021 (NCDMF 2020). Juvenile abundance data generated from the survey is used in the A-R stock assessment as an independent measure of stock abundance. The index is also used as a recruitment failure trigger. If the JAI is below 75 percent of all values from a fixed time series for three consecutive years, the ASMFC Striped Bass Technical Committee will make a recommendation to the ASMFC Striped Bass Management Board about possible causes and if management action is needed. The JAI values for 2018, 2019, and 2020 were 0.4, 1.18, and 0.20 respectively and are below the spawning failure threshold of 1.33 indicating that the recruitment failure trigger has been met (ASMFC 2010). Amendment 2 to the N.C. Estuarine Striped Bass Fishery Management Plan is being jointly developed with the Wildlife Resources Commission.

CSMA Stocks

Estuarine striped bass in North Carolina are managed under Amendment 1 to the North Carolina Estuarine Striped Bass FMP and subsequent revisions and supplement (see CS_Table 5). Due to concerns about the high percentage of stocked fish and minimal natural recruitment in the CSMA systems, the comprehensive review of the Estuarine Striped Bass FMP began in July 2017 instead of as originally scheduled in 2018. Since adoption of the 2004 FMP there has been little change in the size and age distribution, with few age-6 and older fish observed in any system. The need for continued conservation management efforts are supported by the constrained size and age distributions, low abundance, the absence of older fish in all stocks, and the high percentage of stocked fish in the population (Cushman et al. 2018; Farrae et al. 2018). Results from genetic testing of sampled fish in 2017 suggest there were two recent naturally spawned year classes and in February 2019, Supplement A to Amendment 1 to the North Carolina Estuarine Striped Bass FMP was approved instituting a recreational and commercial no-possession limit in the CSMA. The no-possession measure provides additional protection for non-hatchery fish until Amendment 2 to the North Carolina Estuarine Striped Bass FMP is adopted. The stocks were evaluated using a matrix model for the Tar-Pamlico and Neuse rivers and a tagging model for the Cape Fear River. This evaluation will inform recovery metrics for the CSMA stocks in Amendment 2.

FISHERY MANAGEMENT PLAN SCHEDULE RECOMMENDATIONS

The comprehensive FMP review is underway and the division is continuing joint development of Amendment 2 with the Wildlife Resources Commission.

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TABLES - Combined

Table 1. Recreational striped bass effort, harvest and discards from the ASMA, RRMA, and CSMA (2011–2020). In the CSMA, there was a limited recreational harvest season in 2019 prior to closing (January 1–March 19, 2019). The recreational season remained closed in 2020.

Management Area	Year	Striped Bass Fishing Angler Trips	Striped Bass Effort Angler Hours	Number Harvested	Pounds Harvested	Striped Bass Discard (#over-creel)	Striped Bass Discard (#under-sized)	Striped Bass Discard (#legal-sized)	Striped Bass Discard (# slot-sized)	Total Discards
ASMA*	2011	13,114	85,325	13,341	42,536	317	20,114	1,141	N/A	21,572
	2012	14,490	102,787	22,345	71,456	1,024	19,977	3,970	N/A	24,971
	2013	7,053	50,643	4,299	14,897	31	16,034	316	N/A	16,381
	2014	7,264	40,478	5,529	16,867	18	22,558	510	N/A	23,086
	2015	11,132	75,009	23,240	70,008	1,573	45,559	2,402	N/A	49,534
	2016	7,023	42,276	4,794	14,486	252	8,822	1,278	N/A	10,352
	2017	8,822	41,371	4,214	15,479	55	24,003	599	N/A	24,659
	2018	9,057	34,764	3,465	11,763	281	21,388	3,970	N/A	25,639
	2019	18,833	71,800	10,723	36,351	52	32,020	2,896	N/A	34,968
	2020#	22,329	91,265	7,656	25,450	33,013	16,428	107	N/A	49,548
	Total	119,117	635,718	99,606	319,293	36,616	226,903	17,189	N/A	280,710
RRMA	2011	27,311	122,876	22,102	71,561	Disposition of discards not available for all years.				80,828
	2012	27,151	110,982	28,847	88,539					40,772
	2013	19,539	100,391	7,718	25,197					49,148
	2014	15,960	80,256	11,058	33,717					93,471
	2015	22,827	111,419	20,031	58,962					78,401
	2016	25,036	129,132	21,260	65,218					34,753
	2017	19,688	101,565	9,899	32,569					68,693
	2018	18,280	95,447	8,741	26,797					121,969
	2019	20,633	99,259	16,582	53,379					117,550
	2020††	10,258	48,087	5,534	17,326					10,999
	Total	206,683	999,414	151,772	473,265					696,584
CSMA	2011	12,606	51,540	2,728	9,474	9	16,659	5,397	2,123	24,188
	2012	18,338	71,964	3,922	15,240	439	26,343	13,621	2,910	43,313
	2013	20,394	86,918	5,467	19,537	539	19,302	10,619	2,357	32,816
	2014	15,682	70,316	3,301	13,368	1449	19,185	7,934	1641	30,209
	2015	18,159	79,398	3,934	14,269	217	22,272	8,052	813	31,353
	2016	23,675	110,453	6,697	25,260	215	57,874	10,593	6,779	75,461
	2017	26,125	119,680	7,334	26,973	549	101,787	26,501	2,293	131,129
	2018	16,393	69,917	3371	10,884	871	34,128	12,232	1,890	49,122
	2019+	8,820	40,580	959	3,562	924	24,857	7,817	2,481	37,039
	2020†	2,846	13,272	0	0	0	10,439	7,575	1,406	19,420
	Total	163,038	714,037	37,713	138,567	5,212	332,847	110,341	24,692	474,050

***** Estimates of discards not available for the post-harvest season period.

\+ Limited season (Jan 1- March 19, 2019)

† Closed season

Creel estimate for the spring survey is for the period January 1–March 27, 2020.

†† Creel estimate for the spring survey is for the period March 1 to March 18, 2020.

TABLES - Albemarle-Roanoke (AR)

AR_Table 1. Striped bass commercial and recreational harvest and discards in pounds from the Albemarle Sound Management Area (ASMA) and Roanoke River Management Area (RRMA), NC, 1991–2020.

	Commercial Harvest	Commercial Dead Discards	Recreational Harvest		Recreational Dead Discards	
	ASMA	ASMA	ASMA	RRMA	ASMA	RRMA
Year	pounds	numbers	pounds	pounds	numbers	numbers
1991	108,555	10,267	35,344	72,529	1,507	9,516
1992	100,641	8,434	30,758	36,016	1,279	4,725
1993	109,570	8,952	36,049	45,145	847	5,061
1994	102,471	4,302	30,217	28,089		2,927
1995	87,920	4,938	30,564	28,883		3,373
1996	90,213	4,150	29,186	28,178		10,461
1997	96,210	3,967	26,581	29,997	1,969	18,673
1998	124,032	5,817	64,580	73,541	5,881	12,159
1999	163,010	7,401	61,338	72,967	2,581	10,468
2000	214,223	10,500	116,158	120,091	5,052	5,961
2001	220,462	11,630	118,506	112,805	3,931	4,544
2002	223,108	6,633	92,649	112,698	3,300	3,570
2003	266,539	10,394	51,794	39,170	1,618	2,448
2004	273,814	4,475	97,097	90,191	2,627	11,989
2005	232,808	9,566	63,477	107,530	1,358	10,093
2006	186,555	6,715	35,997	84,521	605	4,194
2007	171,828	4,803	26,633	62,492	870	3,360
2008	74,979	2,538	31,628	32,725	2,366	12,137
2009	95,879	3,294	37,313	69,581	2,596	8,702
2010	200,003	10,017	11,470	72,037	1,037	7,930
2011	136,378	6,646	42,536	71,561	1,381	6,894
2012	115,698	4,256	71,456	88,271	1,598	4,033
2013	68,409	6,706	14,897	25,197	1,048	4,750
2014	71,055	2,794	16,867	33,717	1,478	10,594
2015	114,596	3,539	70,008	58,962	3,170	6,927
2016	123,216	3,989	14,487	65,218	663	3,369
2017	76,059	2,762	15,480	32,569	1,578	5,021
2018	116,144	1,754	11,762	26,796	1,638	11,982
2019	136,820	1,175	36,351	53,379	2,238	11,980
2020*	124,385	1,866	17,326	17,326	3,297	703

Due to Covid restrictions, the creel surveys during the spring of 2020 were cut short. Creel estimate for the spring ASMA survey is for the period January 1–March 27, 2020. Creel estimate for the spring RRMA survey is for the period March 1 to March 18, 2020.

AR_Table 2. Striped bass total length (inches) data from commercial fish house sampling from the Albemarle Sound Management Area (ASMA), NC, 2005–2020.

Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2005	21	17	43	719
2006	22	17	44	926
2007	22	17	47	860
2008	22	18	46	547
2009	21	18	41	813
2010	21	17	48	940
2011	21	18	39	990
2012	22	18	39	648
2013	22	18	45	543
2014	23	18	43	484
2015	22	18	43	794
2016	22	18	43	604
2017	22	18	41	246
2018	20	16	41	456
2019	20	17	40	566
2020	22	17	40	191

AR_Table 3. Striped bass total length (inches) data from recreational landings from the Albemarle Sound Management Area (ASMA), NC, 2005–2020.

Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2005	20	16	36	1,653
2006	20	17	32	743
2007	20	17	39	412
2008	20	18	30	632
2009	20	18	42	549
2010	20	17	28	337
2011	20	18	34	979
2012	20	18	36	1,059
2013	20	18	32	527
2014	19	18	28	802
2015	20	17	30	1,523
2016	21	18	28	423
2017	21	18	32	489
2018	18	17	29	312
2019	18	17	27	555
2020	20	16	30	683

AR_Table 4. Striped bass total length (inches) data from recreational landings from the Roanoke River Management Area (RRMA), NC, 2005–2020.

Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2005	20	17	40	981
2006	20	17	39	1,059
2007	20	18	39	709
2008	19	17	35	667
2009	19	17	32	1,049
2010	20	18	28	954
2011	20	18	31	679
2012	20	17	28	688
2013	20	17	27	512
2014	19	17	30	559
2015	19	16	27	1,340
2016	20	17	29	1,133
2017	20	17	34	498
2018	20	17	28	688
2019	20	17	30	1,032
2020	19	18	24	155

AR_Table 5. Striped bass age data from dependent (commercial) and independent (independent gill net survey) surveys from the ASMA, NC, 2005–2020.

Year	Modal Age	Minimum Age	Maximum Age	Total Number Aged
2005	4	1	14	1,258
2006	5	1	14	1,262
2007	5	1	14	1,188
2008	3	1	16	1,191
2009	4	1	14	1,040
2010	5	1	17	885
2011	5	1	11	1,429
2012	2	1	14	802
2013	5	1	13	921
2014	4	2	11	728
2015	4	1	11	713
2016	5	2	12	555
2017	2	2	13	504
2018	4	1	10	674
2019	5	1	14	482
2020	5	1	11	301

AR_Table 6. Albemarle-Roanoke management actions taken as a result of Amendment 1 to the North Carolina Estuarine Striped Bass FMP and its subsequent revisions and/or supplements, with the most recent management actions listed first.

NOVEMBER 2020 REVISION TO AMENDMENT 1	
Management Strategy	**Implementation Status**
BIOLOGICAL REFERENCE POINTS	
Biological Reference Points (F and SSB) for the A/R stock will be determined through benchmark NC A/R striped bass stock assessments, which must be approved by the ASMFC Striped Bass Management Board.	Effective January 1, 2021
$F_{Target} = 0.13$	
$F_{Threshold} = 0.18$	
$SSB_{Target} = 350{,}371$ lb	
$SSB_{Threshold} = 267{,}390$ lb	
NEW TAL of 51,216 lb.	
The TAL will continue to be split evenly between commercial and recreational sectors	
ASMA commercial TAL = 25,608 lb.	
ASMA recreational TAL = 12,804 lb.	
RRMA recreational TAL = 12,804 lb.	
All other management strategies contained in Amendment 1 will remain in force until another Revision or Amendment to the North Carolina Estuarine Striped Bass FMP occurs.	
NOVEMBER 2014 REVISION TO AMENDMENT 1	
Management Strategy	**Implementation Status**
BIOLOGICAL REFERENCE POINTS	
Biological Reference Points (F and SSB) for the A/R stock will be determined through benchmark NC A/R striped bass stock assessments, which must be approved by the ASMFC Striped Bass Management Board.	Effective January 1, 2015
$F_{Target} = 0.33$	
$F_{Threshold} = 0.41$	
$SSB_{Target} = 969{,}496$ lb	
$SSB_{Threshold} = 785{,}150$ lb	
NEW TAL of 275,000 lb.	
The TAL will continue to be split evenly between commercial and recreational sectors	
ASMA commercial TAL = 137,500 lb.	
ASMA recreational TAL = 68,750 lb.	
RRMA recreational TAL = 68,750 lb.	
All other management strategies contained in Amendment 1 will remain in force until another Revision or Amendment to the North Carolina Estuarine Striped Bass FMP occurs.	

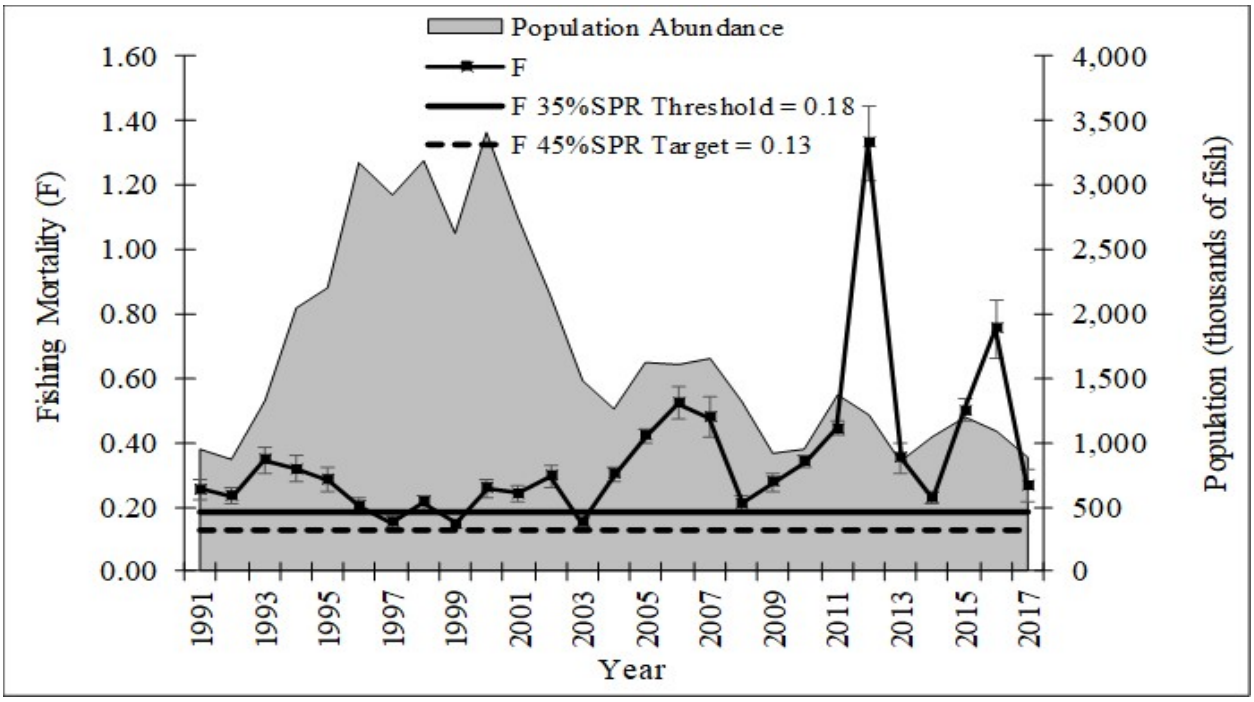
AR_Table 6. Continued.

AMENDMENT 1 MAY 2013	
Management Strategy	**Implementation Status**
RECREATIONAL STRIPED BASS HARVEST CLOSURE (Oregon Inlet Area/Atlantic Ocean) Status Quo – Allow the fishery to continue with catch card survey (May – Oct).	No additional regulatory action required
USE OF SINGLE BARBLESS HOOKS (during Striped Bass Closed Season) Status quo (don't require barbless hooks) and continue to educate anglers on ethical angling practices, with the additional recommendation to include mortality statistics associated with various handling techniques when possible.	Increase angler education about proper angling and handling techniques to reduce discard mortality
ALBEMARLE SOUND MANAGEMENT AREA (Southern Boundary Line Adjustment) Support the necessary rule changes to create a new boundary point.	Rule change: 15A NCAC 03J .0209; 03R .0112; and 03R .0201
CASHIE RIVER (Change in Joint and Coastal Waters Boundary Line) Support the necessary rule changes to create a new boundary point.	Rule change 15A NCAC 03Q .0202
ALBEMARLE SOUND MANAGEMENT AREA and ROANOKE RIVER MANAGEMENT AREA STRIPED BASS MANAGEMENT MEASURES Status Quo with the current management measures in the ASMA and RRMA.	No additional regulatory action required
Status Quo with the current management measures in the ASMA and RRMA.	
Status Quo for ASMA and RRMA management measures maintain the following:	
BIOLOGICAL REFERENCE POINTS	
$F_{Target} = 0.25$	
$F_{Threshold} = 0.29$	
A-R stock has been managed with a Total Allowable Landings (TAL) since 1990	
Maintain current TAL of 550,000 lb.	
The TAL will continue to be split evenly between commercial and recreational sectors	
ASMA commercial TAL = 275,000 lb.	
ASMA recreational TAL = 137,500 lb.	
RRMA recreational TAL = 137,500 lb.	
18 in TL minimum size limit (ASMFC compliance requirement)	
ASMA commercial harvest TAL = 275,000 lb.	
Continue to operate as a bycatch fishery	
Spring season, anytime between Jan 1 – Apr 30	
Fall Season, anytime between Oct 1 – Dec 31	
Daily trip limits for striped bass	
Maintain gill net mesh size and yardage restrictions	
Maintain seasonal and area closures	
Maintain attendance requirements for small mesh nets (mid – May through late November)	
ASMA Recreational Harvest (TAL = 137,500 lb.)	
18 in TL minimum size limit	

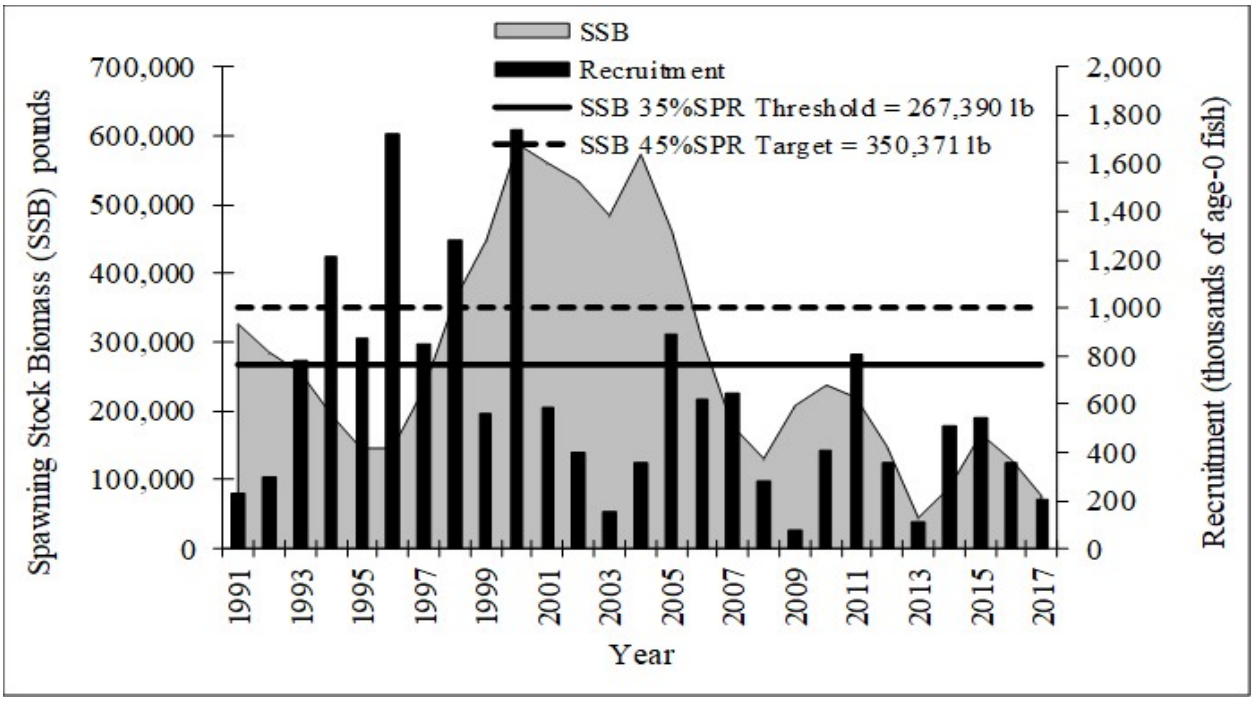
AR_Table 6. Continued.

AMENDMENT 1 MAY 2013	
Management Strategy	**Implementation Status**
Daily creel limit (can be adjusted as necessary to keep harvest below the TAL)	No additional regulatory action required
Open 7 days a week all season (can be adjusted as necessary to keep harvest below the TAL)	
Spring season, anytime between Jan 1 – Apr 30	
Fall season, anytime between Oct 1 – Dec 31	
RRMA Recreational Harvest (TAL = 137,500 lb.)	
18 in TL minimum size limit	
Protective slot (no harvest): 22-27 in TL	
2 fish daily creel, only one of which can be greater than 27 in TL	
Harvest season in entire river opens on March 1 and closes on April 30 by rule since 2008	
Single barbless hook regulation from April 1 – June 30 in Inland waters above the US 258 Bridge	
Management of TAL for ASMA and RRMA	
Short-term Overages: if the harvest point estimate exceeds the total TAC by 10% in a single year, overage is deducted from the next year and restrictive measures implemented in the responsible fishery(ies)	
Long-term Overages: five-year running average of harvest point estimate exceeds the five-year running average of the total TAL harvest by 2%, the responsible fishery exceeding the harvest limit will be reduced by the amount of the overage for the next five years. Should the target F be exceeded, then restrictive measures will be imposed to reduce F to the target level	
PROCLAMATION AUTHORITY For the ASMA, RRMA, and CSMA STRIPED BASS STOCKS:	
It should also be noted that under the provisions of this FMP the NCDMF Director and the NCWRC Chief of Inland Fisheries will maintain the ability to establish seasons, authorize or restrict fishing methods and gear, limit quantities taken or possessed, and restrict fishing areas as deemed necessary to maintain a sustainable harvest.	

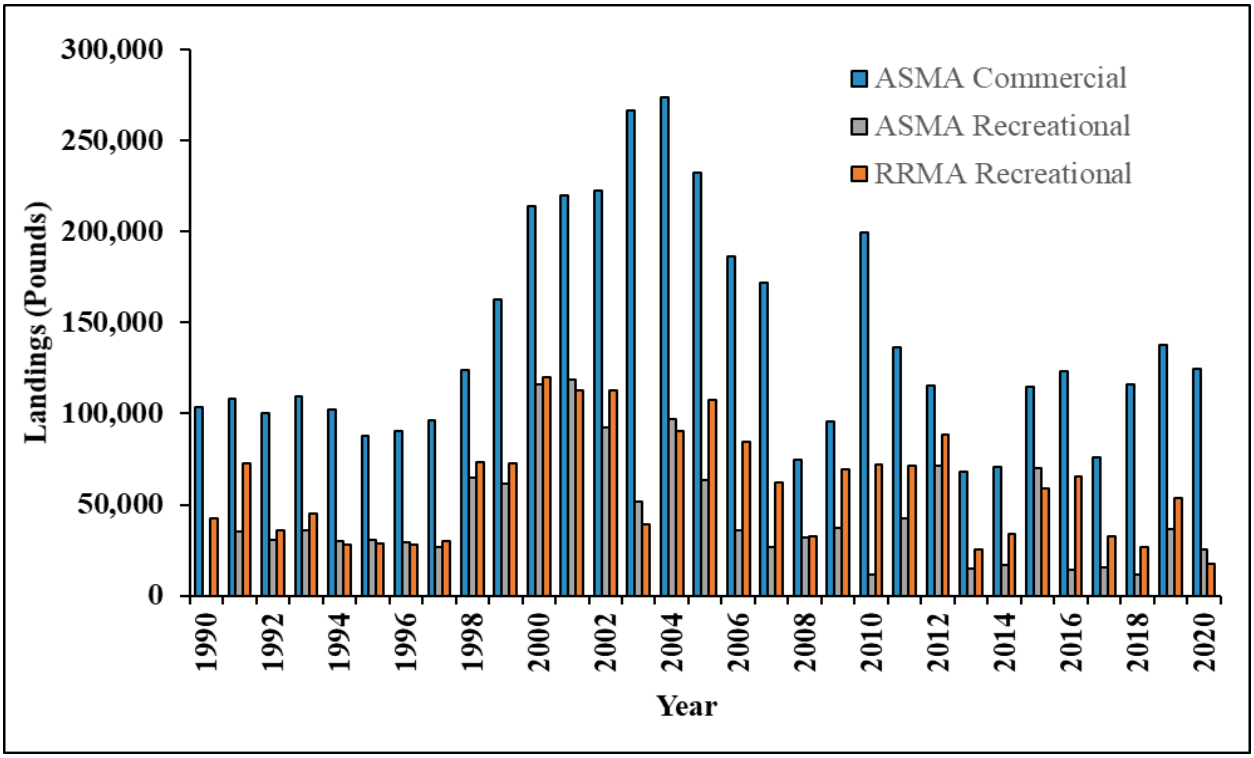
FIGURES - AR



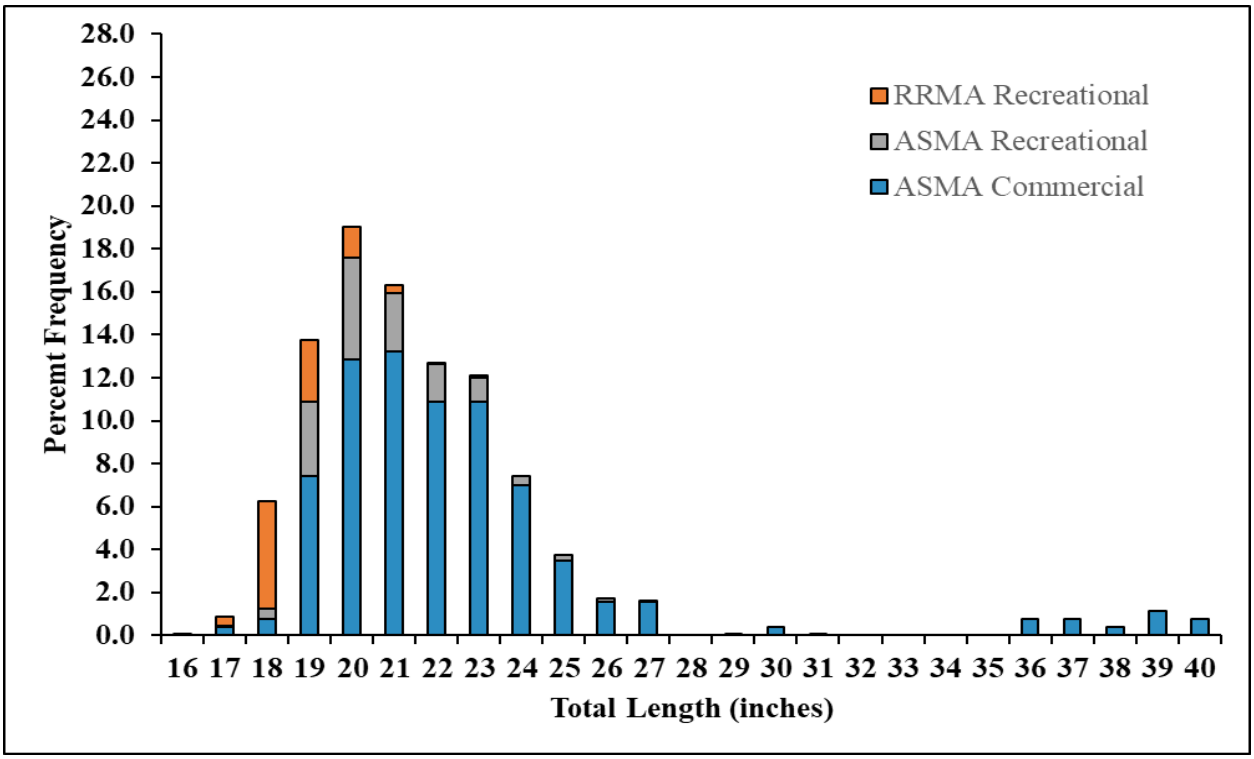
AR_Figure 1. Estimates of fishing mortality (*F*) and population abundance for the Albemarle-Roanoke striped bass stock, 1991–2017. Error bars represent ± two standard errors. Source: Lee et al. 2020.



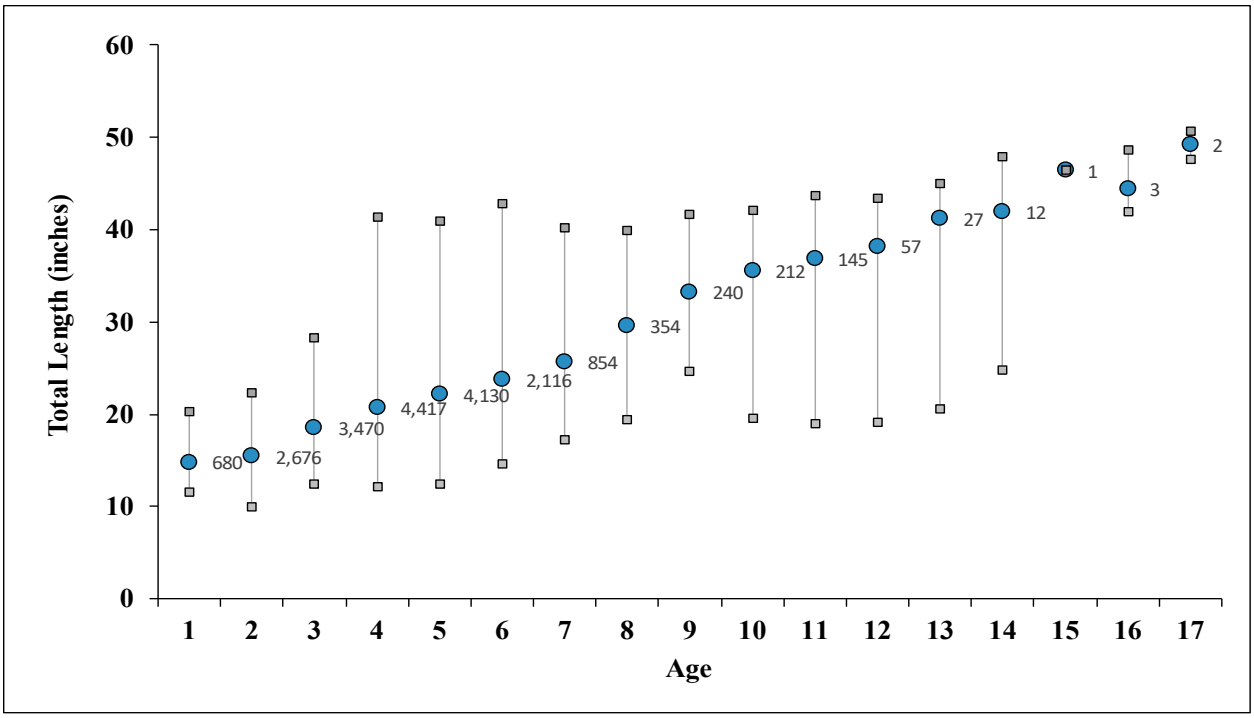
AR_Figure 2. Estimates of spawning stock biomass (SSB) and recruitment of age-0 fish coming into the population each year for the Albemarle-Roanoke striped bass stock, 1991–2017. Source: Lee et al. 2020



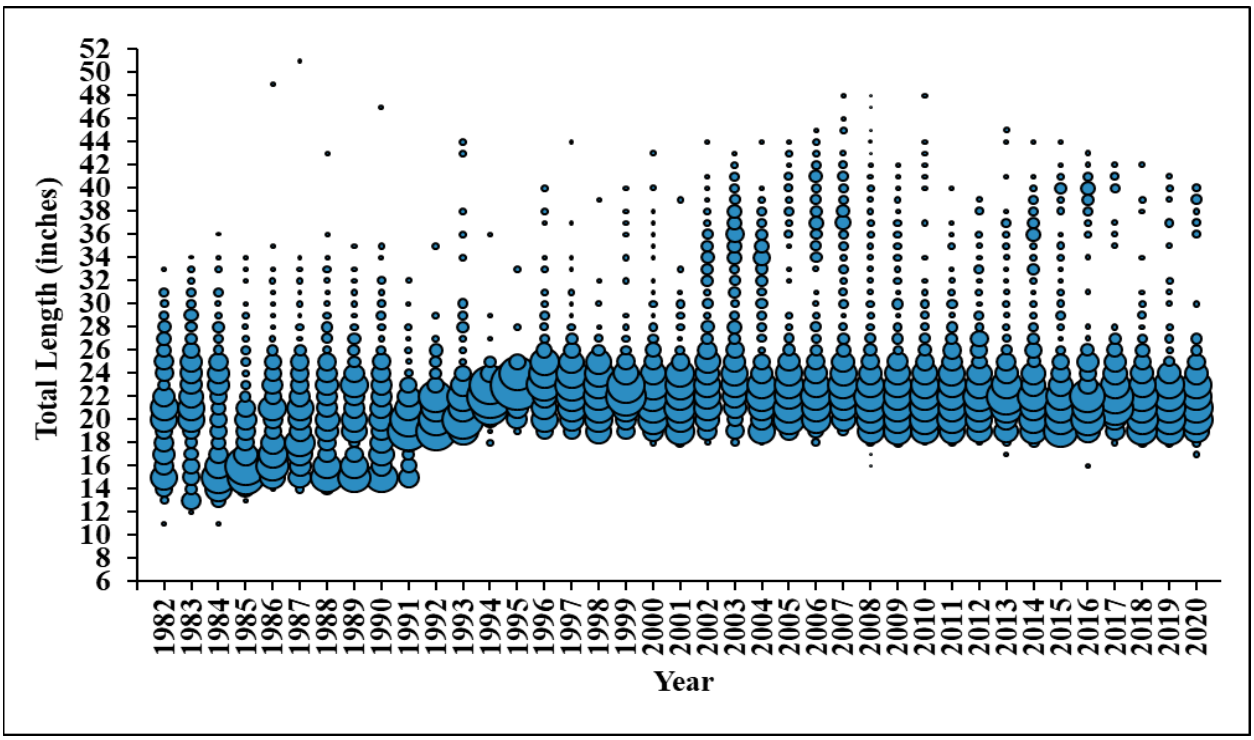
AR_Figure 3. ASMA commercial, ASMA recreational, and RRMA recreational striped bass landings in lbs, NC, 1990–2020. RRMA 2020 recreational landings are for March only. ASMA 2020 landings are from January-March.



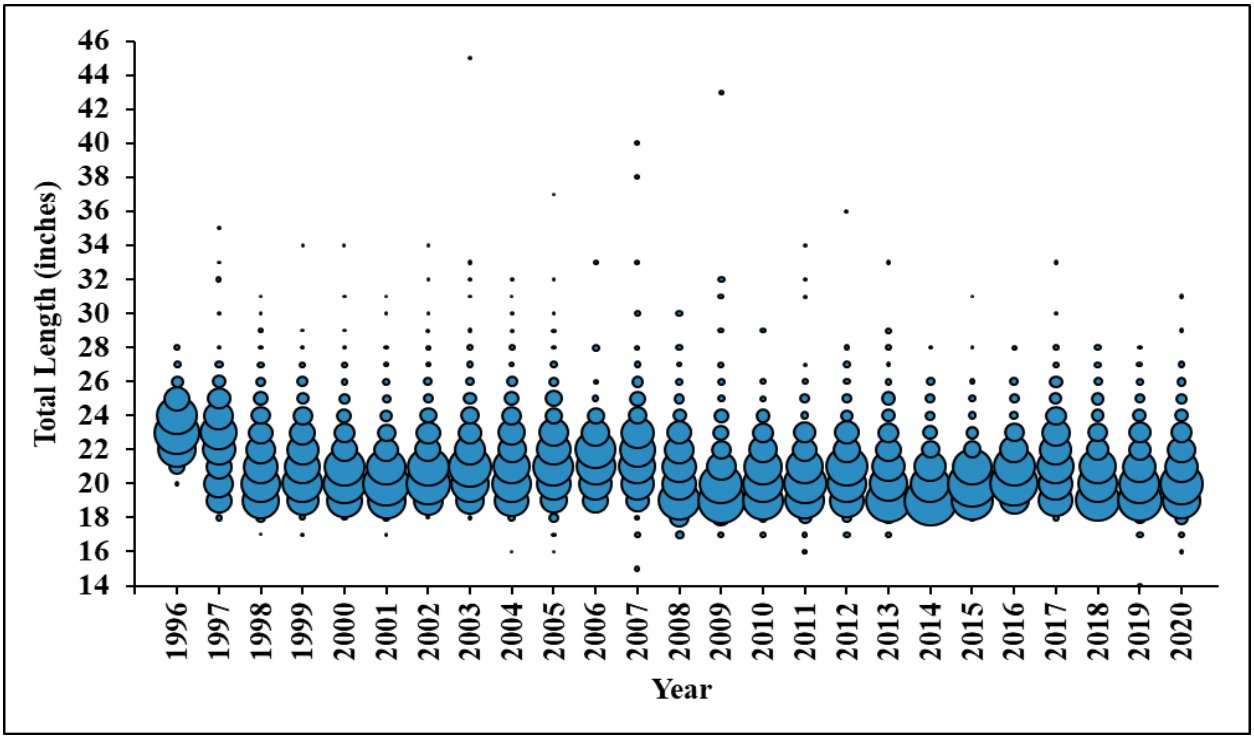
AR_Figure 4. ASMA commercial and recreational length frequency distribution from striped bass harvested in 2020.



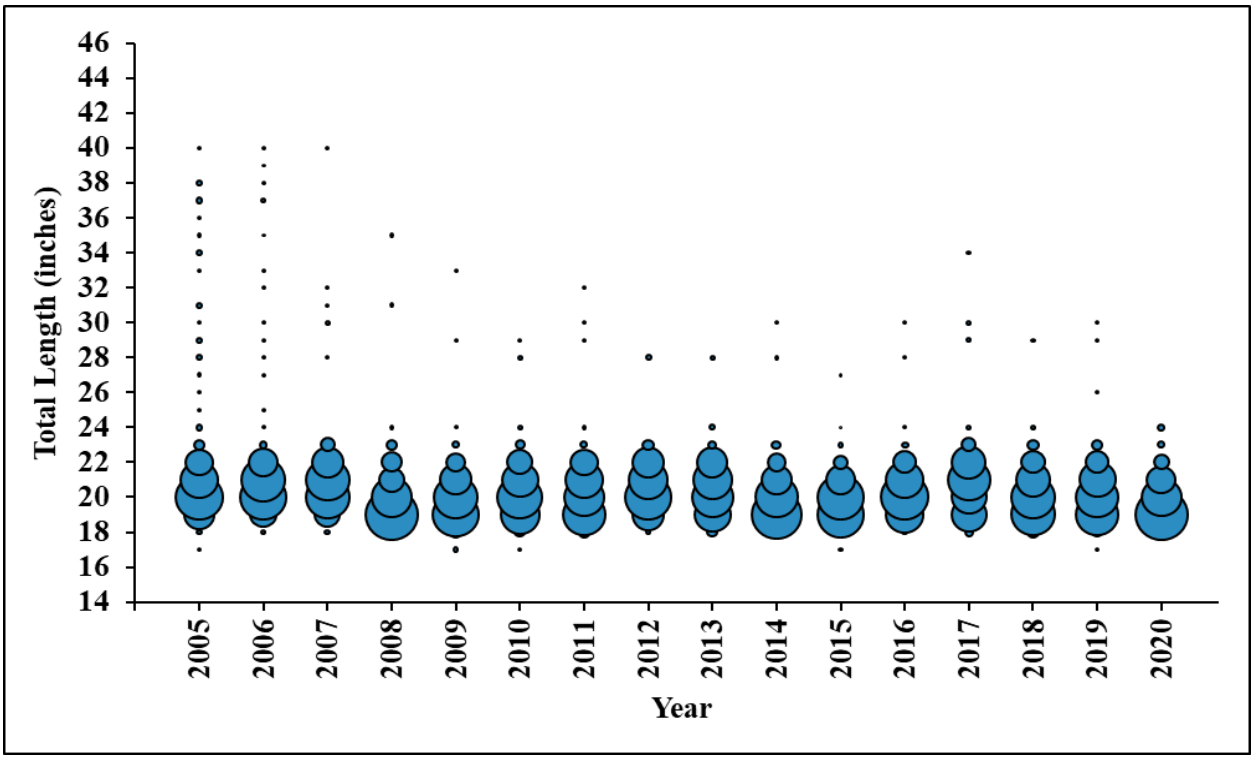
AR_Figure 5. Striped bass length at age based on all commercial samples collected from 1972 to 2020. Blue circles represent the mean size at a given age while the grey squares represent the minimum and maximum observed size for each age.



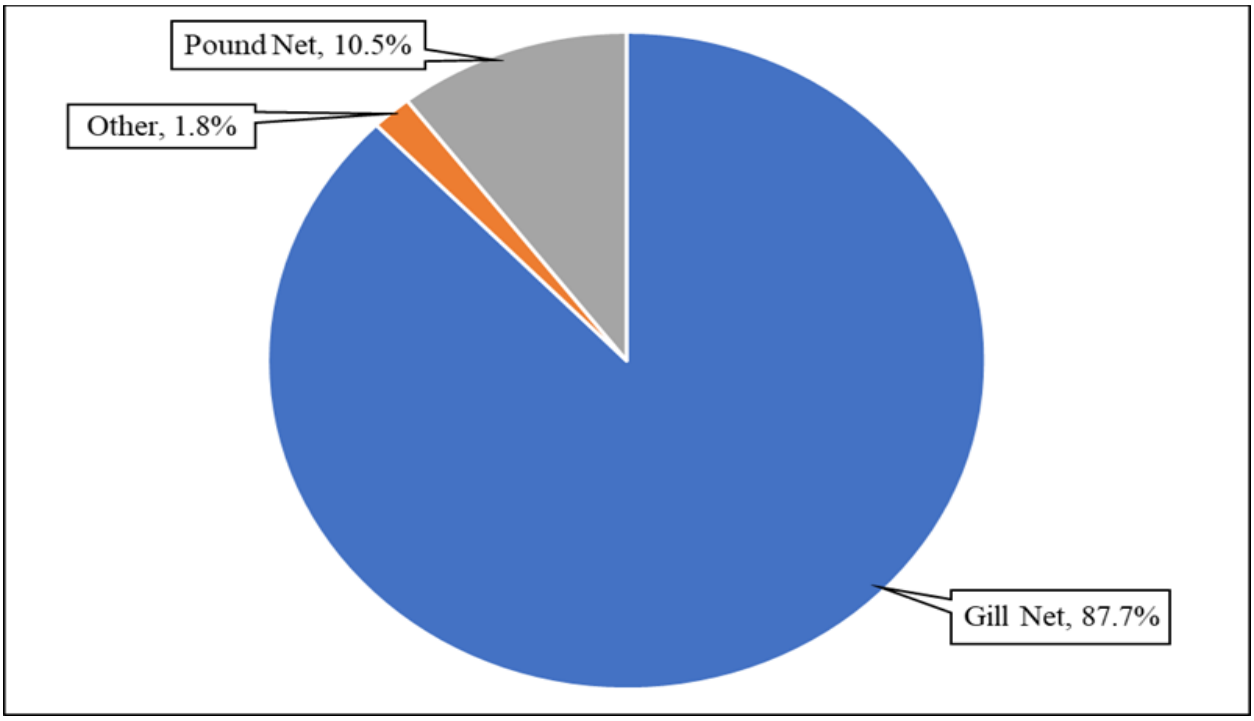
AR_Figure 6. Commercial length frequency (total length, in) of striped bass harvested in the ASMA, NC, 1982 to 2020. Bubble size represents the proportion of fish at length.



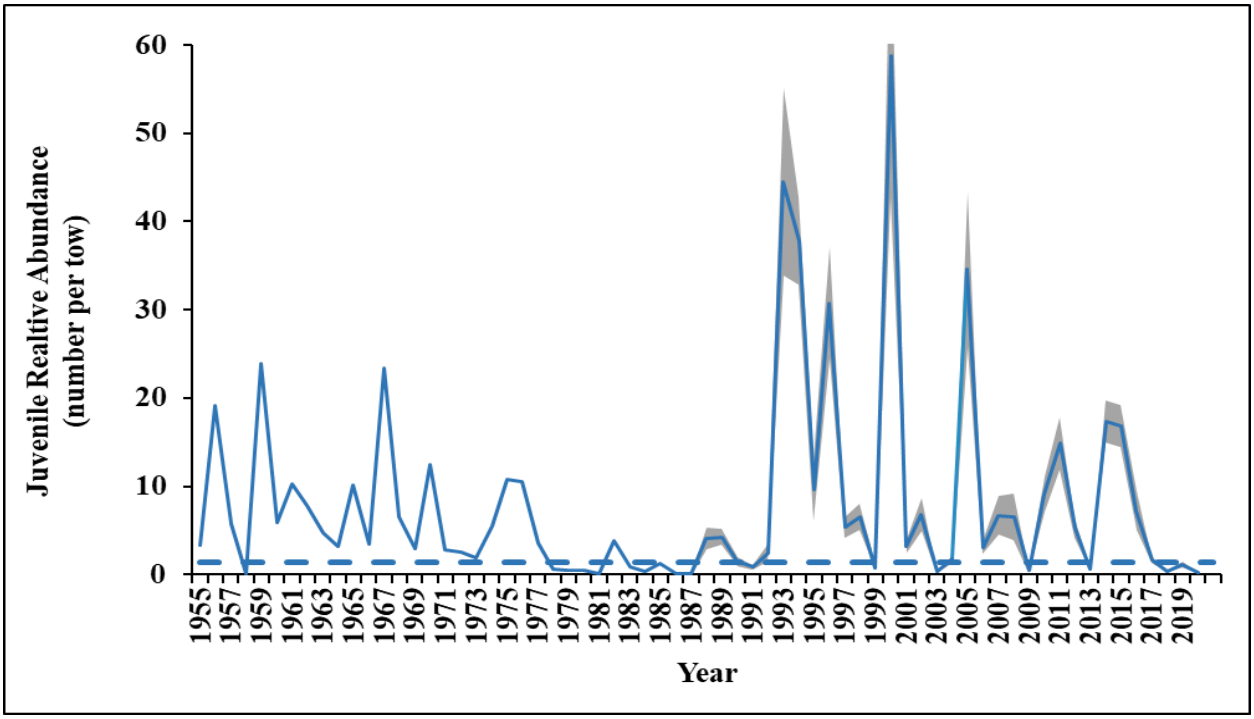
AR_Figure 7. Recreational length frequency (total length, in) of striped bass harvested in the ASMA, NC, 1996–2019. Bubble size represents the proportion of fish at length.



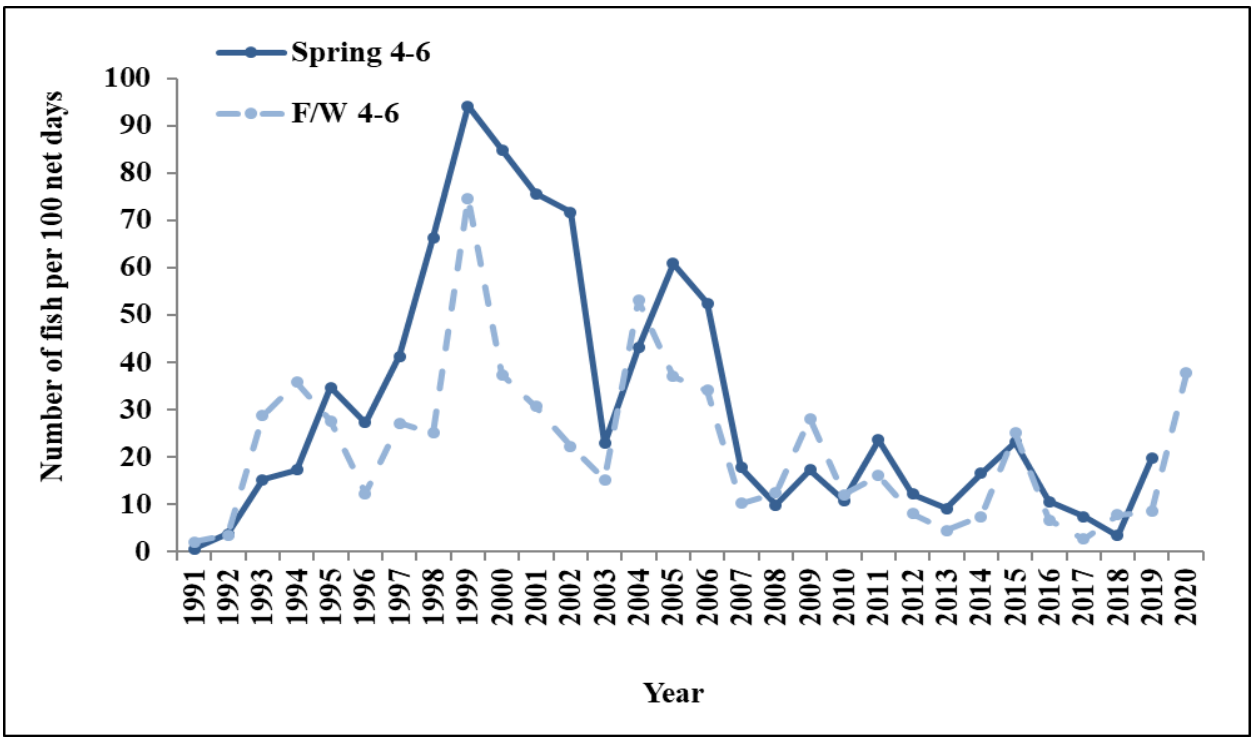
AR_Figure 8. Recreational length frequency (total length, in) of striped bass harvested in the RRMA, NC, 2005–2020. Bubble size represents the proportion of fish at length.



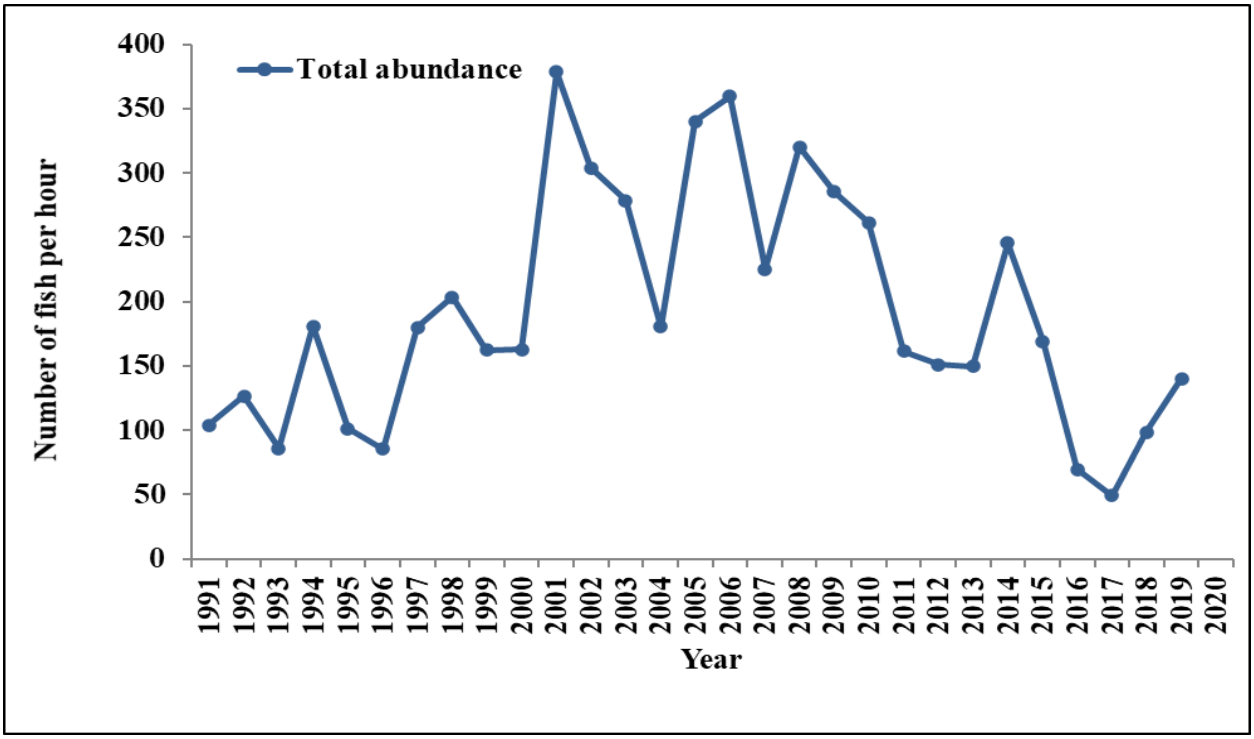
AR_Figure 9. Commercial striped bass landings broken out by major gears in the ASMA, NC, 1994–2020.



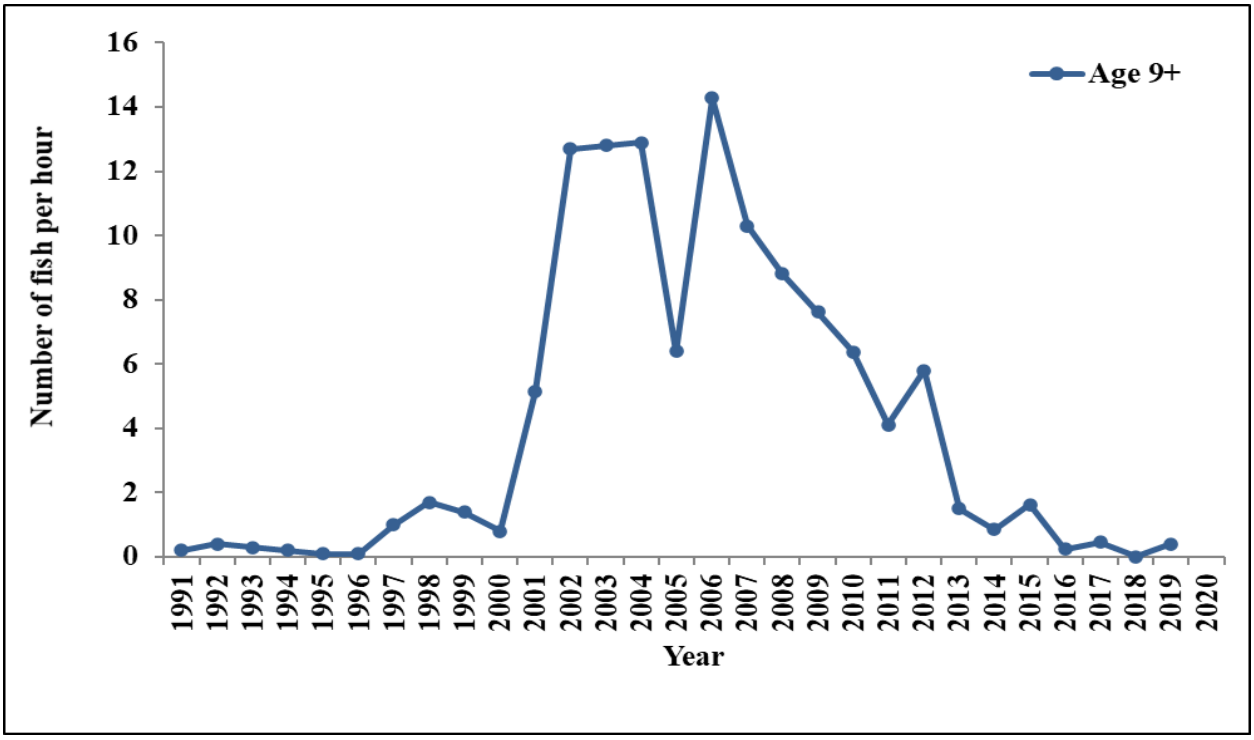
AR_Figure 10. Juvenile abundance index (JAI) of Albemarle-Roanoke striped bass from the NCDMF juvenile trawl survey, western Albemarle Sound, NC, 1955–2020. Dotted line represents ASMFC trigger (1.33 juveniles per tow) for spawning failure.



AR_Figure 11. Relative abundance of age 4–6 Albemarle-Roanoke striped bass from the NCDMF fall/winter and spring independent gill net surveys, Albemarle Sound area, NC, 1991–2020.



AR_Figure 12. Relative abundance of Albemarle-Roanoke striped bass from the NCWRC spawning grounds electrofishing survey, Roanoke River at Weldon, NC, 1991–2020.



AR_Figure 13. Relative abundance of age 9+ Albemarle-Roanoke striped bass from the NCWRC spawning grounds electrofishing survey, Roanoke River at Weldon, NC, 1991–2020.

TABLES - Central-Southern (CS)

CS_Table 1. Striped bass length data (TL - in) from CSMA commercial harvest, 2000–2020. All lengths and numbers (N) of fish sampled are for striped bass, no length data are presented for hybrid striped bass other than the percent sampled. The commercial season closed in 2019.

	Tar-Pamlico/Pungo rivers					Neuse/Bay rivers				
	Length (mm)				% Hybrid Striped Bass in Samples	Length (mm)				% Hybrid Striped Bass in Samples
Year	Mean	Min	Max	N		Mean	Min	Max	N	
2000	23	20	35	126	1.6	25	22	31	5	0.0
2001	23	21	26	116	8.7	25	23	31	12	0.0
2002	24	19	39	96	31.4	25	19	29	31	0.0
2003	23	18	37	173	39.9	24	19	37	19	5.0
2004	24	20	42	131	34.2	25	19	37	74	1.3
2005	23	20	37	127	9.3	24	20	36	70	1.4
2006	22	18	37	119	17.4	24	19	36	144	0.7
2007	22	19	33	112	4.3	22	19	27	63	4.5
2008	22	18	43	84	4.5	23	19	44	39	0.0
2009	22	19	31	99	1.0	22	18	31	85	2.3
2010	22	19	26	194	4.4	23	19	32	263	4.0
2011	23	18	27	284	2.4	23	19	42	195	0.0
2012	24	15	30	254	9.6	24	19	29	96	1.0
2013	25	18	40	225	12.8	25	18	39	301	3.2
2014	22	18	39	52	89.7	24	20	38	56	47.7
2015	24	19	40	97	74.6	24	19	44	97	21.8
2016	24	17	29	257	29.2	23	19	28	78	14.3
2017	24	19	31	151	12.2	24	19	50	97	4.0
2018	23	19	32	76	5.0	24	18	38	163	2.4
2019	-	-	-	-	-	-	-	-	-	-
2020	-	-	-	-	-	-	-	-	-	-

CS_Table 2. Striped bass length data (TL - in) from CSMA recreational harvest, 2004–2019 (includes striped bass and hybrid striped bass). There was a limited recreational season in 2019 (Jan 1–March 19) and the season remained closed in 2020.

Year	Mean Total Length	Minimum Total Length	Maximum Total Length	Total Number Measured
2004	22	17	32	430
2005	22	18	32	318
2006	22	18	30	132
2007	22	17	30	129
2008	21	18	26	50
2009	21	17	24	95
2010	21	18	26	74
2011	21	18	28	140
2012	21	18	28	153
2013	20	17	28	169
2014	21	18	30	115
2015	21	16	27	106
2016	20	18	33	144
2017	20	17	30	202
2018	19	16	29	155
2019	20	17	26	27
2020	-	-	-	-

CS_Table 3. CSMA striped bass otolith and genetic age data from fishery dependent (commercial and recreational creel survey) and independent (independent gill net survey) surveys from the, 2004–2019. Otolith age data from 2019 and 2020 are considered preliminary, and genetic ages for 2020 are not currently available.

	Modal Age		Minimum Age		Maximum Age		Total Number Aged	
Year	otolith	genetic	otolith	genetic	otolith	genetic	otolith	genetic
2004	3	-	1	-	11	-	50	-
2005	2	-	1	-	9	-	78	-
2006	3	-	1	-	9	-	111	-
2007	3	-	1	-	9	-	86	-
2008	3	-	1	-	8	-	103	-
2009	4	-	1	-	6	-	37	-
2010	5	-	1	-	9	-	154	-
2011	3	-	2	-	6	-	56	-
2012	3	-	1	-	7	-	205	-
2013	3	-	1	-	8	-	156	-
2014	3	-	1	-	11	-	172	-
2015	3	-	1	-	9	-	113	-
2016	2	3	1	2	8	6	38	323
2017	2	4	1	1	9	7	98	247
2018	3	4	1	1	12	8	109	201
2019	4	3	1	1	11	9	307	183
2020	5	-	1	-	9	-	147	-

CS_Table 4. Relative abundance of striped bass (number of individuals per sample), total number of striped bass collected, and the number of gill net samples (N) in the Tar-Pamlico and Neuse rivers (April, and October-November, shallow water sets (2004–2019). And in the Cape Fear and New rivers (February-December, all sets; 2008–2019) The Percent Standard Error (PSE) represents a measure of precision. No sampling occurred in 2020.

	Tar-Pamlico River				Neuse River				Cape Fear and New rivers			
Year	Abundance	No. of Striped Bass	N	PSE	Abundance	No. of Striped Bass	N	PSE	Abundance	No. of Striped Bass	N	PSE
2004	3.94	71	18	24	2.83	68	24	44	-	-	-	-
2005	4.61	83	18	17	3.75	90	24	42	-	-	-	-
2006	4.06	73	18	41	2.33	56	24	25	-	-	-	-
2007	3.56	64	18	49	2.83	68	24	28	-	-	-	-
2008	4.61	83	18	37	3.21	77	24	44	0.04	3	84	100
2009	2.78	50	18	36	2.13	51	24	41	0.03	3	119	67
2010	5.67	102	18	26	6.25	150	24	39	0.01	1	120	100
2011	7.72	139	18	32	4.75	114	24	30	0.04	4	120	50
2012	3.28	59	18	39	2.25	54	24	36	0.03	3	120	67
2013	3.22	58	18	36	2.54	61	24	31	0.02	2	120	50
2014	4.56	82	18	20	6.75	162	24	28	0	0	120	-
2015	2.67	48	18	33	5.33	128	24	27	0.14	15	120	36
2016	2.44	44	18	27	2.04	49	24	24	0.11	12	120	45
2017	2.44	44	18	29	3.21	77	24	24	0.08	9	120	50
2018	9.00	162	18	29	3.75	90	24	31	0.03	3	113	67
2019	5.06	91	18	33	4.21	101	24	32	0.01	1	120	100
2020	-	-	-	-	-	-	-	-	-	-	-	-

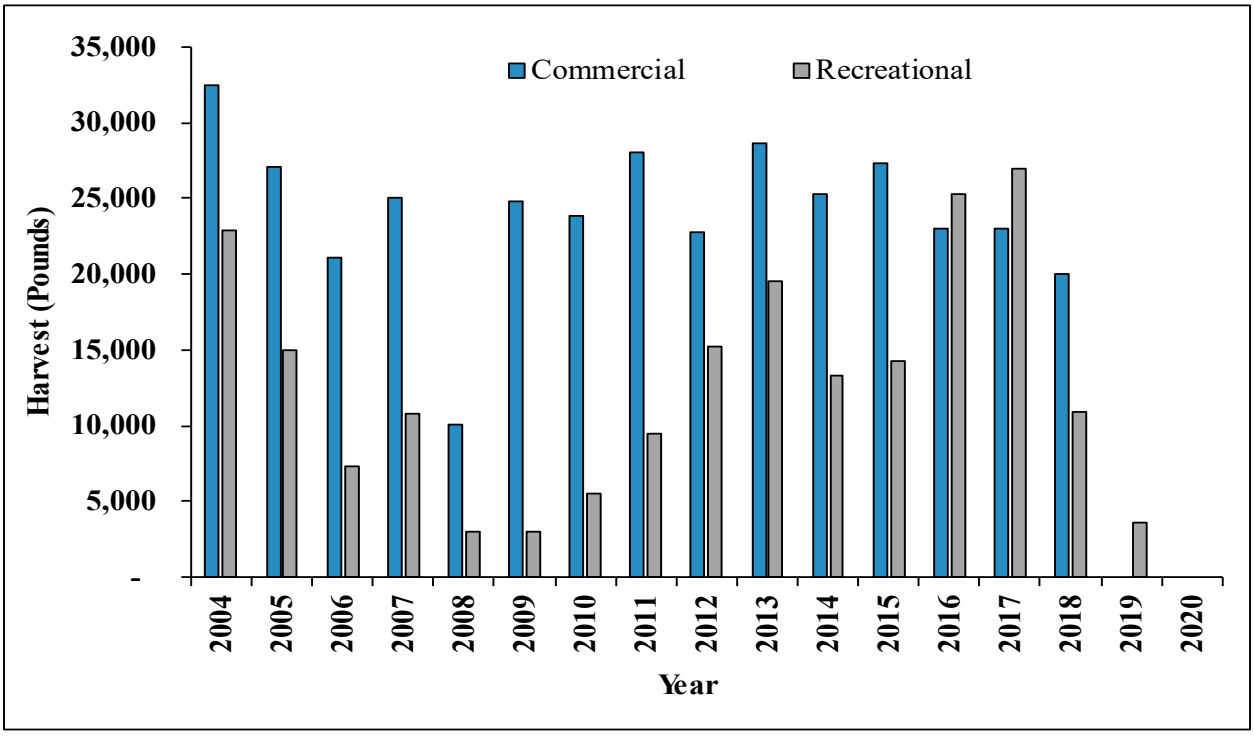
CS_Table 5. Central-Southern management actions taken as a result of Amendment 1 to the North Carolina Estuarine Striped Bass FMP.

SUPPLEMENT A TO AMENDMENT 1	
Management Strategy	**Implementation Status**
NO-POSSESSION MEASURE	
Prohibit commercial and recreational harvest of striped bass in the CSMA.	Effective March 29, 2019
Prohibit the use of all gill nets upstream of the ferry lines from the Bayview Ferry to Aurora Ferry on the Pamlico River and the Minnesott Beach Ferry to Cherry Branch Ferry on the Neuse River.	Proclamation (M-6-2019); Effective March 18, 2019
AMENDMENT 1 MAY 2013	
Management Strategy	**Implementation Status**
STRIPED BASS STOCKING (Coastal Rivers) Status quo and research needs – Goal of 100,000 Phase II striped bass stocked annually per CSMA system (Tar-Pamlico, Neuse, and Cape Fear) with 3,000 stocked fish tagged annually in each system.	No additional regulatory action required
DISCARD MORTALITY (CSMA Commercial Gill Net Sets)Status Quo – continue the gill net requirement for tie downs and restricting gill net from within 50 yards of shore proclamation.	No additional regulatory action required
HOOK and LINE as COMMERCIAL GEAR in ESTUARINE STRIPED BASS FISHERIES Status Quo (don't allow hook and line as commercial gear) and support the necessary rule changes for adaptive management.	Rule change 15A NCAC 03M .0201 and 03M .0202[1]
CENTRAL SOUTHERN MANAGEMENT AREA STRIPED BASS MANAGEMENT MEASURES Status Quo with the addition of instituting a pound for pound payback provision for the commercial harvest TAC[2].	No additional regulatory action required
Status Quo for CSMA management measures maintain the following:	
CSMA Recreational Harvest (Coastal, Joint, and Inland waters)	
AMENDMENT 1 MAY 2013	
Management Strategy	**Implementation Status**
Unified season Oct 1 – Apr 30	
2 fish daily creel limit	
18 in TL minimum size limit	
Protective slot (no harvest) 22 – 27 in TL (joint and inland waters only)	
Harvest moratorium for Cape Fear River and its tributaries	
CSMA Commercial Harvest (Coastal and Joint waters)	
TAC[2] of 25,000 lb. and commercial fishery, excluding Pamlico Sound, is not a bycatch fishery	
18 in TL minimum size limit	
10 fish or less trip limit	
Spring season only, anytime between Jan 1 – Apr 30	
Gill net mesh size restrictions and yardage limits	
18 in TL minimum size limit	

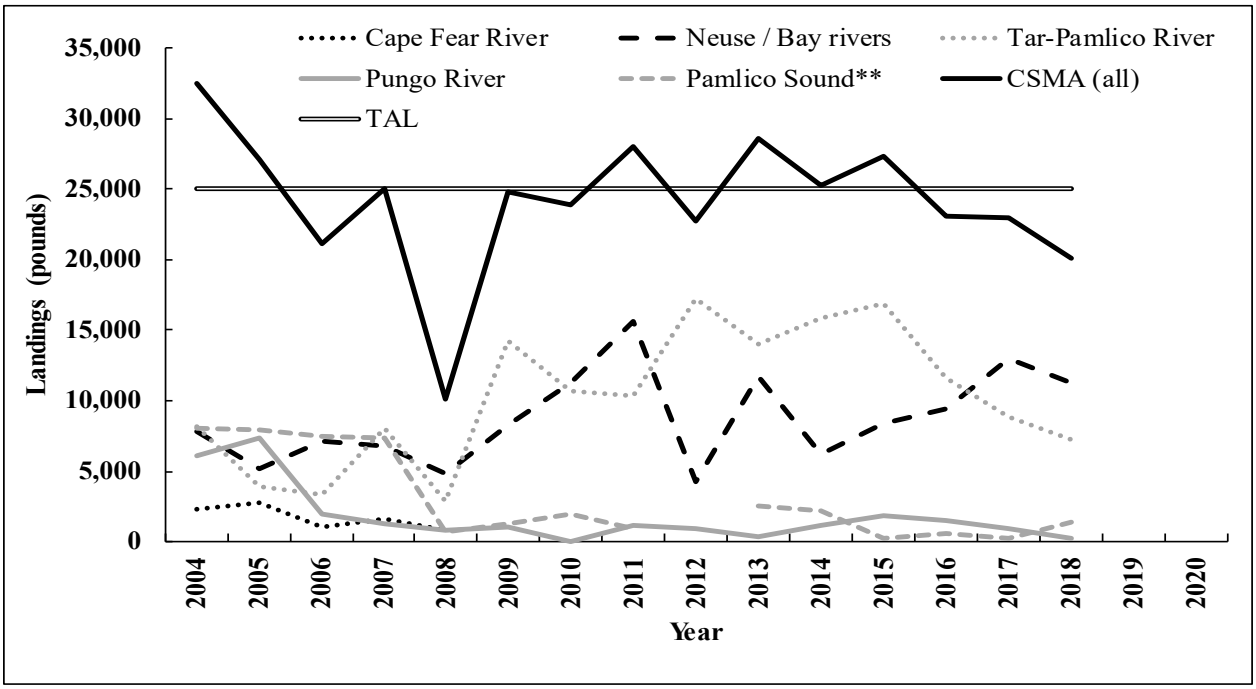
CS_Table 5. Continued.

AMENDMENT 1 MAY 2013	
Management Strategy	**Implementation Status**
Discards – maintain existing gill net tie-down and distance from shoreline (DFS) measures implemented by proclamation.	
Harvest moratorium for Cape Fear River and its tributaries	
PROCLAMATION AUTHORITY For the ASMA, RRMA, and CSMA STRIPED BASS STOCKS:	No additional regulatory action required
It should also be noted that under the provisions of this FMP the NCDMF Director and the NCWRC Chief of Inland Fisheries will maintain the ability to establish seasons, authorize or restrict fishing methods and gear, limit quantities taken or possessed, and restrict fishing areas as deemed necessary to maintain a sustainable harvest.	

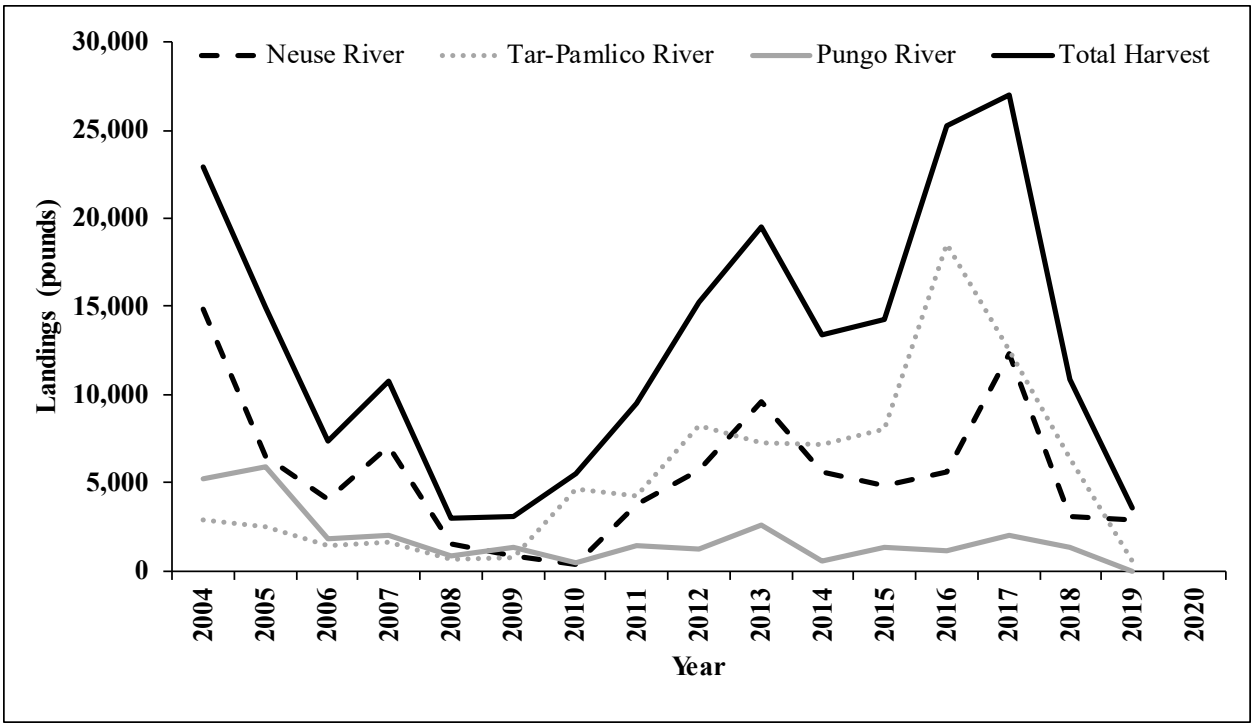
FIGURES - CS



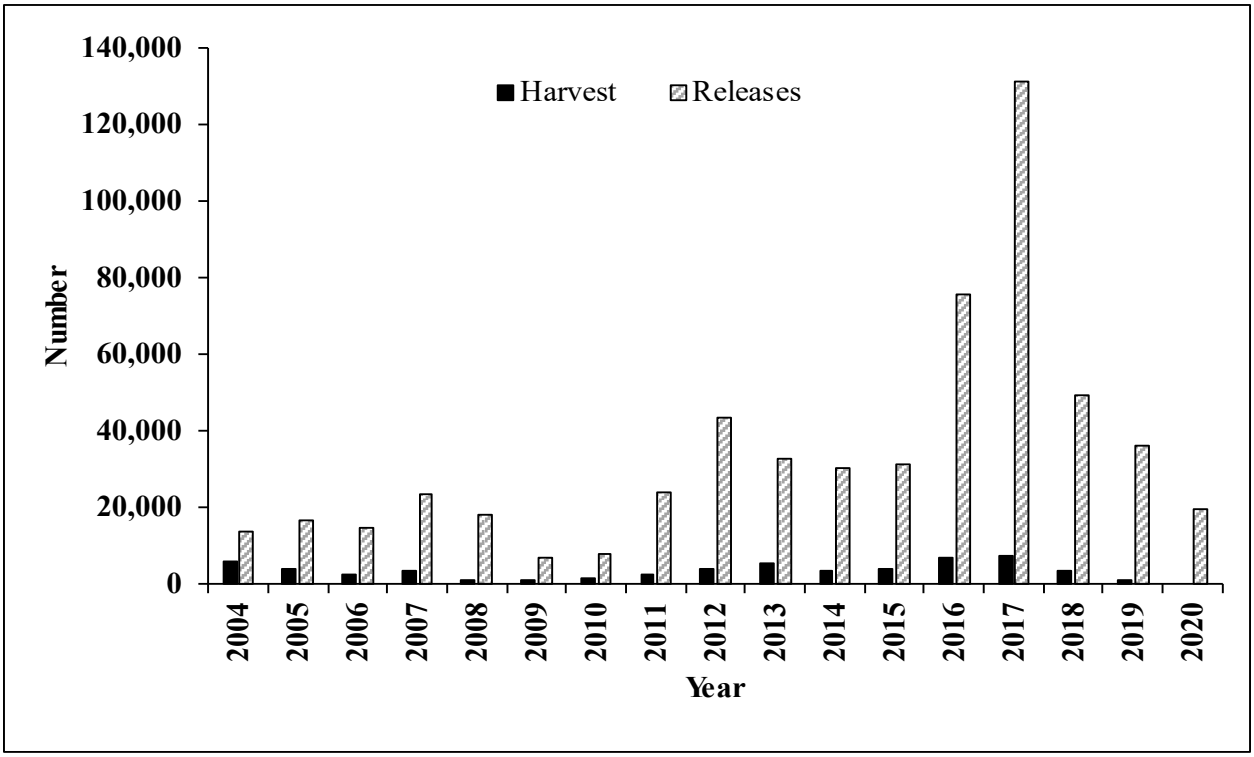
CS_Figure 1. Annual commercial and recreational CSMA striped bass harvest in pounds, 2004-2019. There was no commercial season and a limited recreational season in 2019, lasting from January 1 to March 19, 2019. Commercial and recreational seasons remained closed in 2020.



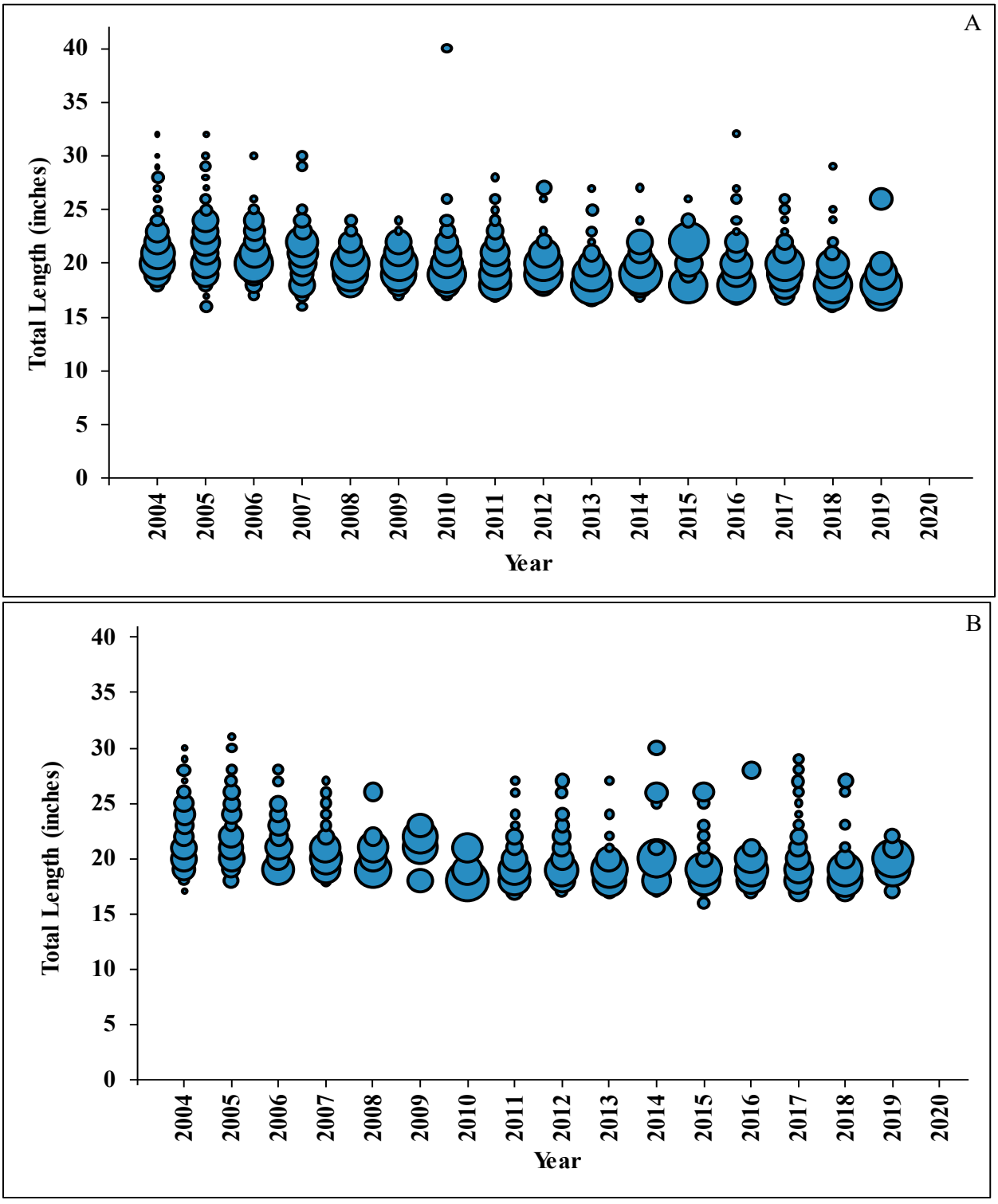
CS_Figure 2. Commercial striped bass harvest by system, and the TAL in the CSMA, 2004-2020. There has been a harvest moratorium in the Cape Fear River since 2009, and a closed season in the CSMA since 2019. Landings data for the Pamlico Sound in 2012 are confidential.



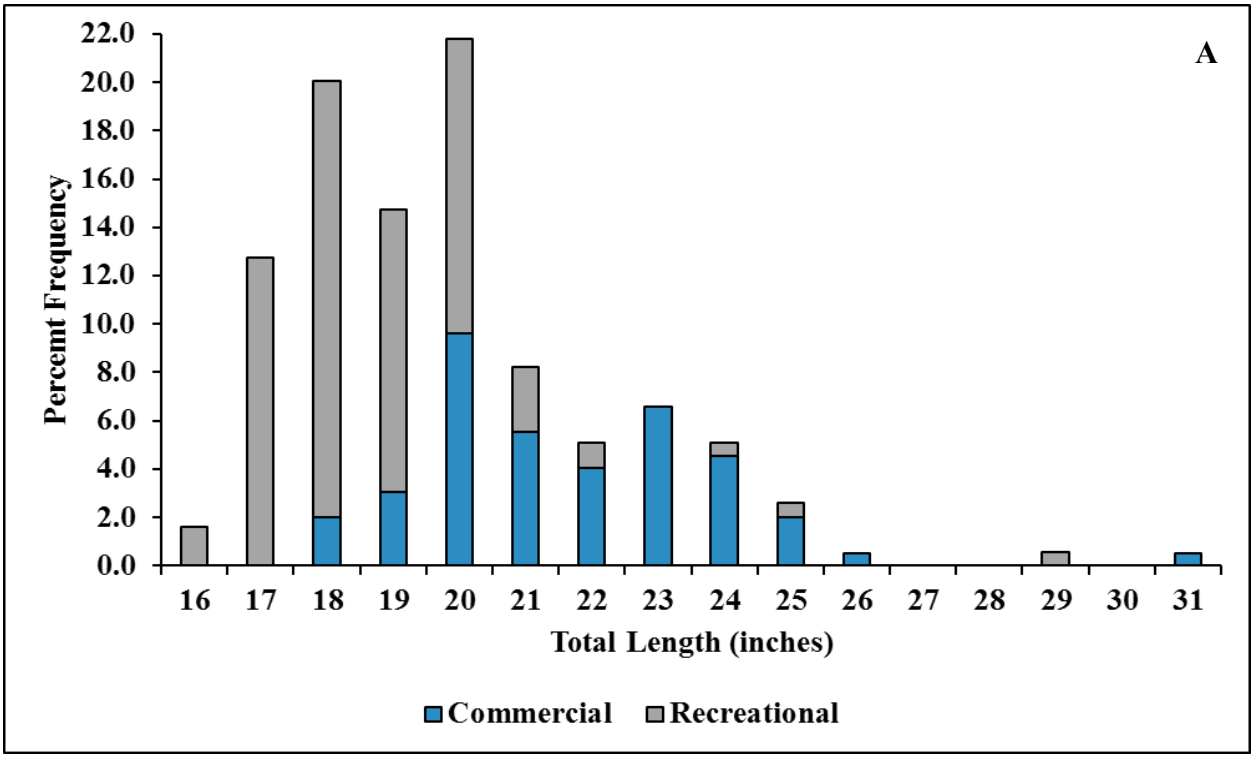
CS_Figure 3. Recreational striped bass harvest in the Tar-Pamlico, Pungo and Neuse rivers, 2004-2020. There was a limited recreational season in 2019, lasting from Jan 1-Mar 19, 2019 and the season remained closed in 2020.

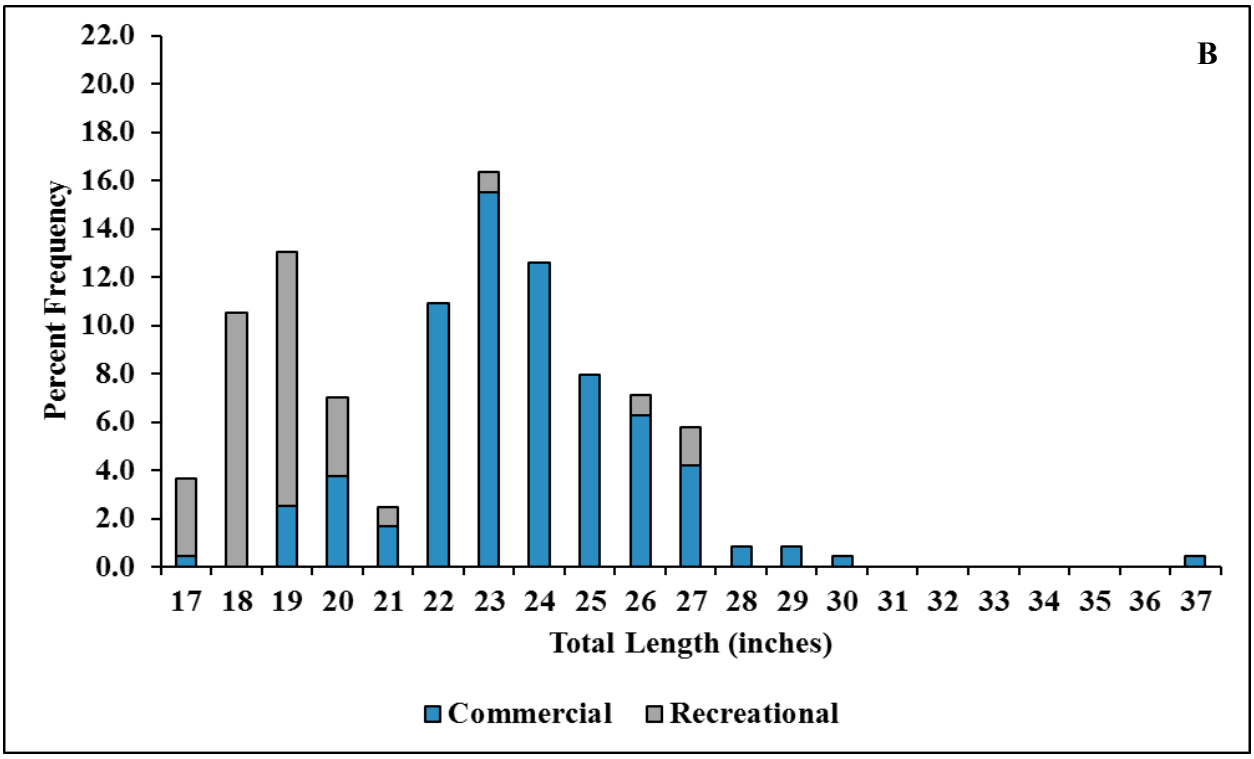


CS_Figure 4. Annual recreational catch (released and/or harvested) of striped bass in the CSMA, 2004-2020. There was a limited recreational harvest season in 2019 prior to the closure, lasting from Jan 1 to Mar 19, 2019 and the harvest season remained closed in 2020.

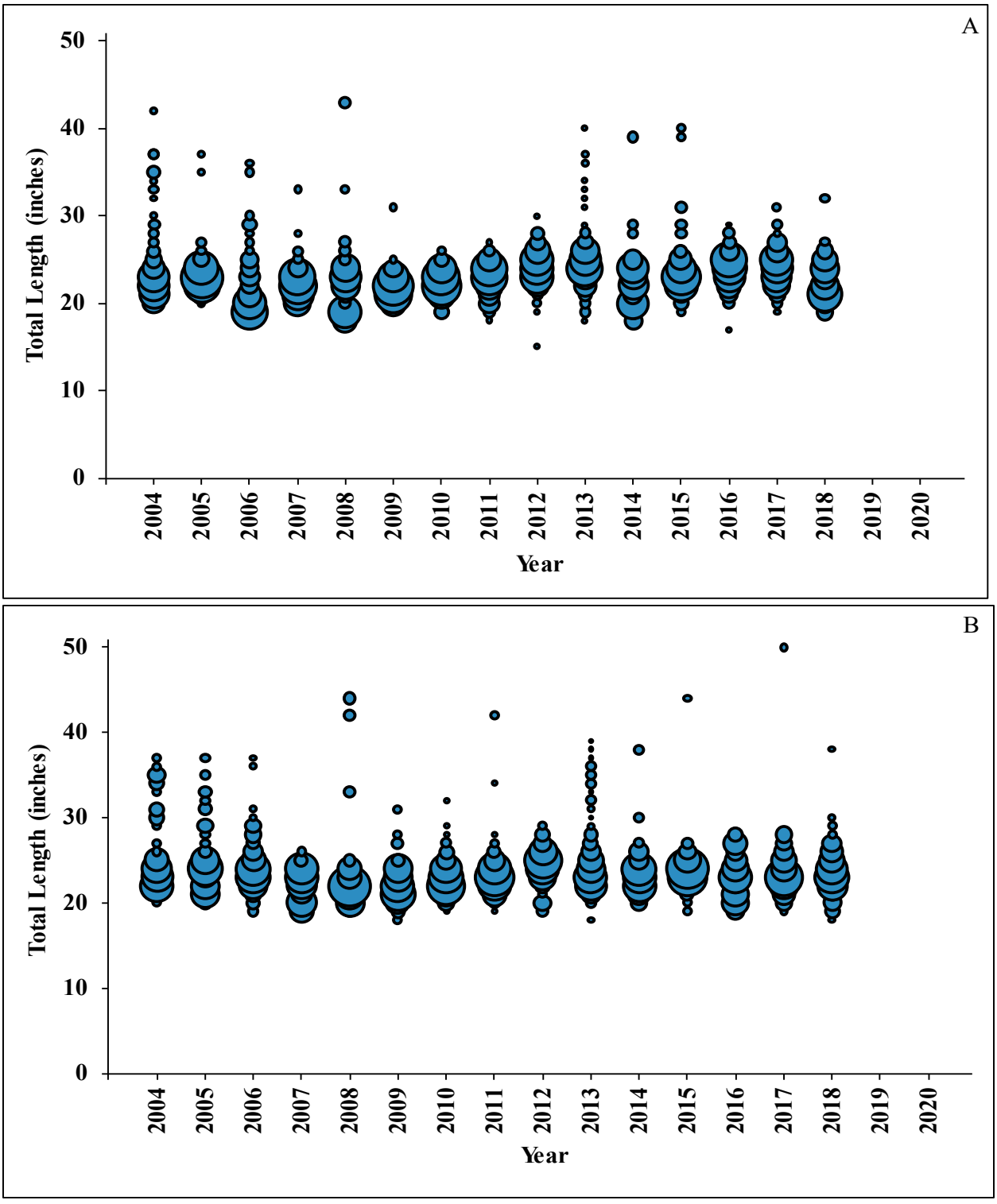


CS_Figure 5. Recreational length frequency of CSMA striped bass harvested in the Tar-Pamlico/Pungo rivers (A), and the Neuse River (B), 2004-2020. Bubble size represents the proportion of fish at length. There was a limited recreational season in 2019 prior to the closure, lasting from Jan 1 to Mar 19, 2019 and the season remained closed in 2020.

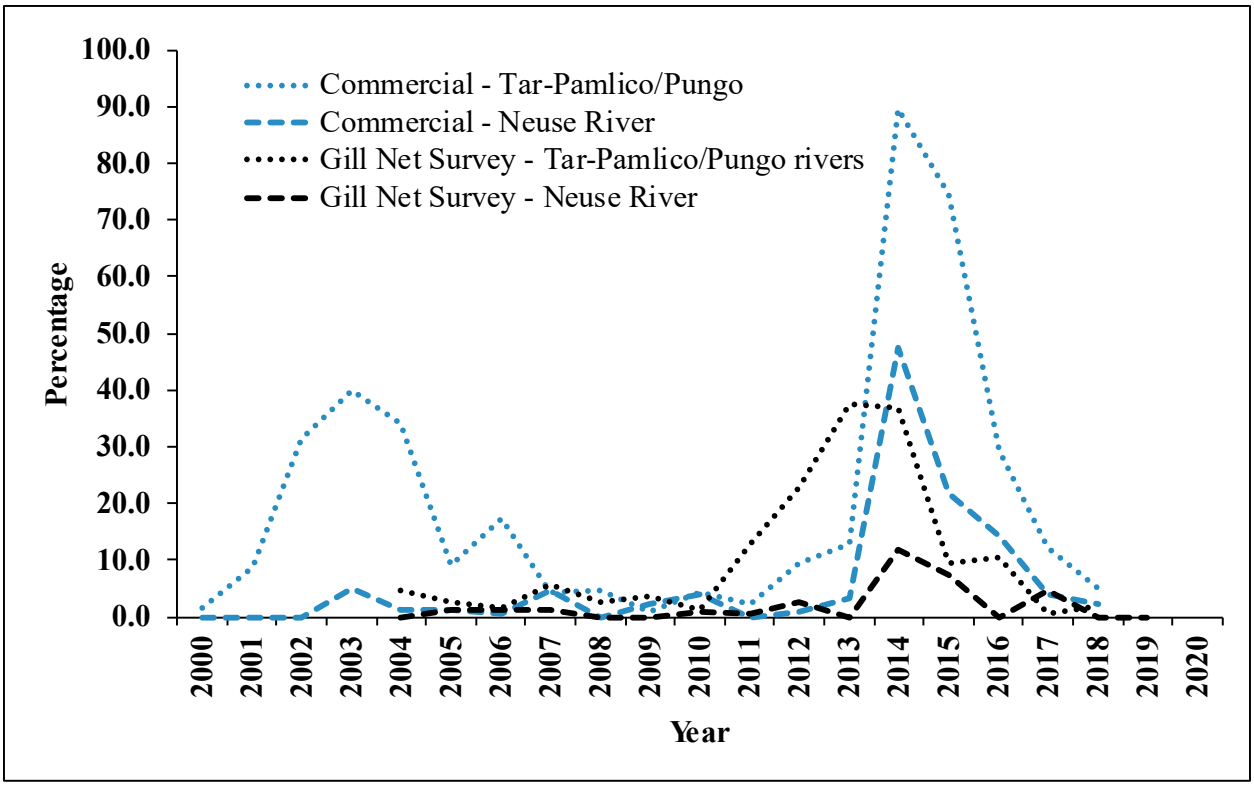




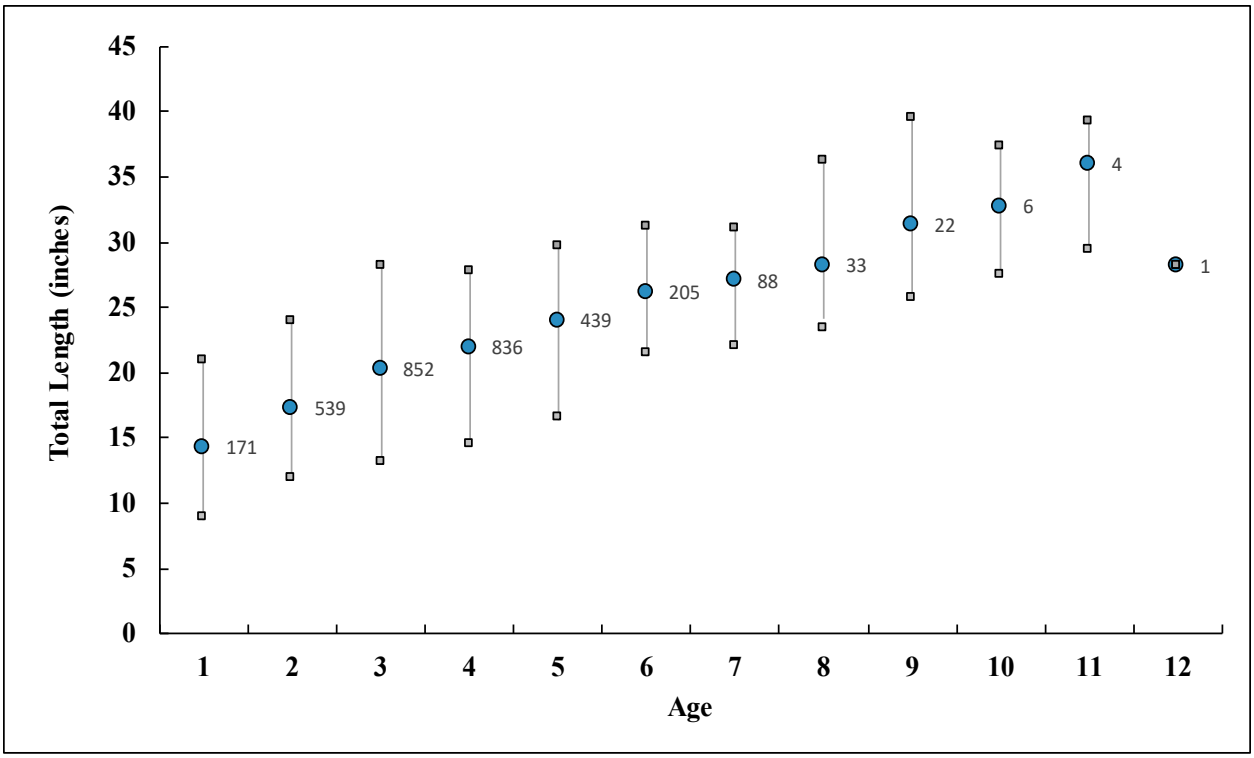
CS_Figure 6. Commercial and recreational length frequency distributions from CSMA striped bass harvested in 2018 from the Tar-Pamlico/Pungo rivers (A) and the Neuse/Bay rivers (B).



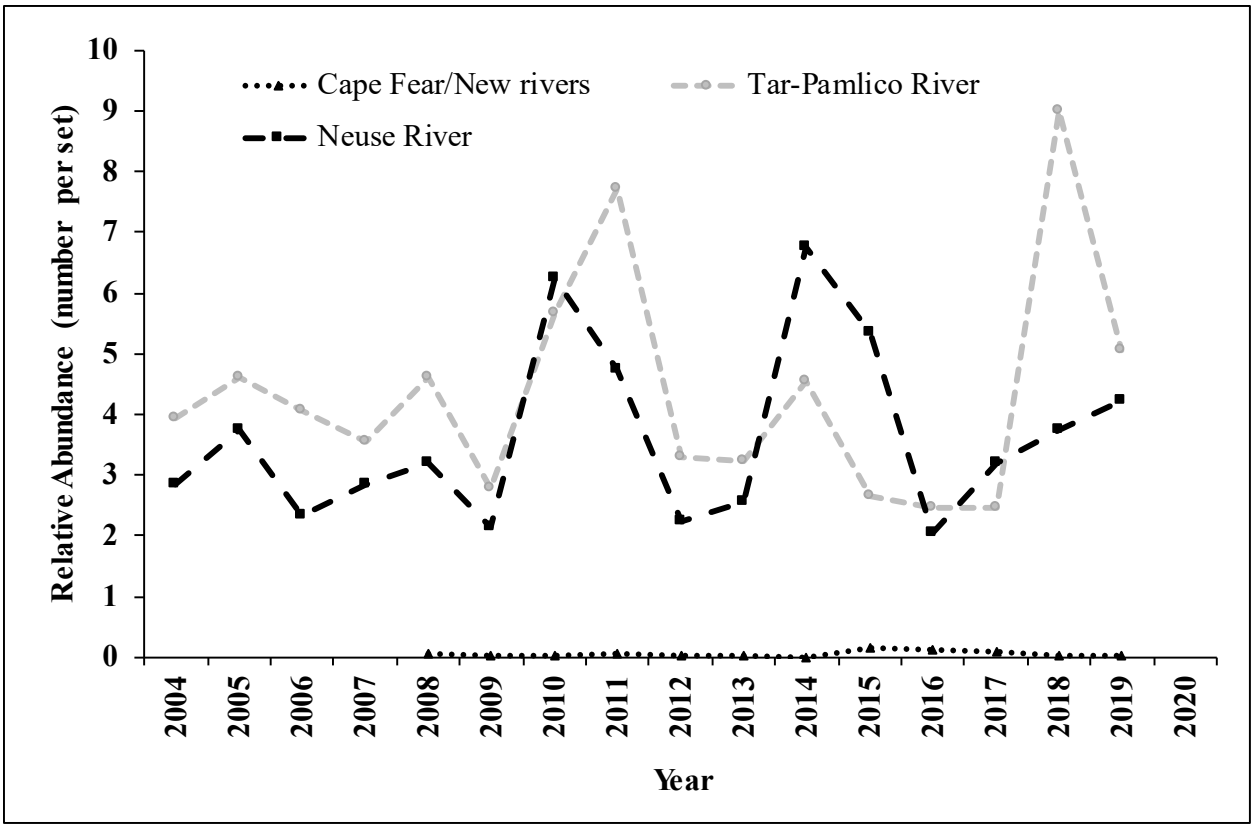
CS_Figure 7. Commercial length frequency of CSMA striped bass landed in the Tar-Pamlico/Pungo rivers (A), and the Neuse/Bay rivers (B) from 2004-2019. Bubble size represents the proportion of fish at length. The commercial season remained closed in 2020.



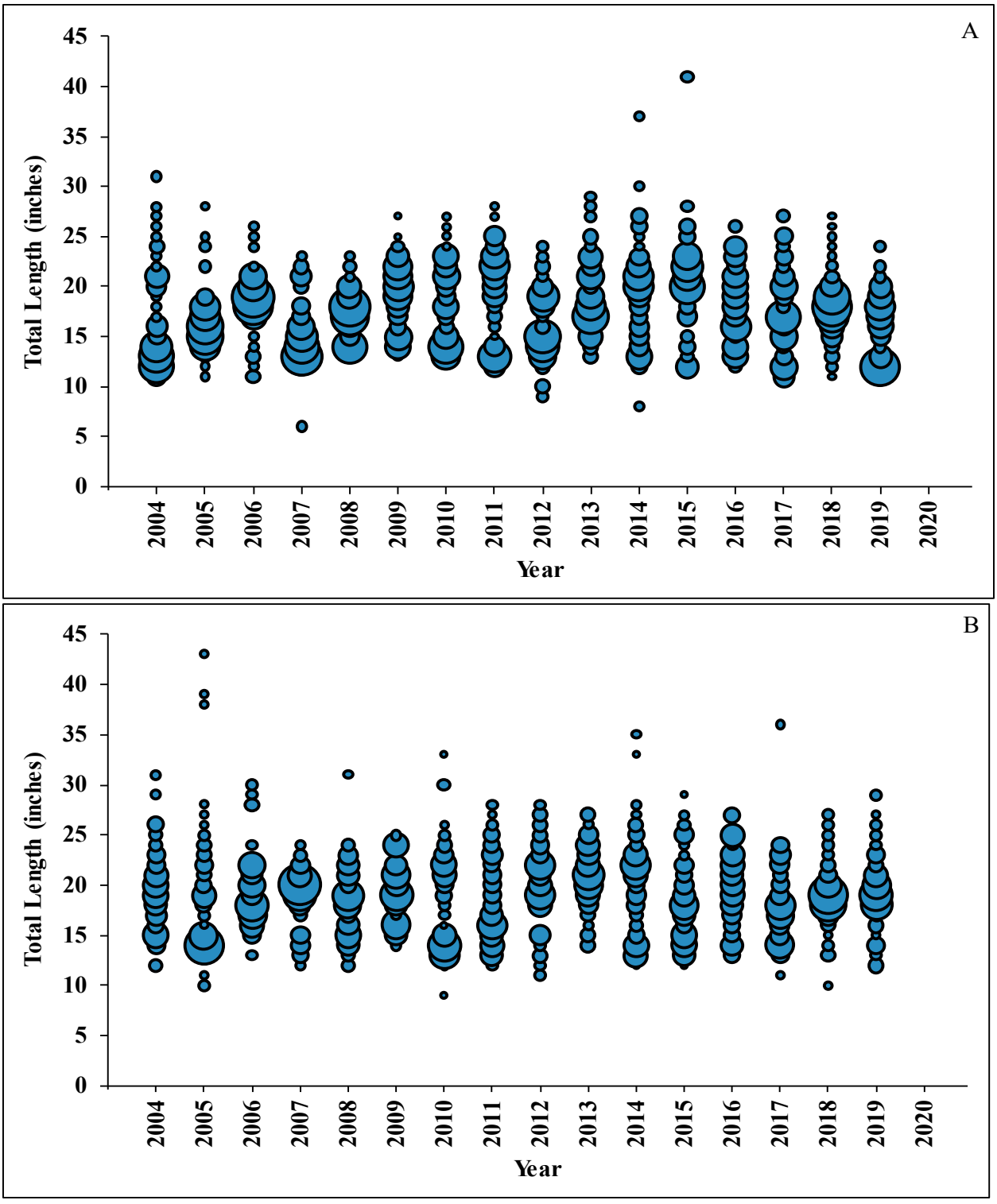
CS_Figure 8. Percentage of CSMA hybrid striped bass in commercial fish house samples (2004-2018) and in the Fisheries Independent Gill Net Survey (2004-2019) from the Tar-Pamlico/Pungo and Neuse/Bay rivers. The commercial season remained closed in 2020 and the gill net survey did not sample in 2020.



CS_Figure 9. CSMA striped bass length at age based on otolith and genetic age samples collected from 2004 to 2020. Blue circles represent the mean size at a given age with the number of samples. The grey squares represent the minimum and maximum observed size for each age. Otolith age data from 2019 and 2020 are considered preliminary, genetic ages from 2020 are not currently available.



CS_Figure 10. Annual indices of adult abundance of CSMA striped bass in the Fisheries Independent Gill Net Survey (P915) for the Tar-Pamlico and Neuse rivers during April, and October-November, in shallow water sets (2004-2019) and the Cape Fear/New rivers (2008-2019). No sampling occurred in 2020.



CS_Figure 11. Length frequency of CSMA striped bass captured in the Fisheries Independent Gill Net Survey (P915) in the Tar-Pamlico River (A), and the Neuse River (B) during April, and October-November, in shallow water sets (2004-2019). No sampling occurred in 2020. Bubble size represents the proportion of fish at length.