**FISHERY MANAGEMENT PLAN UPDATE
ESTUARINE STRIPED BASS
AUGUST 2023**

STATUS OF THE FISHERY MANAGEMENT PLAN

Fishery Management Plan History

Original FMP Adoption:	January 1994	
	May 2004	
Amendments:	Amendment 1	May 2013
	Amendment 2	November 2022
Revisions:	Revision to Amendment 1	November 2014
	Revision to Amendment 1	November 2020
Supplements:	Supplement A	February 2019
Information Updates:	None	
Schedule Changes:	August 2016	
Comprehensive Review:	2027	

Estuarine striped bass (*Morone saxatilis*) in North Carolina are managed under Amendment 2 to the North Carolina Estuarine Striped Bass Fishery Management Plan (FMP). It is a joint plan between the North Carolina Marine Fisheries Commission (MFC) and the North Carolina Wildlife Resources Commission (WRC). The Striped Bass FMP, Revisions, Amendments, and Supplement (DMF and WRC 1994, 2004, 2013, 2014, 2019, 2020, and 2022) are available on the North Carolina Division of Marine Fisheries (DMF) website.

The MFC and the WRC 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 MFC in November 1993 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 a 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 7 to the Interstate FMP for Atlantic Striped Bass.

In response to the 2013 benchmark A-R striped bass stock assessment that indicated fishing mortality was above the target, the MFC approved a Revision to Amendment 1 in November 2014 (NCDMF 2014). The November 2014 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 November 2014 Revision maintained the 25,000-pound commercial TAL for the CSMA, 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 November 2014 Revision utilizes 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 MFC 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 stocked fish and minimal natural recruitment in the CSMA systems.

On June 1, 2018, a WRC 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 MFC 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 was developed. Supplement A to the Estuarine Striped Bass FMP was adopted by the MFC at their February 2019 business meeting and by the WRC in March 2019 (NCDMF 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 WRC 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 anchored 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 benchmark 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 MFC 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.

Amendment 2 to the North Carolina Estuarine Striped Bass FMP was developed collaboratively by the DMF and WRC and adopted by the MFC in November 2022 (NCDMF 2022). Management measures for the A-R stock in Amendment 2 include continuing to use the stock assessment to set a TAL for sustainable harvest, implementing pound-for-pound payback in the following year if a TAL is exceeded by a fishery, continuing to manage the ASMA commercial harvest as a bycatch fishery, implementing a 18-25 inch slot limit with no fish above 25 inches in the ASMA, and prohibiting harvest of fish over 22 inches in the RRMA.

Management measures for the Tar-Pamlico and Neuse rivers stocks in Amendment 2 continued the no-possession measure in Supplement A to Amendment 1. It also maintained the gill net closure above the ferry lines and the use of 3-foot tie-downs below the ferry lines. Additionally, in 2025, data through 2024 will be reviewed to determine if populations are self-sustaining and if sustainable harvest can be determined. In addition, the approved motion included language to: "maintain the gill net prohibition through 2024 to allow for assessment of its performance".

In the Cape Fear River, Amendment 2 maintained the harvest moratorium. Under adaptive management, juvenile striped bass surveys and parentage-based tagging (PBT) analysis will be used to monitor natural reproduction and if levels of natural reproduction increase or decrease, management measures may be re-evaluated and adjusted using the proclamation authority of the DMF and WRC directors. Management measures which may be adjusted include means and methods, harvest area, season, size and creel limit (as allowed for in rule). Management measures may be adjusted contingent on evaluation by the Striped Bass Plan Development Team (PDT) and consultation with the Finfish Advisory Committee (AC).

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 striped bass 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 MFC. Within the RRMA, commercial regulations are the responsibility of the MFC while recreational regulations are the responsibility of the WRC. The A-R stock is also included in the management unit of Amendment 7 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 MFC and the WRC 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 2 is to manage the estuarine striped bass fisheries to achieve self-sustaining populations that provide sustainable harvest based on science-based decision-making processes. If biological and/or environmental factors prevent a self-sustaining population, then alternate management strategies will be implemented that provide protection for and access to the resource. The following objectives will be used to achieve this goal.

- Implement management strategies within North Carolina and encourage interjurisdictional management strategies that maintain and/or restore spawning stock with adequate age structure and abundance to maintain recruitment potential and to prevent overfishing.

- Restore, enhance, and protect critical habitat and environmental quality in a manner consistent with the Coastal Habitat Protection Plan (CHPP), to maintain or increase growth, survival, and reproduction of the striped bass stocks.

- Use biological, social, economic, fishery, habitat, and environmental data to effectively monitor and manage the fisheries and their ecosystem impacts.

- Promote stewardship of the resource through public outreach and interjurisdictional cooperation regarding the status and management of the North Carolina striped bass stocks, including practices that minimize bycatch and discard mortality.

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. 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 ranges from 223,110 eggs for Age-3 females to 3,273,206 eggs for Age-10 females (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 at 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 occur 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. 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 crab.

Albemarle Sound-Roanoke River Management Area

Stock Status: A-R Stock

The most recent assessment of the A-R striped bass stock was completed in 2022, utilizing data from 1991–2021. Results from the 2022 A-R striped bass stock assessment indicate the stock is overfished and overfishing is occurring (Lee et. al 2022). The estimate of F in the terminal year of the assessment (2021) was 0.77, above the $F_{35\%SPR\ Threshold}$ of 0.18 (Figure 1) and the estimate of

SSB was 35,494 pounds, below the $SSB_{35\%SPR\ Threshold}$ of 267,390 pounds (Figure 2). Estimates of F have been above the $F_{35\%SPR\ Threshold}$ in 20 out of the 30 years of the time period of the assessment (Figure 1). Female SSB declined steadily from a high of 587,516 pounds in 2000 to 45,418 pounds in 2013. Female SSB increased through 2015 to 167,053 pounds and has declined since to a low of 35,494 pounds in 2021 (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 2021, which has contributed to the decline in SSB since 2003. Average recruitment during 1993–2000 was 1,085,650 age-0 fish per year while average recruitment for years 2001–2021 was 333,745 age-0 fish per year.

Several years of poor recruitment occurred during 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 2022 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 2022).

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 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 DMF also approved it for management use.

DESCRIPTION OF THE FISHERY: ASMA/RRMA

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/RRMA

Harvest in the ASMA commercial sector in 2022 was limited by an annual TAL of 25,608 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 ($\geq$ 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. Harvest in the newly developing strike net fishery for blue catfish has also increased in recent years. 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 in 2022 was limited by an annual TAL of 12,804 pounds. The recreational sector also has an 18-inch total length minimum size limit and a one 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 DMF for the most recent proclamation on striped bass harvest limits including trip limits and bycatch requirements.

Commercial harvest in the RRMA is prohibited. The RRMA recreational sector also had a TAL of 12,804 pounds in 2022. Due to the reduced TAL, the 2022 harvest season for striped bass in the RRMA was open April 23–24, and April 28–April 29, 2022. 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 was a one 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.

Commercial Fishery: ASMA

Commercial landings in the ASMA have been controlled by an annual TAL since 1991 (Table 1). Due to gill net mesh regulations and minimum size limits in place, most harvest consists of fish 4–6 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. During 2005–2009 landings steadily declined and averaged about 150,000 pounds, even though gill net trips remained steady during that period (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 sustainability parameters being exceeded in the American Shad Sustainable Fishery Plan. Most landings traditionally have come during the American shad season. Length frequency distribution in 2022 is presented in Figure 4. Length at age for all commercial samples collected 1972–2021 are presented in Figure 5. Commercial length frequencies are represented in 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 there was a decrease in modal length in 2018. Fish between 18–24 inches TL dominate the fishery.

Recreational Fishery: ASMA/RRMA

The recreational sector's landings in the ASMA are dominated by fish aged 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. (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 was decreased to two fish per person per day in January 2016 and further to one fish in January 2021. Recreational harvest during 1991–2022 has averaged 42,296 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 19,838 fish (Table 2). Length frequency distribution in 2022 is presented in Figure 4. ASMA recreational length frequencies for 1996–2022 are presented in 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 and 2020 from the previous several years (2016–2019). Landings were substantially lower from 2021–2022 than previous years as a result of a reduced TAL.

The recreational sector's landings in the RRMA are dominated by fish aged 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 2022 has averaged 57,366 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 discards from 2011 through 2022 in the RRMA have averaged 101,342 fish (Table 2).

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; 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 WRC, 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 2022 is presented in Figure 4. RRMA recreational length frequencies for 2005–2022 are presented in Figure 8. Since 2005 abundance of older fish in the recreational creel survey has decreased.

MONITORING PROGRAM DATA: A-R STOCK

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 87.8% of the harvest in the ASMA (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 2022 was 21.6 inches (Table 3).

The recreational harvest of striped bass in the ASMA and RRMA has been consistently monitored by the DMF since 1990 and the WRC since 1988 respectively. The mean total length during 2005–2022 was 20 inches total length for the ASMA and RRMA (Tables 4 and 5). Age data from the dependent and independent surveys in the ASMA are presented in Table 6. The minimum and maximum age for the independent and dependent surveys are 1 and 17 years respectively with an average age of 5.

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 DMF 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 July–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; 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 saw improved annual spawning success, with above average JAI values in 2011, 2014, and 2015, with one year (2013) below the spawning failure threshold. However, the JAI values since 2018 averaged 0.60 and are all below the spawning failure threshold of 1.33 (ASMFC 2010) (Figure 10).

A fall/winter fishery independent gill net survey has been conducted by the DMF 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 2½-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. Sampling in 2020 was suspended due to COVID-19 restrictions and Atlantic sturgeon protected species interactions but resumed in the fall of 2021. After resuming sampling in 2021 survey methods were altered to decrease sturgeon interactions. As a result of these changes from 2021 onward catch per unit of effort is measured as the abundance of fish per 40-yard net soaked for 12 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. No index of abundance is available for the spring survey in 2020 and 2021 or the winter survey in 2021. Sampling did not occur in 2020 due to COVID-19 restrictions and Atlantic sturgeon protected species interactions but resumed in March of 2022.

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 4–6-year-old abundance. The trend in abundance of 4–6-year-old shows 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 4–6-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 (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 during 2001–2010. In 2022 the abundance of 4–6-year-old fish was below average in the fall/winter portion of the survey and increased in the spring. The spring index has been increasing since 2018 with a slight increase from 2019 to 2022 (Figure 11). It should be noted that beginning with the 2022 fall/winter survey changes were made to the independent gillnet survey that may increase rate of catch of striped bass, making the survey from 2022 forward not directly comparable to previous years. Expectations are the abundance of 4–6-year-old fish will decline over the next few years because of the repeated spawning failures the

stock has experienced since 2018 (Figure 10). 2022 had the lowest fall/winter age 4-6 abundance since 2017 and may be an indicator of the expected decline.

An electrofishing survey has been conducted by the WRC 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 2017 of 50 fish per hour (Figure 12). The abundance of fish in 2022 was 69 fish per hour. 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. In 2018 no age 9+ fish were captured. In 2022 the survey caught 0.99 fish per hour which was the highest rate since 2015 but well below the time series average of 3.88 fish per hour (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 2016–2022 is similar to the abundance levels seen in the early to mid 90's.

Tagging Program: A-R Stock

In 2014, a mark-recapture tagging program was initiated utilizing both volunteer anglers and DMF staff throughout the state. Striped bass collected in good condition during DMF fishery independent and electrofishing sampling are tagged with conventional internal anchor tags. The total number of striped bass tagged in 2022 in the ASMA, was 1,234 resulting in 59 recaptures (Table 7; Figure 14, 25). The time series average was 203 days at large with an average distance travelled of 61 miles (Table 7). Most recaptures occur within the state of North Carolina, however, the maximum distance travelled was 579 miles off the coast of New Jersey (Figure 14. 15). The maximum days between release and recapture was 1,905 days or just over five years (Table 7). Data collected from the tagging programs may serve as a recovery indicator and help guide future research needs for the ASMA striped bass stocks. The tagging data from this survey will be used to help determine hatchery contribution to the stocks, as well as movement and migration patterns.

RESEARCH NEEDS: A-R STOCK

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

High

- Improve estimates of discard mortality rates and discard losses from the ASMA commercial gill-net fisheries (ongoing through observer program).

- Identify environmental factors (e.g., flow, salinity, predation, dissolved oxygen, algal blooms) affecting survival of striped bass eggs, larvae, and juveniles and investigate methods for incorporating environmental variables into stock assessment models.

- Expand, modify, or develop fishery-independent sampling programs to fully encompass all bass life stages (egg, larval, juvenile, and adult). (Ongoing through preliminary larval tows)

- 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.

Medium

- 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.

Low

- 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).

MANAGEMENT STRATEGY: A-R STOCK

Estuarine striped bass in North Carolina are managed under Amendment 2 to the North Carolina Estuarine Striped Bass FMP and subsequent revisions. Striped bass fisheries in the Atlantic Ocean of North Carolina are managed under ASMFC's Amendment 7 to the Interstate FMP for Atlantic Striped Bass. 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 % 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, to 2022 were between 0.4 and 0.7 and are all below the spawning failure threshold of 1.33 indicating that the recruitment failure trigger has been met (ASMFC 2010).

Central Southern Management Area

Stock Status: 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.

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: CSMA Stocks

A stock assessment is not available for these stocks.

Current Regulations: CSMA

Commercial and recreational harvest in the CSMA is prohibited. Amendment 2 to the Estuarine Striped Bass FMP adopted by the MFC in November 2022 maintained the no-possession and gill net measures in Supplement A to Amendment 1. The WRC hook-and-line closure proclamation had the effect of suspending rules 15A NCAC 10C .0107 (l) and 10C .0314 (g), and the measures maintained in Amendment 2 included:

- 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). Proclamation M-6-2019 maintained the year-round tie-down and distance from shore restrictions for large mesh gill nets and prohibited the use of all gill nets upstream of the ferry lines from the Bayview Ferry to Aurora Ferry on the Tar-Pamlico River and the Minnesott Beach Ferry to Cherry Branch Ferry on the Neuse River to further reduce bycatch of striped bass.

Commercial Fishery: CSMA

Due to the no possession measure approved in Supplement A and maintained in Amendment 2, the commercial striped bass fishery has been closed since 2019. From 1994–2018 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 (Table 8, Figure 16A). Most commercial landings come from the Tar-Pamlico and Pungo rivers and the Neuse and Bay rivers, with the remainder coming from Pamlico Sound. From 2004 to 2018, there was only a spring harvest season, opening March 1 each year and closing when the TAL was reached.

Recreational Fishery: CSMA

The DMF 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 in Supplement A, there was minimal recreational harvest in February 2019 (959 pounds) until the recreational season closed in March 2019, with the no recreational possession measure continuing through 2022. Recreational landings fluctuated during 2004–2018, ranging from lows in 2008 and 2009 to a high of 26,973 pounds in 2017 (Table 8; Figure 16B).

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 8). Harvest on the Pungo River 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 (Table 9).

Although the recreational striped bass season in the CSMA has remained closed since March 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 ten years (2012-2021) have averaged 47,212 fish annually (Table 9; Figure 17). Undersized discards peaked in 2017 mainly due to the large number of undersized striped bass available in the Tar-Pamlico River system. In 2022, the number of striped bass discards was 30,026, which was a slight increase from 2021, but below the ten-year average of 50,710 fish. Under sized discards (n=10,639), remained below the ten-year average of 38,351 fish. In 2022, discards of legal sized striped bass slightly increased (n=14,685) from the past two years, after a high of 26,501 in 2017. Fish released that were within the slot limit, have fluctuated since 2004 and have ranged from lows in 2004, 2006, and 2007 of zero fish to a high of 6,779 fish in 2016 (Table 9). In 2022, there were approximately 4,701 discarded striped bass that were within the slot limit. CSMA recreational length frequencies are presented in Figure 18. 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 (Figure 19).

MONITORING PROGRAM DATA: CSMA STOCKS

Fishery-Dependent Monitoring: CSMA

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 Tar-Pamlico/Pungo and Neuse rivers 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 (Table 10). 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 (Figure 19). CSMA commercial length frequencies are represented in Figure 20 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.

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 27 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 (Table 11).

Fishery-Independent Monitoring: CSMA

The Fishery Independent Gill Net Survey (Program 915) was initiated by the DMF in May of 2001 in Pamlico Sound. The survey was expanded to the Tar-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. Pamlico Sound and Pungo River data is excluded from striped bass abundance calculations due to mixed stock concerns (Mathes et al. 2020). Overall, the percent frequency of occurrence is lower and PSE values are typically higher in the deep stratum; thus, only the shallow stratum was used in the relative abundance calculations for striped bass. The months of April and October–November are used in index calculation because striped bass are most available to the survey during these months. In the Cape Fear River, although striped bass catch rates are low, data were used to calculate relative abundance. New River data were not used to calculate relative abundance because striped bass are seldom captured. P915 sampling in 2020 was suspended due to COVID-19 restrictions and protected species interactions and was not resumed until July 2021.

Over the past fifteen years (2004–2022), striped bass relative abundance has been higher in the Tar-Pamlico and Neuse rivers when compared to the Cape Fear River and New rivers (Table 12). Since 2004, striped bass relative abundance in the Tar-Pamlico and Neuse rivers ranged from 0.83 to 9 fish per sample, whereas relative abundance in the Cape Fear River ranged from 0 to 0.35 fish per sample (Table 12). In 2022, striped bass relative abundance in the Tar-Pamlico River (0.83 fish per set) was the lowest in the time series and well below the time series average of 4.2 striped bass per set (Table 12; Figure 21). In the Neuse River, striped bass relative abundance was 1.17 fish per set, the lowest value in the time series and well below the time series average of 3.6 striped bass per set (Table 12; Figure 22). In 2022, relative abundance in the Cape Fear River (0.05 fish per set) was below the time series average of 0.11 striped bass per set (Table 12; Figure 23).

Length frequencies from P915 are represented in Figure 24. Length frequency distributions are variable between years but generally range 10–25 inches TL, however in 2016–2017 in the Tar-Pamlico/Pungo River and 2015–2017 in the Neuse River 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 which continued in 2021 and 2022. Length frequency distributions are not provided for the Cape Fear and New rivers due to low numbers of striped bass captured in the fishery independent gill net survey. Samples collected from P915 on the Tar-Pamlico and Neuse rivers show most striped bass were captured in the upper and middle portions of the rivers.

In 2017, the Juvenile Anadromous Survey (Program 100) was expanded to include the Tar-Pamlico, Neuse, Cape Fear, and Northeast Cape Fear rivers. The survey employs 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.

In 2021, two juvenile striped bass were captured on the Tar-Pamlico River, which PBT analysis indicated were not of hatchery origin (Table 13). In 2022, 25 juvenile striped bass were collected in the Tar-Pamlico and Neuse rivers. Subsequent PBT analysis of 24 juvenile striped bass captured

in 2022 revealed all of these fish were hatchery origin released as phase-I size (25–50 mm; 1–2 in) striped bass fingerlings.

In the Northeast Cape Fear River, 24 juvenile striped bass were captured in 2018, four in 2019, and one in 2020 (Table 14). Subsequent PBT analysis of five of the 24 juvenile striped bass captured in 2018 revealed these striped bass were not hatchery origin and therefore were most likely wild fish.

Age data are presented in Table 15 and Figure 25; from 2004 to 2022, a total of 2,486 otolith samples were aged and from 2016 to 2022, 1,552 genetic samples were collected to provide striped bass ages and hatchery origin (Table 15). Figure 25 shows an increasing trend of size at length with a maximum age of 12 years old. Limited age data was collected in 2019 from the recreational creel survey (n=15) and no commercial samples were collected. Otolith age data from 2022 are considered preliminary, and genetic ages for 2020–2022 are not currently available.

Electrofishing surveys have been conducted by the WRC on CSMA spawning grounds since 1996 (Figure 26; Tar-Pamlico River), 1994 (Figure 27; Neuse River), and 2003 (Figure 28; Cape Fear River). The objectives of the WRC spawning ground surveys are to monitor and quantify population metrics of striped bass migrating to the spawning grounds during spring of each year. The survey uses a stratified random sampling design in the Tar-Pamlico and Neuse rivers, and a fixed station survey design in the Cape Fear River. Relative abundance is measured as the number of fish captured per hour of electrofishing. The WRC did not sample in 2020.

Since 1996, striped bass abundance in the Tar-Pamlico River has ranged from a low of 18.2 striped bass per hour to a peak of 100.0 per hour in 2010 (Figure 26). In 2022, the relative abundance was 33.5 fish, which is near the time series average of 40.0 fish per hour. Since 1994, striped bass abundance in the Neuse River has been highly variable ranging from a low of 4.4 fish per hour to a high of 20.4 striped bass (Figure 27). Data are not currently available in the Neuse River for 2021 and 2022. Since 2003, striped bass relative abundance in the Cape Fear River has ranged from a low of 6.5 striped bass to a high of 25.4 fish per hour (Figure 28). In 2022, the relative abundance was 18.6 fish per hour which was an increase from the 2021 relative abundance value and was above the time series average of 11.9 fish per hour.

Tagging Program: CSMA

In 2014, a mark-recapture tagging program was initiated utilizing both volunteer anglers and DMF staff throughout the state. Striped bass collected in good condition during DMF fishery independent and electrofishing sampling are tagged with conventional internal anchor tags. In addition, approximately 9,000 (3,000 per system) phase-II (125–200 mm; 5–8 in) size striped bass fingerlings are tagged annually prior to stocking in the Tar-Pamlico, Neuse, and Cape Fear river systems. The total number of striped bass tagged in 2022 from CSMA systems, excluding the Cape Fear River, was 6,640 resulting in 71 recaptures (Table 16; Figure 27). The time series average was 279 days at large with an average distance travelled of 25 miles (Table 16). Most recaptures occur within the state of North Carolina, however, the maximum distance travelled was 527 miles off the coast of Rhode Island (Figure 28). The maximum days between release and recapture was 2,192 days or just under six years (Table 16). In the Cape Fear River, the total number of striped bass tagged in 2022 was 529 resulting in 56 recaptures (Table 17; Figure 31). The time series

average was 317 days at large with an average distance travelled of 15 miles (Table 16). Most recaptures occur within the state of North Carolina; however, the maximum distance travelled was 566 miles into Long Island Sound, Connecticut (Figure 32). The maximum days between release and recapture was 1,944 days or just over five years (Table 17). Data collected from the tagging programs may serve as a recovery indicator and help guide future research needs for the CSMA striped bass stocks. The tagging data from this survey will be used to help determine hatchery contribution to the stocks, as well as movement and migration patterns.

RESEARCH NEEDS: CSMA

The research recommendations listed below 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 DMF 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 DMF 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 DMF 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: CSMA STOCKS

Estuarine striped bass in North Carolina are managed under Amendment 2 to the North Carolina Estuarine Striped Bass FMP. 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 is 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, Amendment 2 maintains a recreational and commercial no-possession limit in the CSMA initially implemented under Supplement A to Amendment 1 in March 2019. The measure provides additional protection for non-hatchery fish.

FISHERY MANAGEMENT PLAN SCHEDULE RECOMMENDATIONS

The next comprehensive FMP review is scheduled in 2027. In 2025 data through 2024 from the Tar-Pamlico and Neuse Rivers will be reviewed to determine if populations are self-sustaining and if sustainable harvest can be determined. In addition, the review will allow for the assessment of the gill net provision through 2024.

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TABLES

Table 1.   ASMA and RRMA recreational harvest (number of fish landed and weight in pounds) and releases (number of fish) and ASMA commercial harvest (weight in pounds) of striped bass from North Carolina, 1990–2022.

| Year | ASMA Recreational | | | RRMA Recreational | | | ASMA Commercial | |
	Numbers Landed	Numbers Released	Weight Landed (lb)	Numbers Landed	Numbers Released	Weight Landed (lb)	Weight Landed (lb)	Total Weight (lb)
1990	-	-	-	-	-	-	103,757	103,757
1991	14,395	23,540	35,344	26,934	-	72,529	108,555	216,428
1992	10,542	19,981	30,758	13,372	-	36,016	100,641	167,415
1993	11,404	13,241	36,049	14,325	-	45,145	109,570	190,764
1994	8,591	-	30,217	8,284	-	28,089	102,471	160,777
1995	7,343	-	30,564	7,471	-	28,883	87,920	147,367
1996	7,433	-	29,186	8,367	52,698	28,178	90,213	147,577
1997	6,901	30,771	26,581	9,364	163,452	29,997	96,210	152,788
1998	19,566	91,888	64,580	23,109	291,765	73,541	124,032	262,153
1999	16,967	40,321	61,338	22,479	189,978	72,967	163,010	297,315
2000	38,085	78,941	116,158	38,206	163,555	120,091	214,223	450,472
2001	40,127	61,418	118,506	35,231	93,148	112,805	220,462	451,773
2002	27,896	51,555	92,649	36,422	71,003	112,698	223,108	428,455
2003	15,124	25,281	51,794	11,157	55,775	39,170	266,539	357,503
2004	28,004	41,041	97,097	26,506	38,256	90,191	273,814	461,102
2005	17,954	21,220	63,477	34,122	187,331	107,530	232,808	403,815
2006	10,711	9,455	35,997	25,355	157,697	84,521	186,555	307,073
2007	7,143	13,599	26,633	19,306	65,524	62,492	171,828	260,953
2008	10,048	36,975	31,628	10,541	52,501	32,725	74,979	139,332
2009	12,069	40,563	37,313	23,248	189,638	69,581	95,879	202,773
2010	3,504	16,200	11,470	22,445	135,964	72,037	200,003	283,510
2011	13,341	21,572	42,536	22,102	123,910	71,561	136,378	250,475
2012	22,345	24,971	71,456	28,847	107,693	88,271	115,698	275,425
2013	4,299	16,381	14,897	7,718	63,018	25,197	68,409	108,503
2014	5,529	23,086	16,867	11,058	74,221	33,717	71,055	121,639
2015	23,240	49,534	70,008	20,031	165,539	58,962	114,596	243,566
2016	4,794	10,352	14,487	21,260	108,240	65,218	123,216	202,921
2017	4,214	24,659	15,480	9,899	52,644	32,569	76,059	124,108
2018	3,465	25,639	11,762	8,741	78,447	26,796	116,144	154,702
2019	8,502	34,968	29,005	16,582	187,214	53,379	136,820	219,204
2020*	6,849	50,009	22,951	20,376	187,192	27,243	124,385	174,579
2021	2,258	7,782	8,258	7,795	10,999	27,546	27,930	63,734
2022	2,789	6,166	8,417	1,949	123,704	6,069	24,026	38,512
Mean	12,982	31,418	42,296	18,519	116,011	57,366	132,766	229,408

*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 with data imputed for April based on harvest in April 2015 and 2016.

Table 2.   Recreational striped bass effort, harvest, and discards from the ASMA and RRMA (2011–2022).

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	19,864	61,645	8,502	34,968	2,301	34,452	1,625	N/A	38,378
2020#	20,559	84,584	6,849	22,951	32,805	15,256	1,947	N/A	50,009
2021	8,080	29,174	2,258	8,258	689	5,684	1,408	N/A	7,782
2022	14,175	49,949	2,789	8,417	967	4,626	573	N/A	6,166
Total	140,633	698,005	101,625	332,086	40,313	238,473	19,739	N/A	298,529
				RRMA					
2011	27,311	122,876	22,102	71,561					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		Disposition of			93,471
2015	22,827	111,419	20,031	58,962		discards not			78,401
2016	25,036	129,132	21,260	65,218		available for all			34,753
2017	19,688	101,565	9,899	32,569		years.			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†	26,648	131,565	20,376	27,243					54,622
2021	12,976	69,281	7,795	27,546					57,188
2022	3,373	17,014	1,949	6,069					123704
Total	239,422	1,169,187	176,358	516,797					1,216,099

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 with data imputed for April based on harvest in April 2015 and 2016.

Table 3.   Striped bass total length (inches) data from commercial fish house sampling from the Albemarle Sound Management Area (ASMA), North Carolina, 2005–2022.

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
2021	22	19	28	165
2022	23	18	40	250

Table 4.   Striped bass total length (inches) data from recreational landings from the Albemarle Sound Management Area (ASMA), North Carolina, 2005–2022.

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
2021	21	17	28	290
2022	21	11	31	242

Table 5.   Striped bass total length (inches) data from recreational landings from the Roanoke River Management Area (RRMA), North Carolina, 2005–2022.

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
2021	20	18	40	630
2022	20	18	28	374

Table 6.   Striped bass age data from dependent (commercial) and independent (independent gill net survey) surveys from the ASMA, North Carolina, 2005–2022.

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
2021	5	4	9	120
2022*	3	1	11	551

*Preliminary data from independent survey only.

Table 7.   Summary of ASMA striped bass tagging and recapture data, 2014 – 2022.

Year Tagged	Total Fish Tagged (#)	Total Fish Recaptured (#)	Average Days At Large	Max Days At Large	Average Distance Traveled (miles)	Max Distance Traveled (miles)
2014	270	42	231	524	88	270
2015	2,341	281	278	1,905	76	279
2016	1,197	107	192	1,538	43	242
2017	1,159	106	205	1,311	59	189
2018	1,533	197	157	1,345	44	165
2019	1,831	257	193	1,082	56	272
2020	340	42	246	949	62	133
2021	1,212	116	173	589	64	579
2022	1,234	59	65	227	70	378

Table 8.   Recreational harvest (number of fish landed and weight in pounds) and releases (number of fish) and commercial harvest (weight in pounds) of CSMA striped bass from North Carolina, 1994–2022.

| Year | Recreational | | | Commercial | |
	Numbers Landed	Numbers Released	Weight Landed (lb)	Weight Landed (lb)	Total Weight (lb)
1994				19,858	19,858
1995				14,325	14,325
1996				33,250	33,250
1997				28,520	28,520
1998				25,973	25,973
1999				33,959	33,959
2000				31,048	31,048
2001				24,705	24,705
2002				37,585	37,585
2003				41,384	41,384
2004	6,141	13,557	22,958	32,479	55,437
2005	3,832	16,854	14,965	27,132	42,097
2006	2,481	14,895	7,352	21,149	28,501
2007	3,597	23,527	10,794	25,008	35,802
2008	843	17,966	2,990	10,115	13,105
2009	895	6,965	3,061	24,847	27,908
2010	1,757	7,990	5,537	23,888	29,425
2011	2,728	24,188	9,474	28,054	37,528
2012	3,922	43,313	15,240	22,725	37,964
2013	5,467	32,816	19,537	28,597	48,134
2014	3,301	30,209	13,368	25,245	38,613
2015	3,934	31,353	14,269	27,336	41,605
2016	6,697	75,461	25,260	23,041	48,301
2017	7,334	131,129	26,973	23,018	49,991
2018	3,371	49,122	10,884	20,057	30,941
2019	959	36,080	3,562	0	3,562
2020	0	19,420	0	0	0
2021	0	23,216	0	0	0
2022	0	30,026	0	0	0
Mean	3,181	33,057	11,457	23,332	30,697

Table 9. Recreational striped bass effort, harvest, and discards from the CSMA (2004–2021). 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 2022.

| Year | Striped Bass Fishing (Angler Trips) | Striped Bass Effort (Angler Hours) | Number Harvested | Pounds Harvested | Striped Bass Discards | | | | |
					Number Over-Creel	Number Under-Sized	Number Legal-Sized	Number Slot-Sized	Total Discards
2004	12,782	63,791	6,141	22,958	85	11,729	1,743	0	13,557
2005	16,414	69,370	3,832	14,965	152	15,609	1,016	77	16,854
2006	10,611	42,066	2,481	7,352	33	12,548	2,314	0	14,895
2007	10,971	46,655	3,597	10,794	147	21,673	1,707	0	23,527
2008	6,621	28,413	843	2,990	2,838	11,721	3,316	91	17,966
2009	5,642	26,611	895	3,061	7	4,471	1,769	718	6,965
2010	6,559	25,354	1,757	5,537	29	5,200	2,401	360	7,990
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	1,449	19,185	7,934	1,641	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	3,371	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
2021**	4,772	18,241	0	0	0	9,124	12,322	1,769	23,216
2022**	5,200	17,885	0	0	0	10,639	14,685	4,701	30,026
Total	242,610	1,052,424	57,259	206,224	8,503	435,561	151,615	32,409	628,087

* Limited harvest season (Jan 1–March 19, 2020)
** Closed harvest season

Table 10. Mean, minimum, and maximum length of striped bass (total length – inches) and number (N) collected from the commercial harvest, 2000–2022.

| | Tar-Pamlico/Pungo rivers | | | | Neuse/Bay rivers | | | |
| | Length (inches) | | | | Length (inches) | | | |
Year	Mean	Min	Max	N	Mean	Min	Max	N
2000	23	20	35	126	25	22	31	5
2001	23	21	26	116	25	23	31	12
2002	24	19	39	96	25	19	29	31
2003	23	18	37	173	24	19	37	19
2004	24	20	42	131	25	19	37	74
2005	23	20	37	127	24	20	36	70
2006	22	18	37	119	24	19	36	144
2007	22	19	33	112	22	19	27	63
2008	22	18	43	84	23	19	44	39
2009	22	19	31	99	22	18	31	85
2010	22	19	26	194	23	19	32	263
2011	23	18	27	284	23	19	42	195
2012	24	15	30	254	24	19	29	96
2013	25	18	40	225	25	18	39	301
2014	22	18	39	52	24	20	38	56
2015	24	19	40	97	24	19	44	97
2016	24	17	29	257	23	19	28	78
2017	24	19	31	151	24	19	50	97
2018	23	19	32	76	24	18	38	163
2019	-	-	-	-	-	-	-	-
2020	-	-	-	-	-	-	-	-
2021	-	-	-	-	-	-	-	-
2022	-	-	-	-	-	-	-	-

Table 11. Mean, minimum and maximum length of striped bass (total length – inches) and number collected from the recreational harvest, 2004–2021 (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 2022.

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	-	-	-	-
2021	-	-	-	-
2022	-	-	-	-

Table 12. Relative abundance (Index) 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 (2004–2022), and in the Cape Fear and New rivers (February–December, all sets; 2008–2022) The Percent Standard Error (PSE) represents a measure of precision. No sampling occurred in 2020 and limited sampling occurred in 2021 (July–December).

	Tar-Pamlico River				Neuse River				Cape Fear and New Rivers			
Year	Index	No. of Striped Bass	N	PSE	Index	No. of Striped Bass	N	PSE	Index	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	-	-	-	-	-	-	-	-	-	-	-	-
2021	0.92	11	12	43	4.25	68	16	38	0.03	3	88	67
2022	0.83	15	18	73	1.17	28	24	82	0.05	4	79	40

Table 13. Relative abundance of striped bass (number of individuals per sample), total number of striped bass collected, and the number of beach seine and trawl samples (N) in the Tar-Pamlico and Neuse rivers, 2017-2022.

	Tar-Pamlico River						Neuse River					
	Seine			Trawl			Seine			Trawl		
Year	Striped bass (N)	Samples (N)	Relative Abundance	Striped bass (N)	Samples (N)	Relative Abundance	Striped bass (N)	Samples (N)	Relative Abundance	Striped bass (N)	Samples (N)	Relative Abundance
2017	0	54	0.00	0	48	0.00	0	54	0.00	0	48	0.00
2018	0	30	0.00	0	36	0.00	0	30	0.00	0	36	0.00
2019	0	36	0.00	0	48	0.00	0	36	0.00	0	48	0.00
2020	0	48	0.00	0	48	0.00	0	48	0.00	0	48	0.00
2021*	2	48	0.04	0	48	0.00	0	48	0.00	0	48	0.00
2022†	21	48	0.44	0	36	0.00	4	48	0.08	0	36	0.00
Total	23	264	0.09	0	264	0.00	4	264	0.02	0	264	0.00

* PBT analysis: natural reproduction
† PBT analysis: hatchery origin

Table 14. Relative abundance of striped bass (number of individuals per sample), total number of striped bass collected, and the number of beach seine and trawl samples (N) in the Cape Fear and Northeast Cape Fear rivers, 2017-2022.

	Cape Fear River						Northeast Cape Fear River					
	Seine			Trawl			Seine			Trawl		
Year	Striped bass (N)	Samples (N)	Relative Abundance	Striped bass (N)	Samples (N)	Relative Abundance	Striped bass (N)	Samples (N)	Relative Abundance	Striped bass (N)	Samples (N)	Relative Abundance
2017	0	25	0.00	0	32	0.00	0	29	0.00	0	32	0.00
2018*	0	58	0.00	0	10	0.00	0	34	0.00	24	27	0.89
2019	0	47	0.00	0	23	0.00	4	32	0.13	0	40	0.00
2020	0	11	0.00	0	24	0.00	1	8	0.13	0	40	0.00
2021	0	44	0.00	0	21	0.00	0	22	0.00	0	27	0.00
2022	0	34	0.00	0	19	0.00	0	19	0.00	0	31	0.00
Total	0	219	0.00	0	129	0.00	5	144	0.03	24	197	0.12

* PBT analysis: natural reproduction (n=5 of 24 striped bass analyzed)

Table 15. CSMA striped bass otolith and genetic age data from fishery dependent (commercial and recreational creel survey) and independent (independent gill net survey) surveys, 2004–2022. Otolith age data from 2022 are considered preliminary, and genetic ages for 2020 – 2022 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	172*
2021	3	-	1	-	10	-	352	265*
2022	3	-	1	-	11	-	114	161*

* Number of genetic sampled collected, ages are not currently available.

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Table 16. Summary of CSMA striped bass tagging and recapture data, 2014 – 2022.

Year Tagged	Total Fish Tagged (#)	Total Fish Recaptured (#)	Average Days At Large	Max Days At Large	Average Distance Traveled (miles)	Max Distance Traveled (miles)
2014	6,233	46	556	2,129	36	133
2015	6,751	154	368	1,643	30	527
2016	6,680	158	348	1,881	44	223
2017	6,986	237	257	2,077	33	180
2018	7,002	141	229	1,002	39	203
2019	6,785	159	322	1,315	39	248
2020	6,709	181	237	964	21	208
2021	6,959	134	190	565	26	112
2022	6,640	71	105	259	25	84

Table 17. Summary of Cape Fear River striped bass tagging and recapture data, 2014 – 2022.

Year Tagged	Total Fish Tagged (#)	Total Fish Recaptured (#)	Average Days At Large	Max Days At Large	Average Distance Traveled (miles)	Max Distance Traveled (miles)
2014	3,047	13	490	1,383	22	129
2015	3,692	159	484	1,944	17	281
2016	3,600	158	368	1,329	15	566
2017	3,367	75	262	1,544	11	98
2018	3,422	66	237	1,443	15	78
2019	3,279	73	368	1,039	16	157
2020	3,265	89	223	784	14	138
2021	3,323	78	185	680	14	270
2022	529	56	100	338	11	66

FIGURES
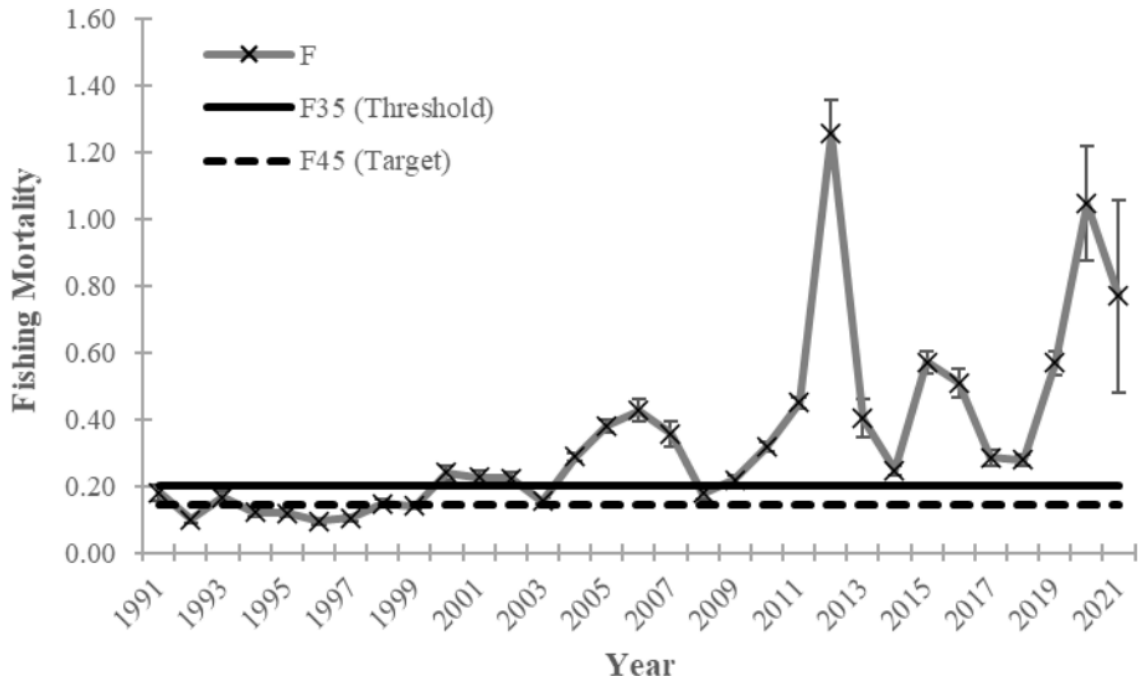
Figure 1.   Estimates of fishing mortality (*F*) Albemarle-Roanoke striped bass stock, 1991–2021. Error bars represent ± two standard errors. Source: Lee et al. 2022.
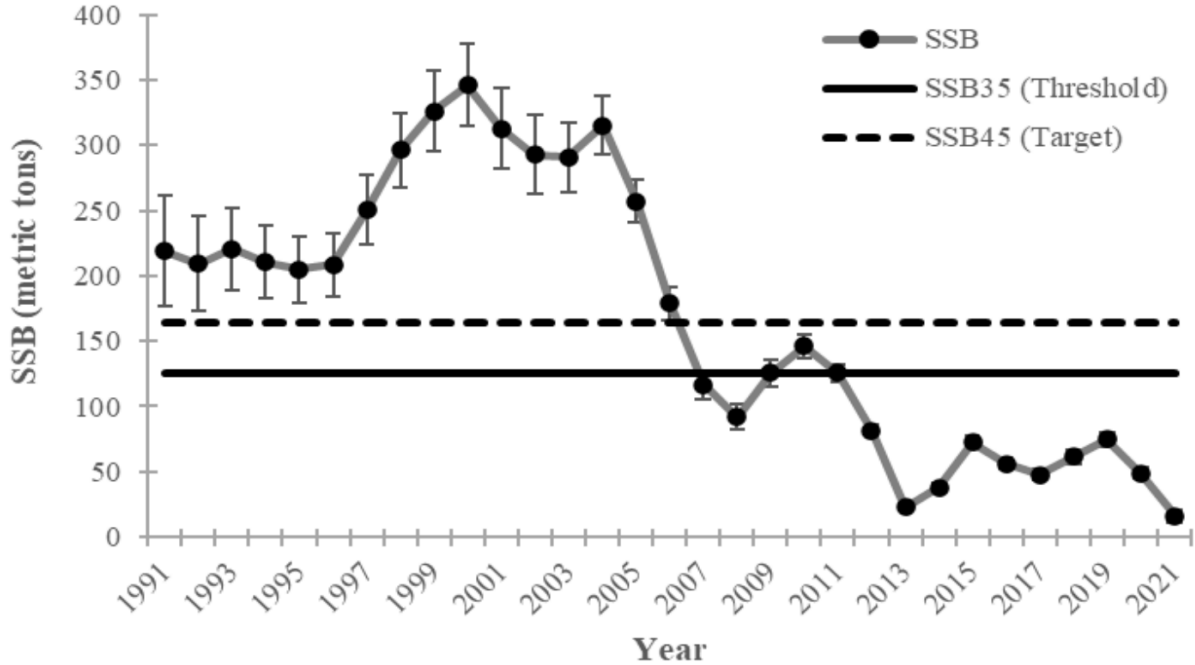
Figure 2.   Estimates of spawning stock biomass (SSB) each year for the Albemarle-Roanoke striped bass stock, 1991–2021. Error bars represent ± two standard errors. Source: Lee et al. 2022
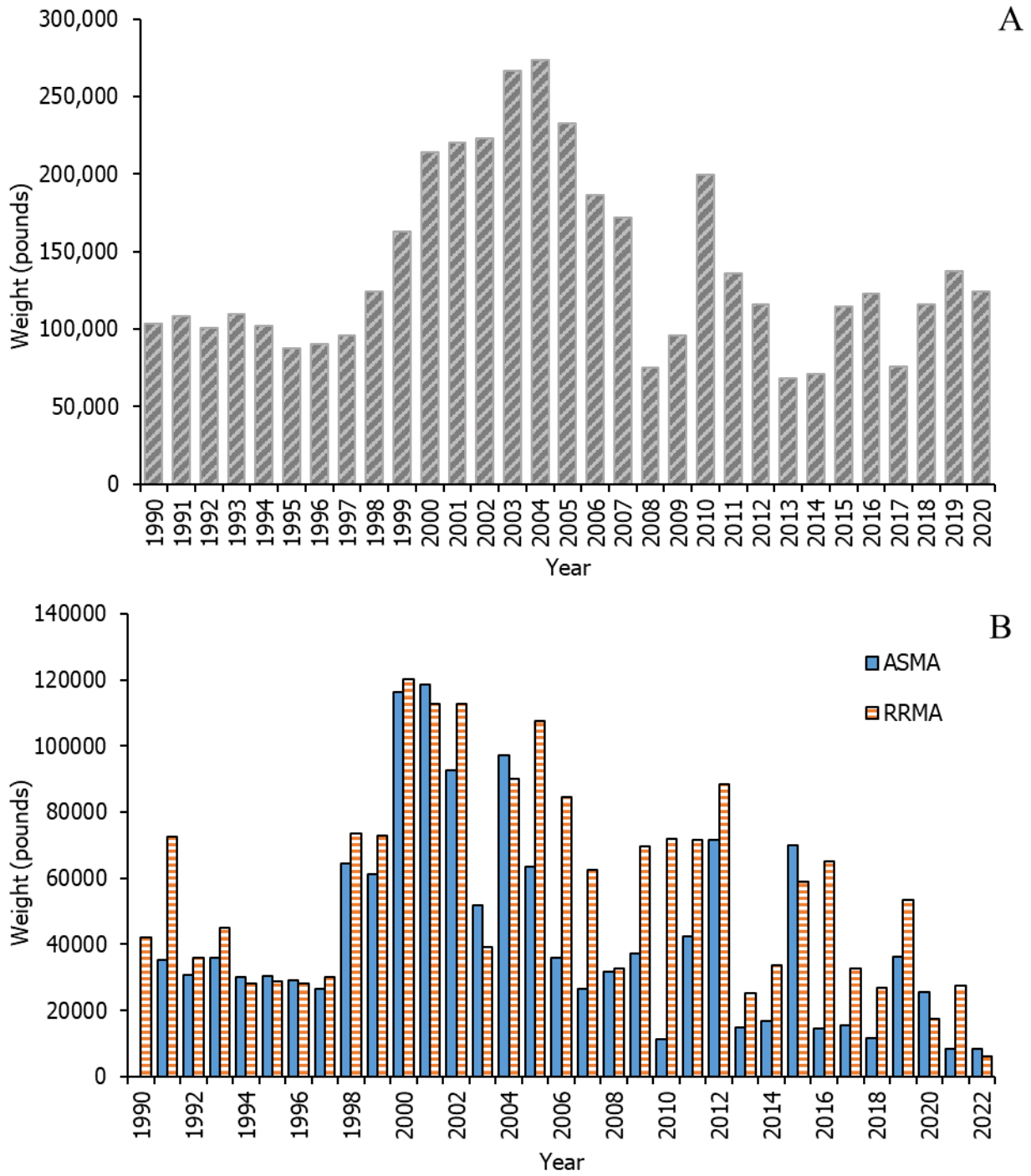
Figure 3.   ASMA commercial (A), ASMA recreational (Blue), and RRMA recreational (Orange stripes) (B)
striped bass landings in pounds, NC, 1990–2022. RRMA 2020 recreational landings are for March only.
ASMA 2020 landings are from January–March.
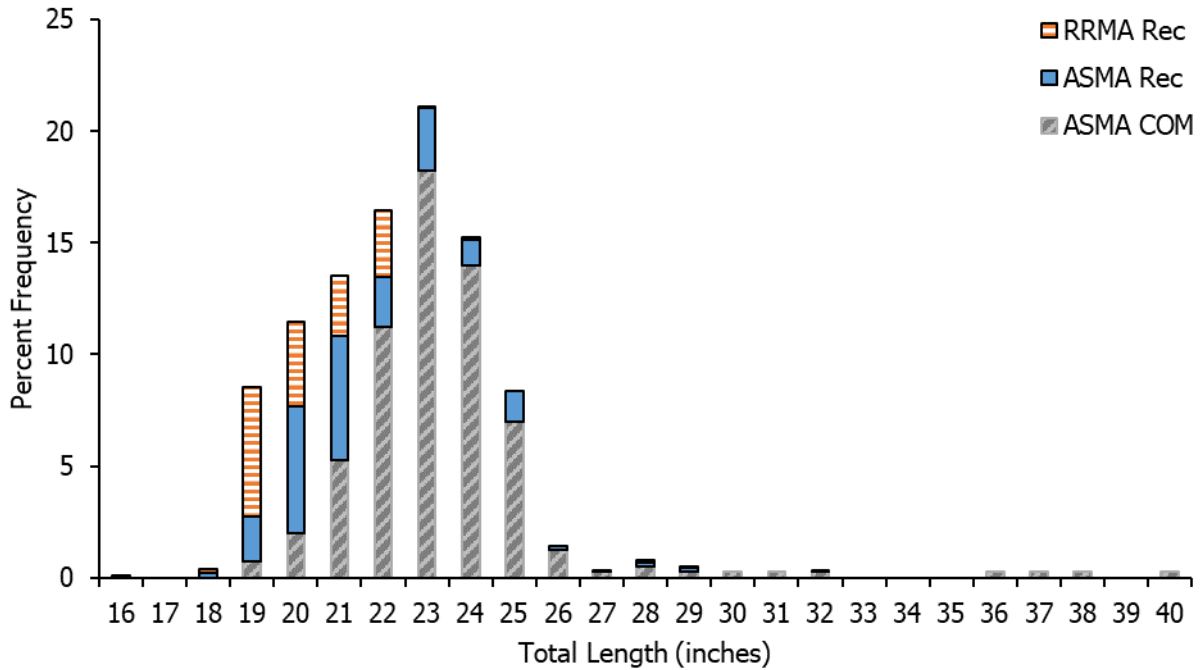
Figure 4.   ASMA commercial, ASMA recreational, and RRMA recreational length frequency distribution from striped bass harvested in 2022.
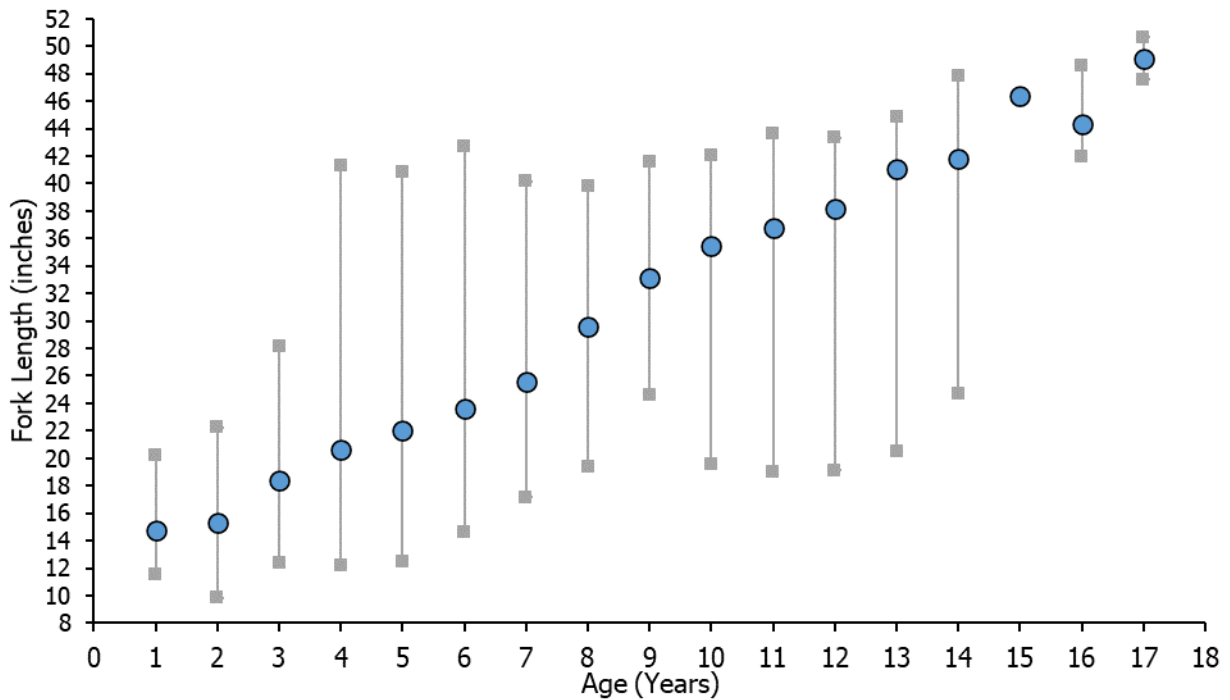
Figure 5.   Striped bass length at age based on all commercial samples, 1972–2021. Blue circles represent the mean size at a given age while the grey squares represent the minimum and maximum observed size for each age. Age data for 2022 were not available at time of publication.
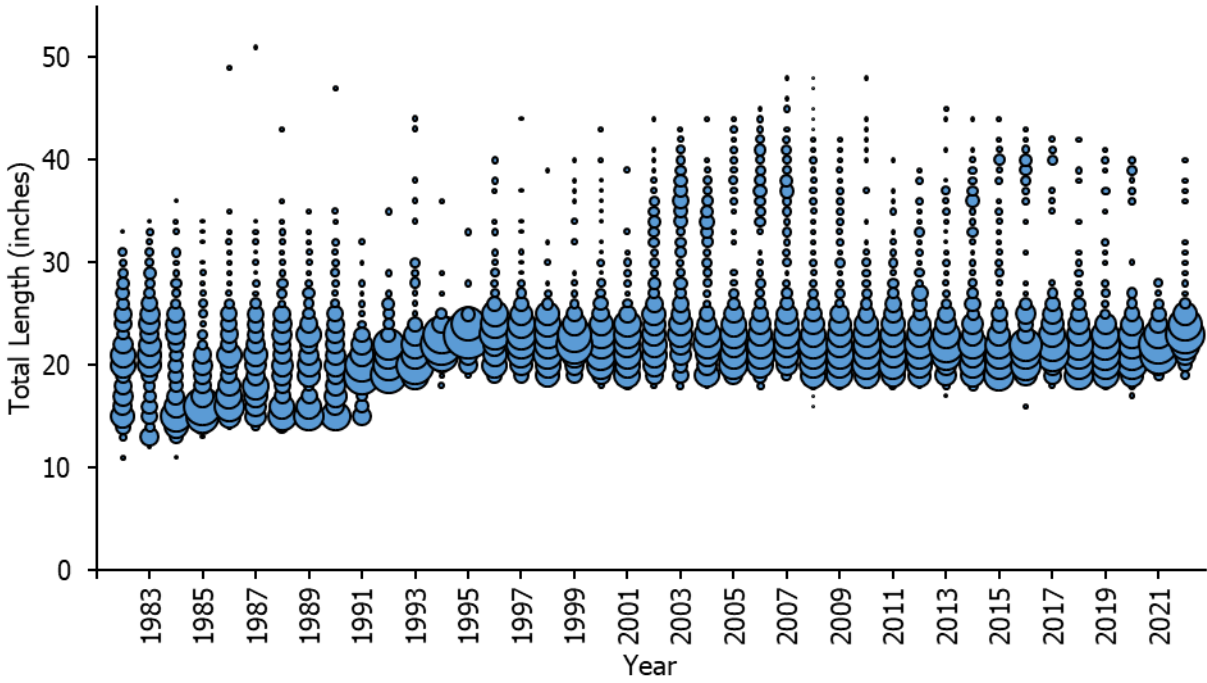
Figure 6.   Commercial length frequency (total length, inches) of striped bass harvested in the ASMA, NC, 1982–2022. Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length.
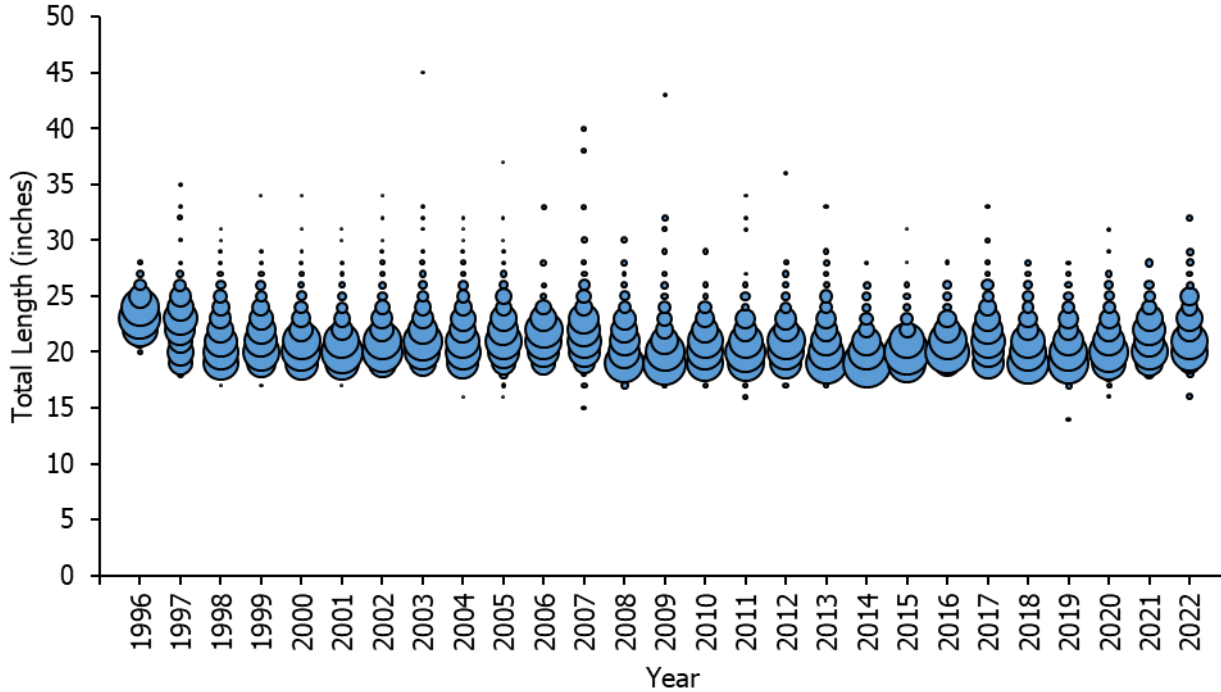
Figure 7.   Recreational length frequency (total length, inches) of striped bass harvested in the ASMA, NC, 1996–2022. Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length.
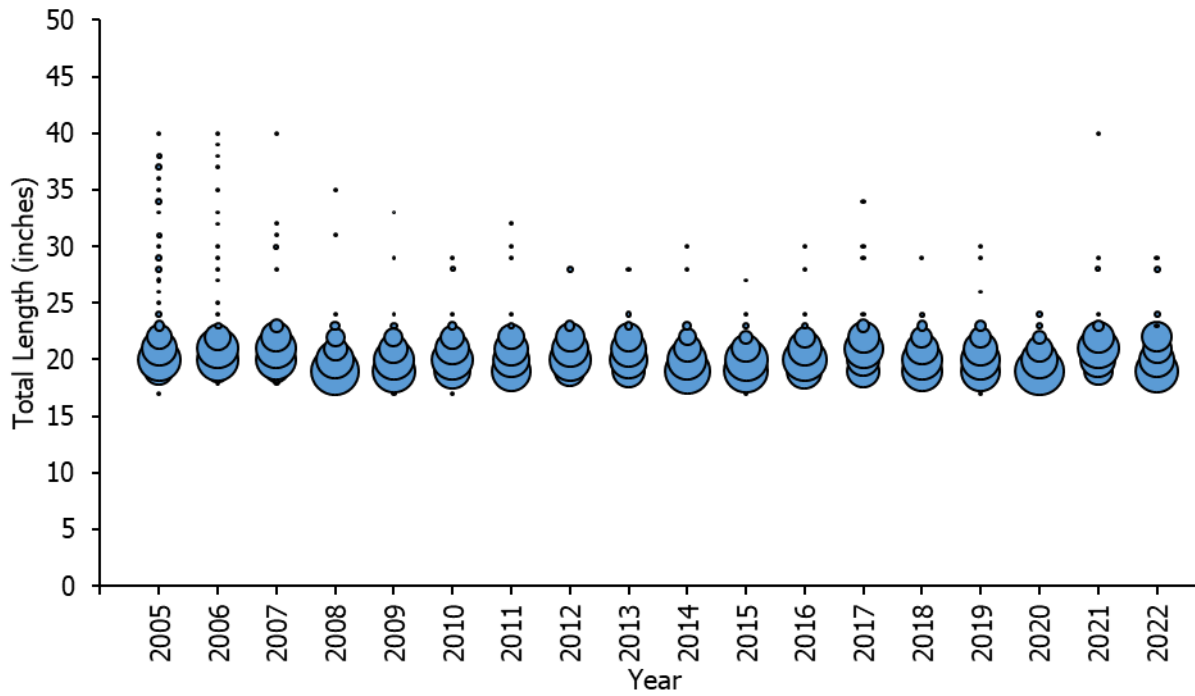
Figure 8.   Recreational length frequency (total length, inches) of striped bass harvested in the RRMA, NC, 2005–2021. Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length.
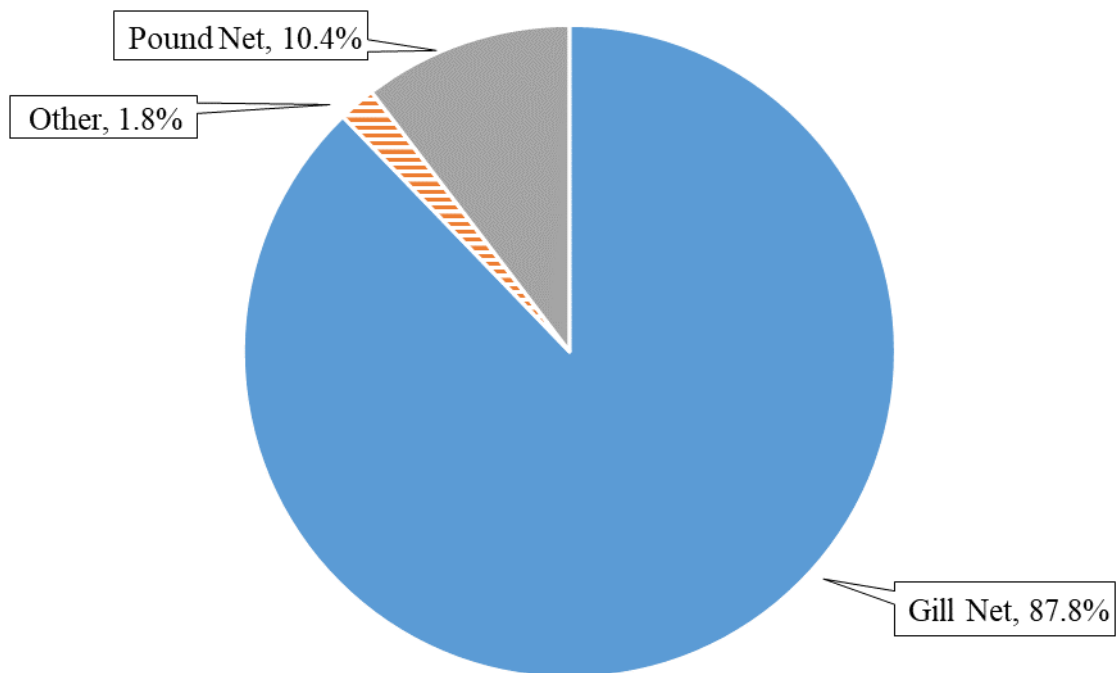
Figure 9.   Commercial striped bass landings broken out by major gears in the ASMA, NC, 1994–2022.
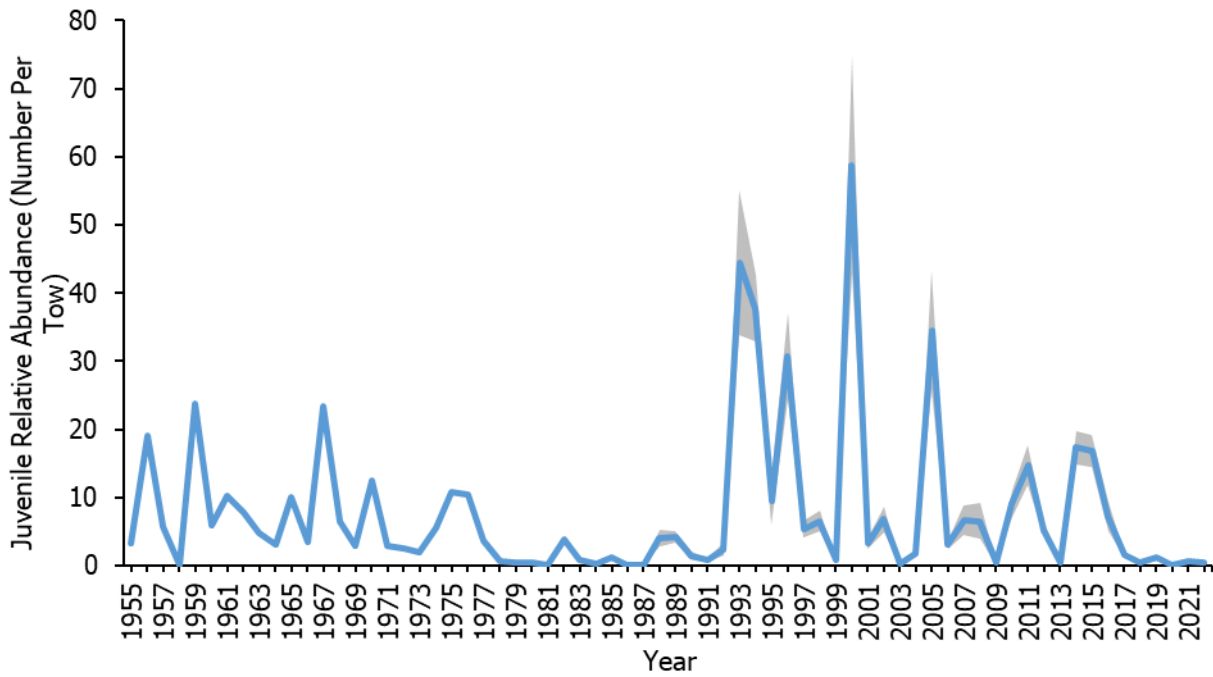
Figure 10.   Juvenile abundance index (JAI) of Albemarle-Roanoke striped bass from the DMF juvenile trawl survey, western Albemarle Sound, NC, 1955–2022.
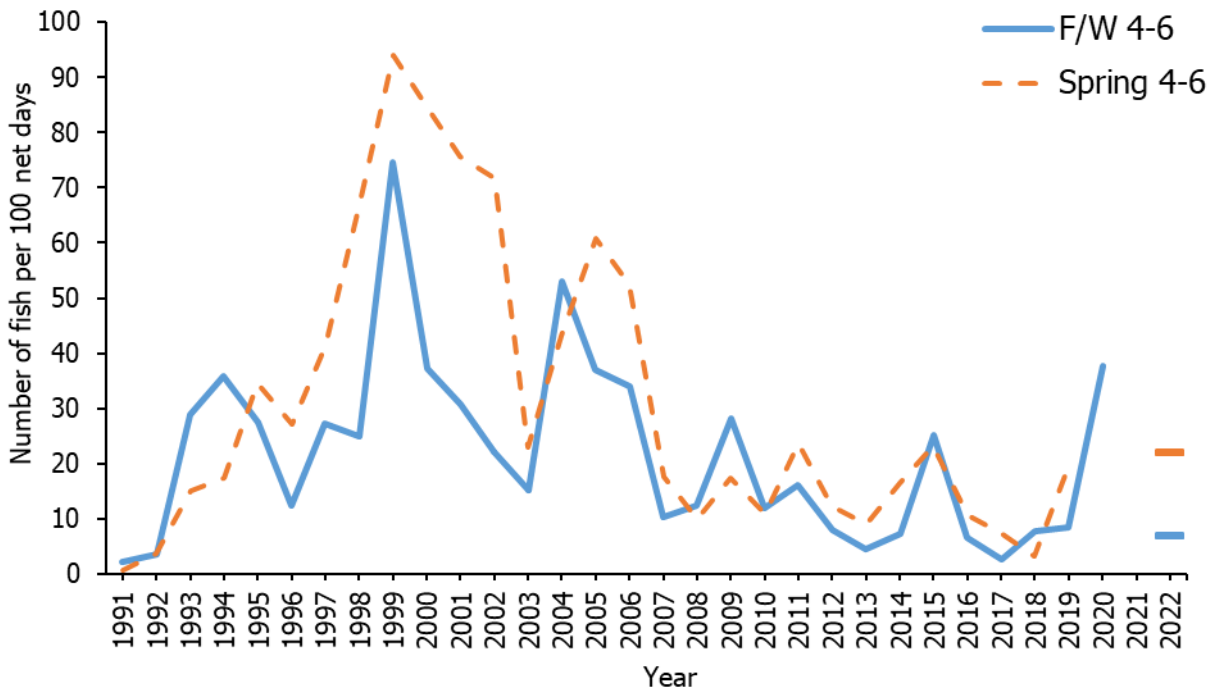
Figure 11.   Relative abundance of age 4–6 Albemarle-Roanoke striped bass from the DMF fall/winter and spring independent gill net surveys, Albemarle Sound area, NC, 1991–2022. Age data for 2022 are preliminary.
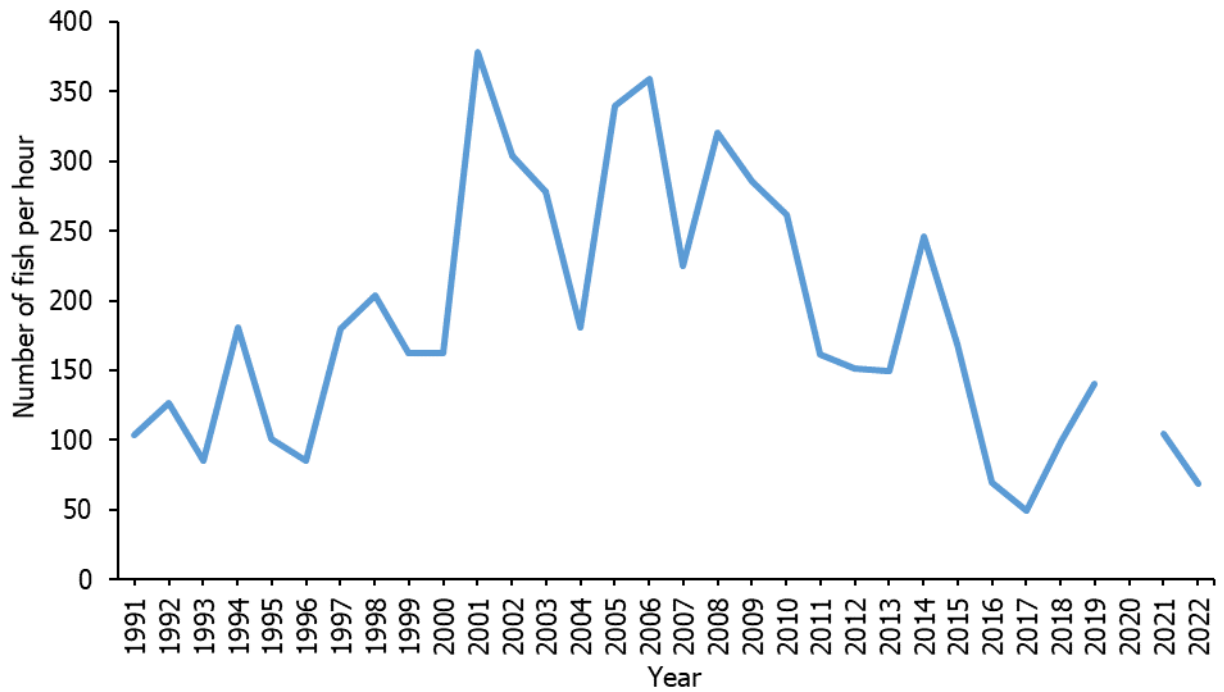
Figure 12. Relative abundance of Albemarle-Roanoke striped bass from the WRC spawning grounds electrofishing survey, Roanoke River at Weldon, NC, 1991–2022.
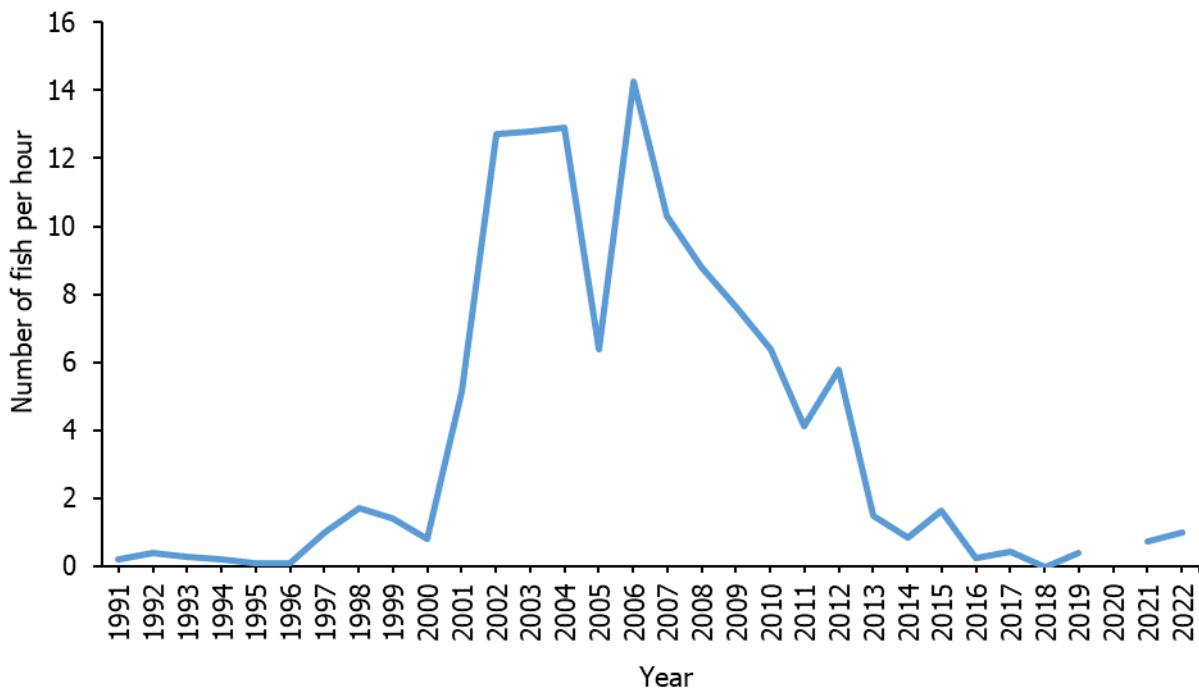
Figure 13. Relative abundance of age 9+ Albemarle-Roanoke striped bass from the WRC spawning grounds electrofishing survey, Roanoke River at Weldon, NC, 1991–2022.
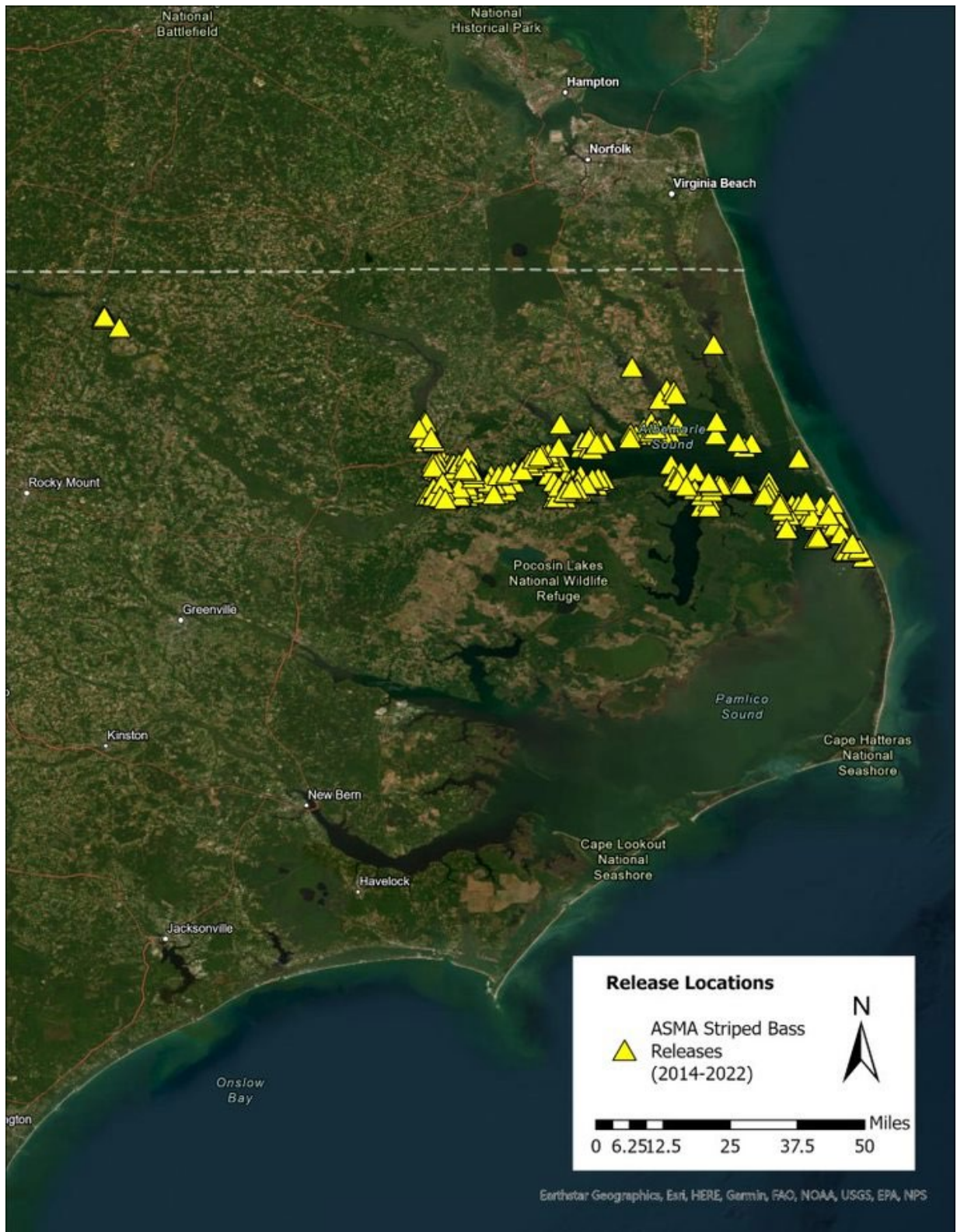
Figure 14. ASMA (Roanoke River and Albemarle Sound) striped bass tagging release locations, 2014-2022.
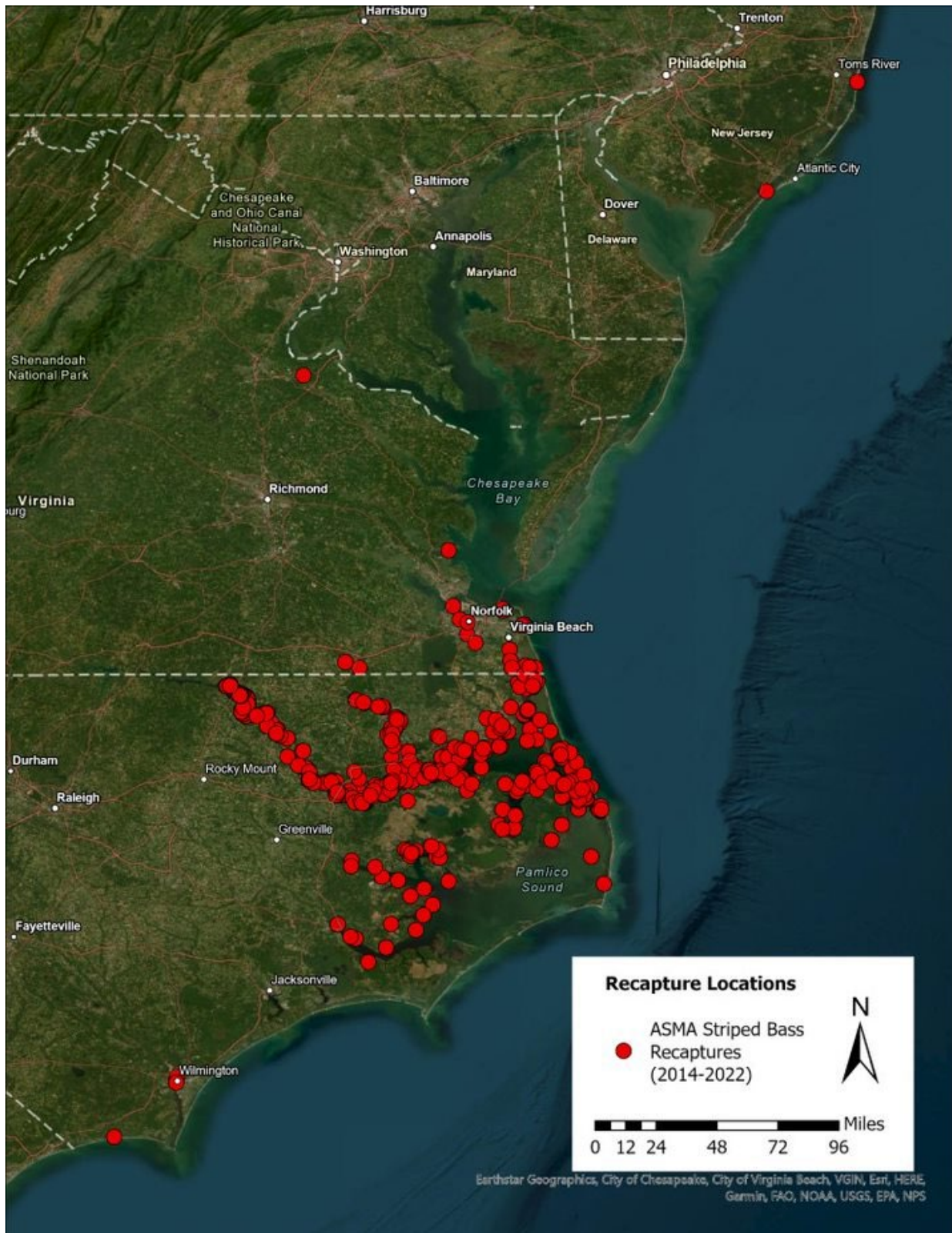
Figure 15. ASMA (Roanoke River and Albemarle Sound) striped bass tagging recapture locations, 2014-2022.
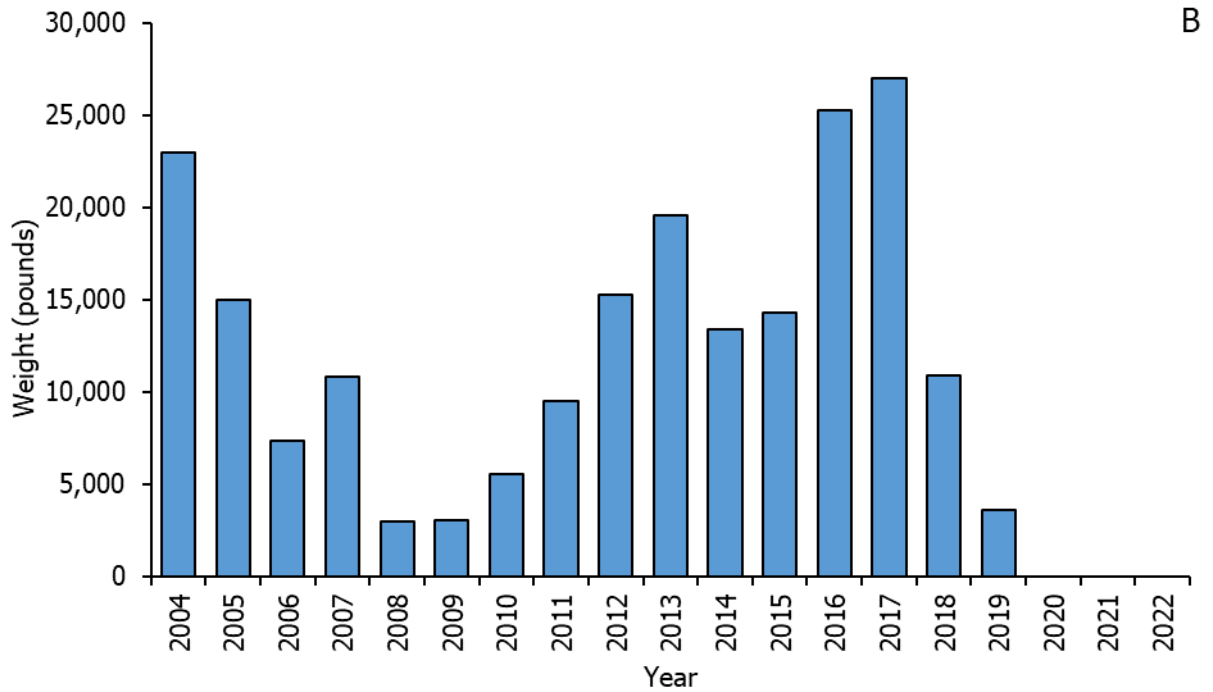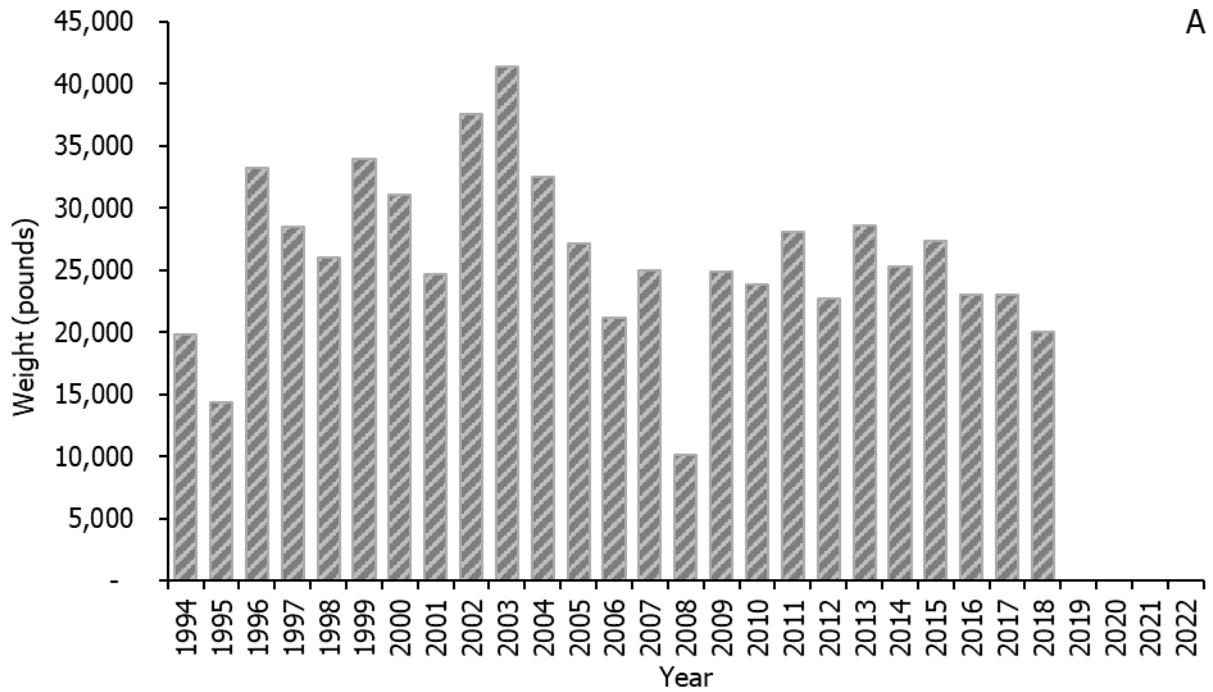
Figure 16. Annual commercial landings (pounds) reported through the North Carolina Trip Ticket Program, 1994-2022 (A), and recreational landings (pounds) estimated from the CSMA Recreational Creel Survey, 2004–2022. There was no commercial season and a limited recreational season in 2019, lasting from January 1 to March 19, 2019. Commercial and recreational seasons remained closed in 2022.
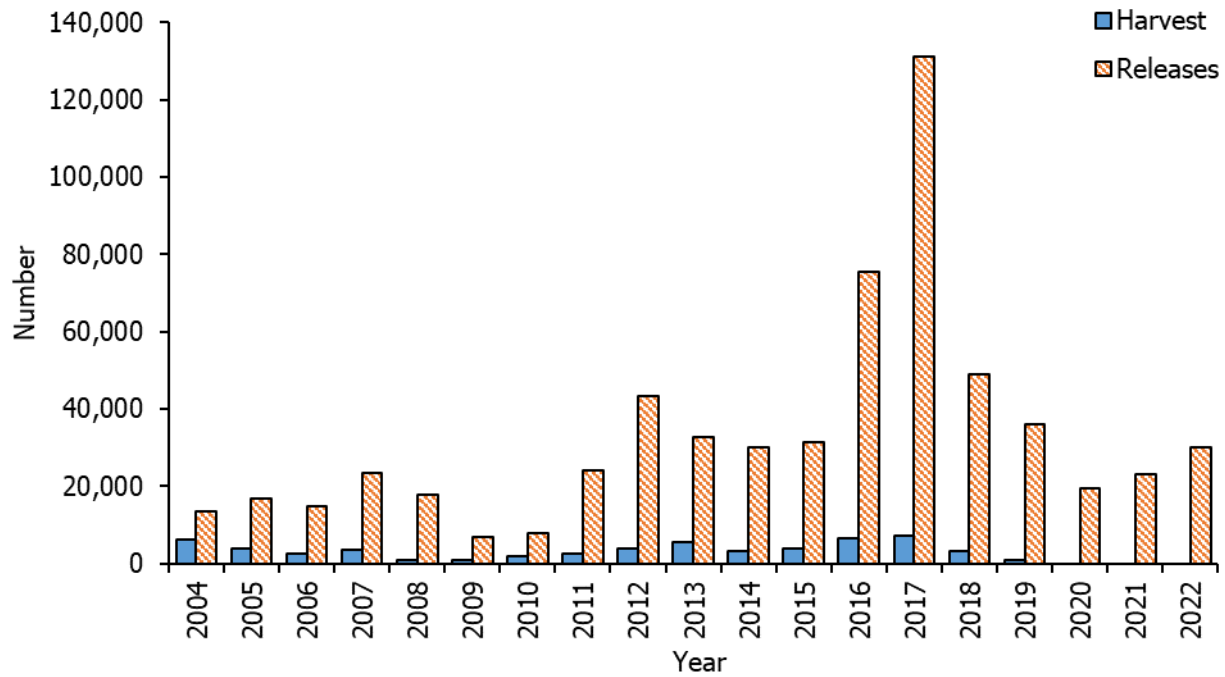
Figure 17. Annual recreational catch (harvested and/or released) of striped bass in the CSMA, 2004–2022. There was a limited recreational harvest season in 2019 prior to the closure, lasting from Jan 1 to Mar 19, 2019. The harvest season remained closed in 2022.
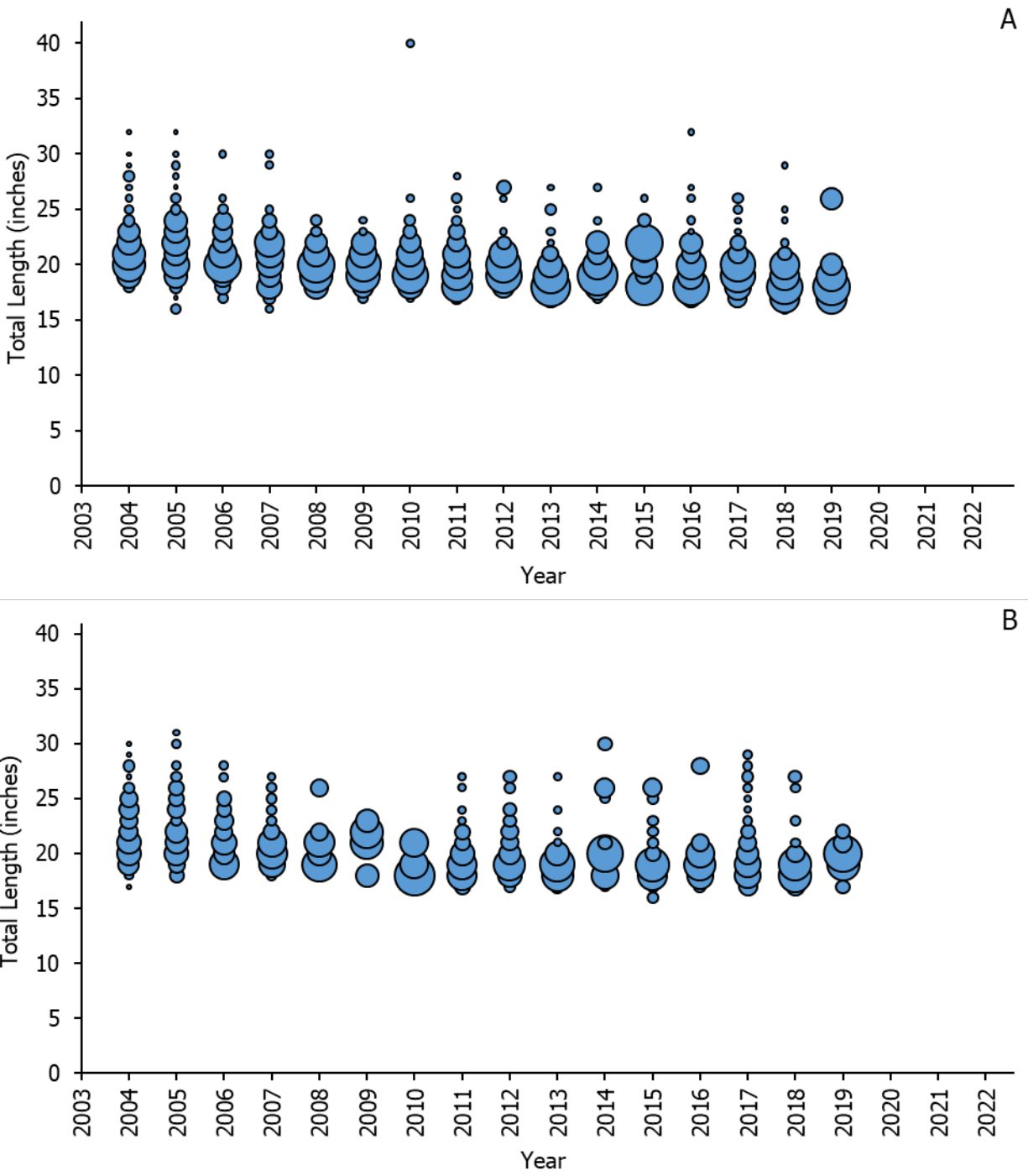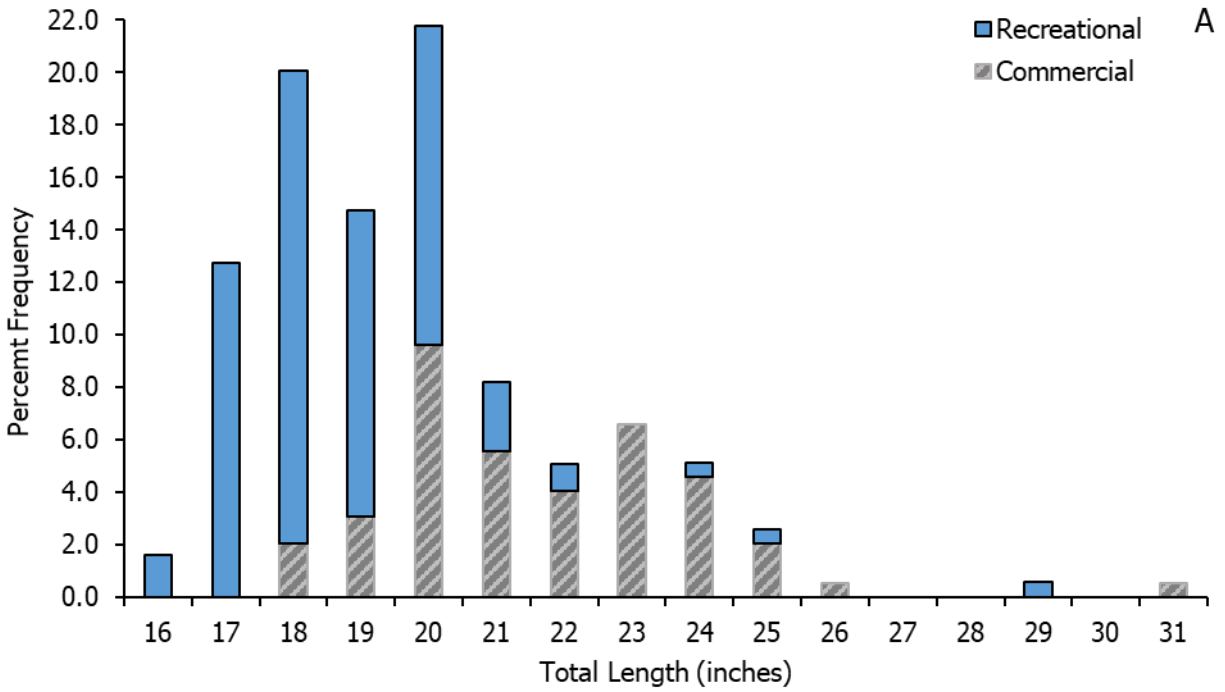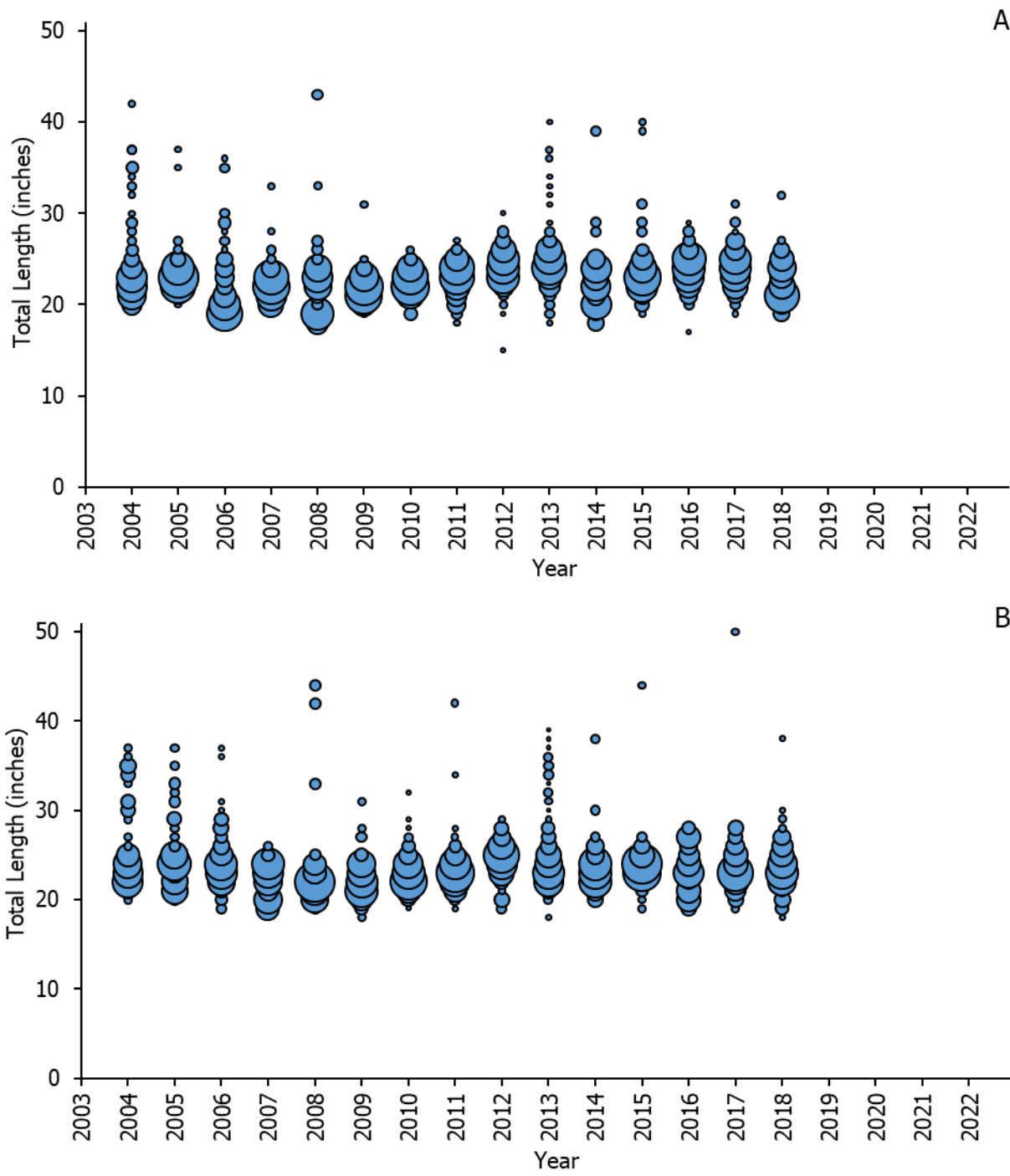
Figure 18. Recreational length frequency of CSMA striped bass harvested in the Tar-Pamlico/Pungo rivers (A), and the Neuse River (B), 2004–2022. Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length. There was a limited recreational season in 2019 prior to the closure, lasting from Jan 1 to Mar 19, 2019. The recreational season remained closed in 2022.
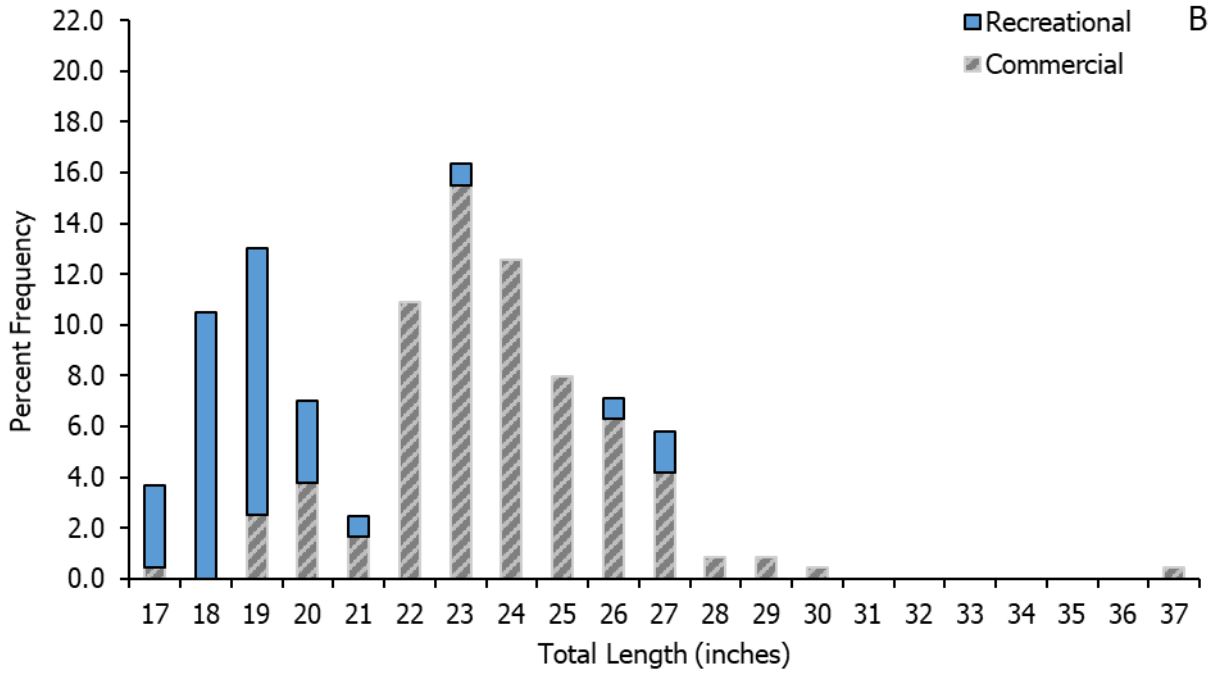
Figure 19. Commercial and recreational length frequency distributions from CSMA striped bass harvested in 2018 from the Tar-Pamlico/Pungo rivers (A) and the Neuse/Bay rivers (B).

Figure 20. Commercial length frequency of CSMA striped bass landed in the Tar-Pamlico/Pungo rivers (A), and the Neuse/Bay rivers (B) from 2004–2022. Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length. The commercial season remained closed in 2022.
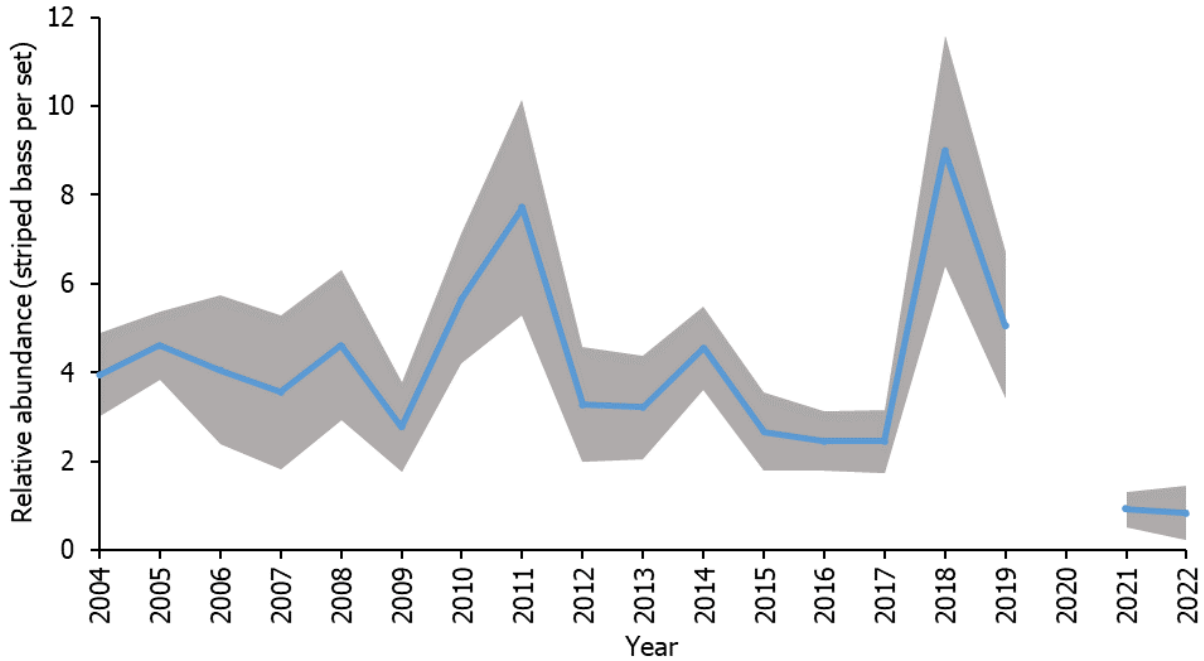
Figure 21. Annual index of adult striped bass relative abundance from the Fisheries Independent Gill Net Survey (P915) in the Tar-Pamlico River during April, and October-November, in shallow water sets, 2004–2022. No sampling occurred in 2020 and limited sampling occurred in 2021 (July–December). Error bars represent ± 1 standard error.
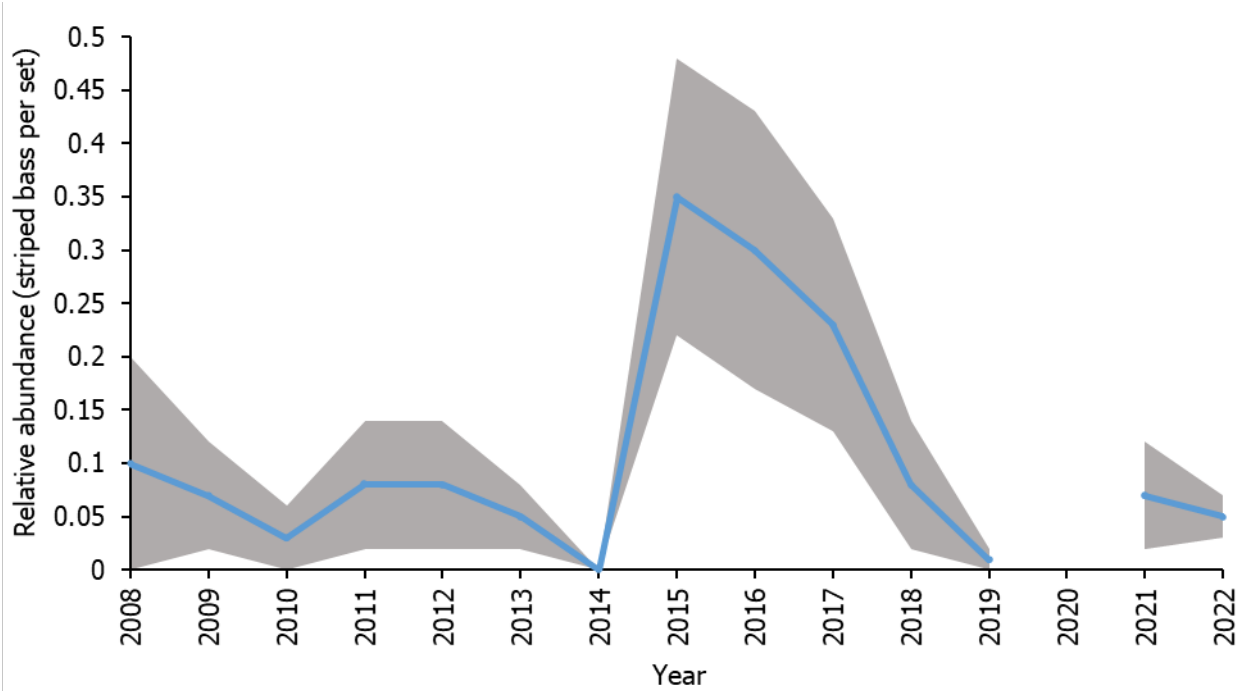

Figure 22. Annual index of adult striped bass relative abundance in the Fisheries Independent Gill Net Survey (P915) in the Neuse River during April, and October-November, in shallow water sets, 2004–2022. No sampling occurred in 2020 and limited sampling occurred in 2021 (July–December). Error bars represent ± 1 standard error.

Figure 23. Annual index of adult striped bass relative abundance in the Fisheries Independent Gill Net Survey (P915) in the Cape Fear and New rivers, 2008–2022. No sampling occurred in 2020 and limited sampling occurred in 2021 (July–December). Error bars represent ± 1 standard error.
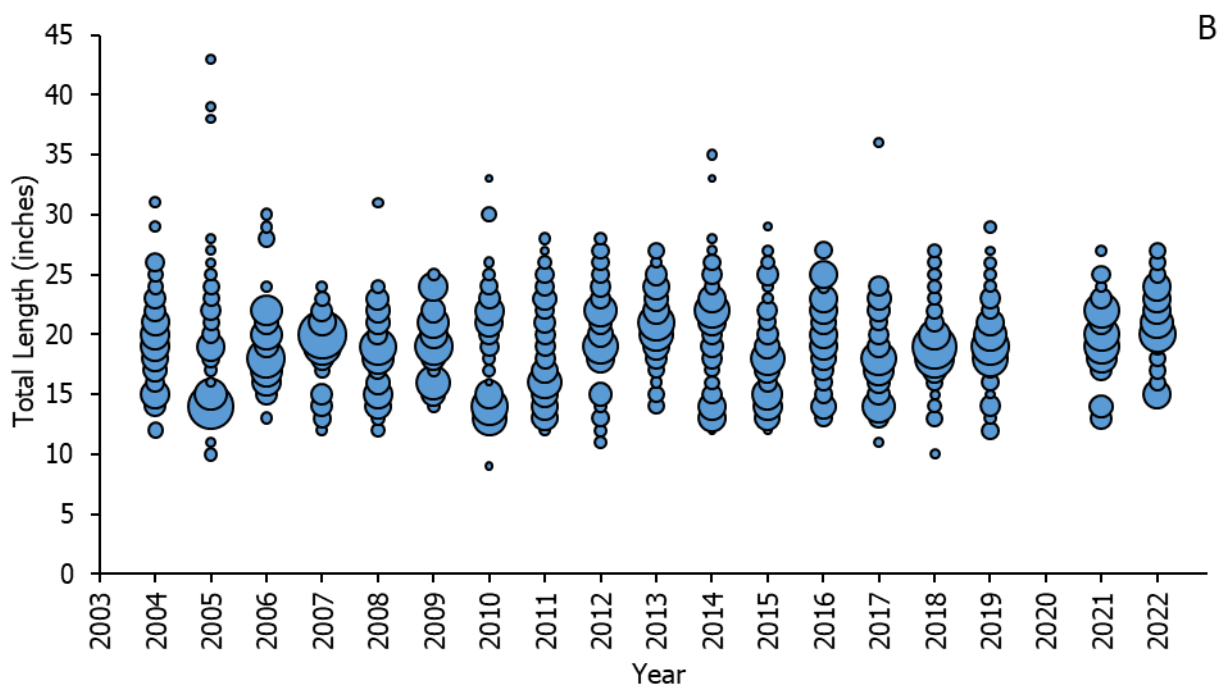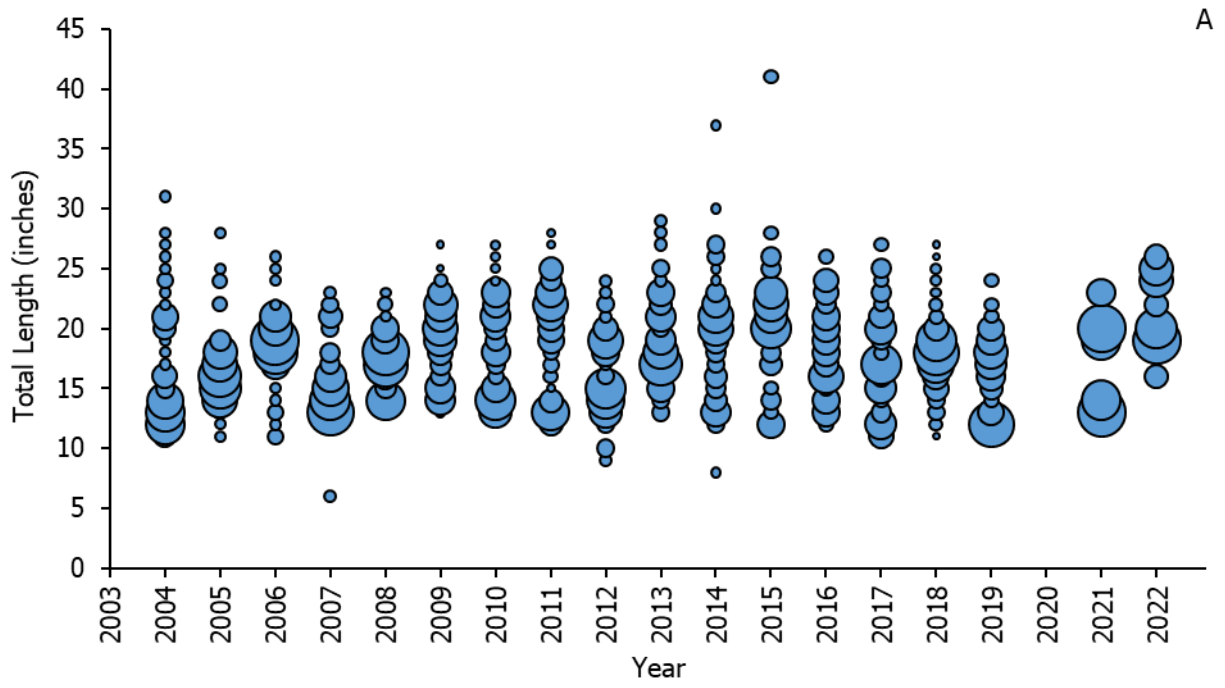
Figure 24. Length frequency of striped bass captured in the Fisheries Independent Gill Net Survey (P915) in the Tar-Pamlico River (A), and the Neuse River (B) during April, and October-November, in shallow water sets (2004–2022). No sampling occurred in 2020 and limited sampling occurred in 2021 (July–December). Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length.
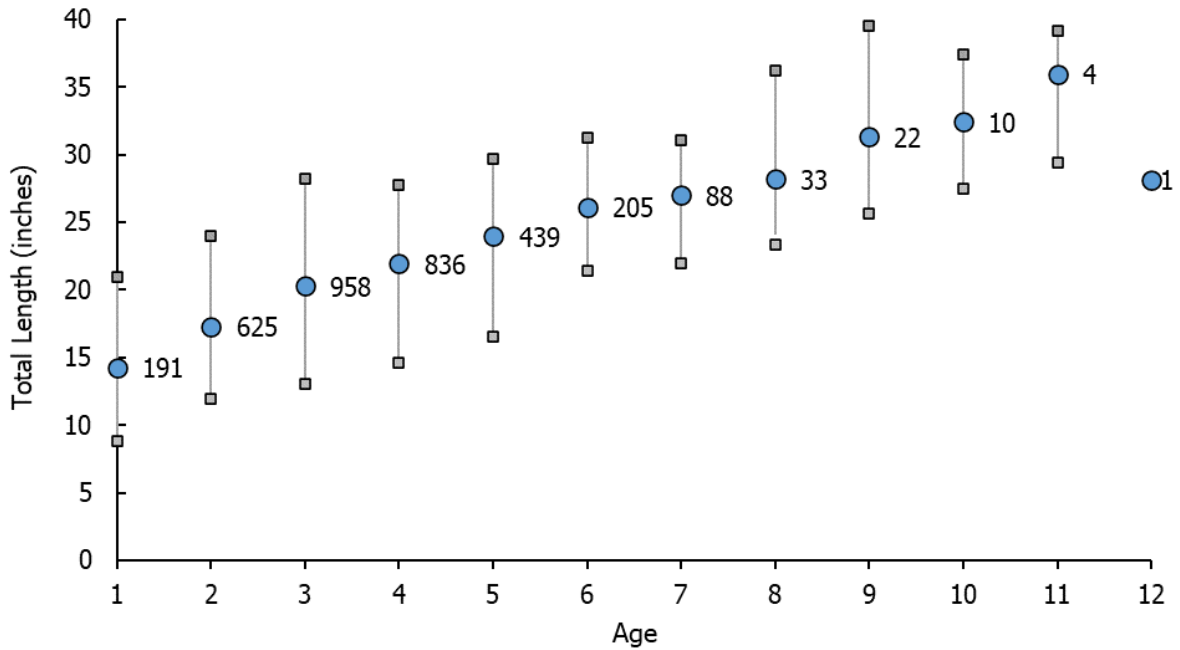
Figure 25. CSMA striped bass length at age based on otolith and genetic age samples collected, 2004–2022. Blue circles represent the mean size at a given age with the number of samples. The grey squares represent the minimum and maximum observed size for each age. Otolith age data from 2022 are considered preliminary, and genetic ages from 2020 - 2022 are not currently available.
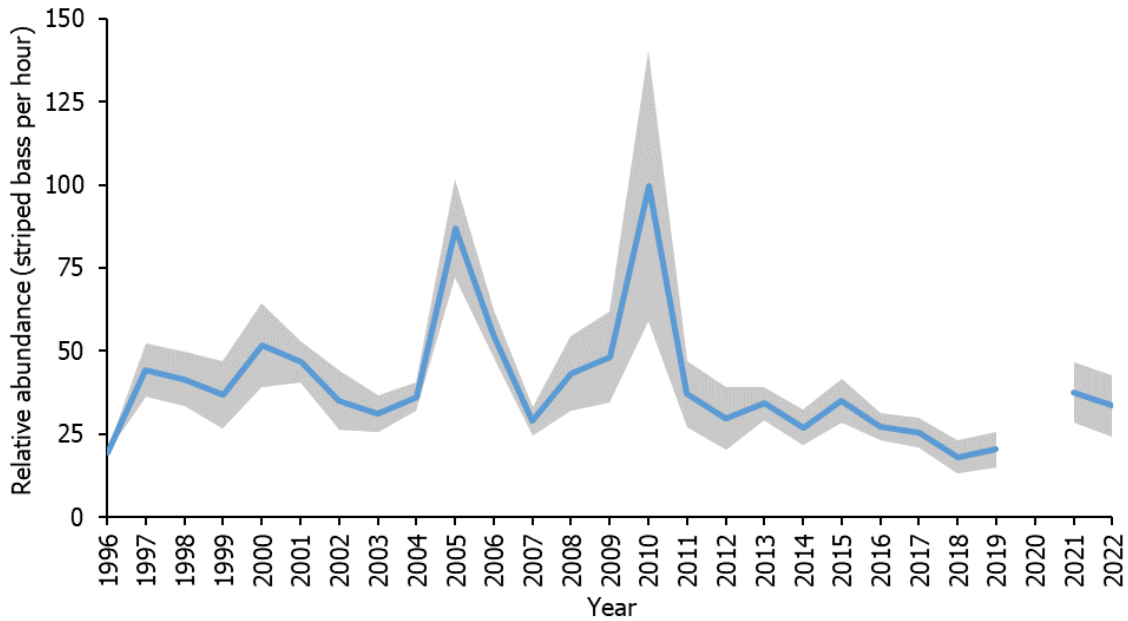

Figure 26. Relative abundance of Tar-Pamlico River striped bass from the WRC spawning grounds electrofishing survey, 1996–2022. No sampling occurred in 2020. Error bars represent ± 1 standard error.
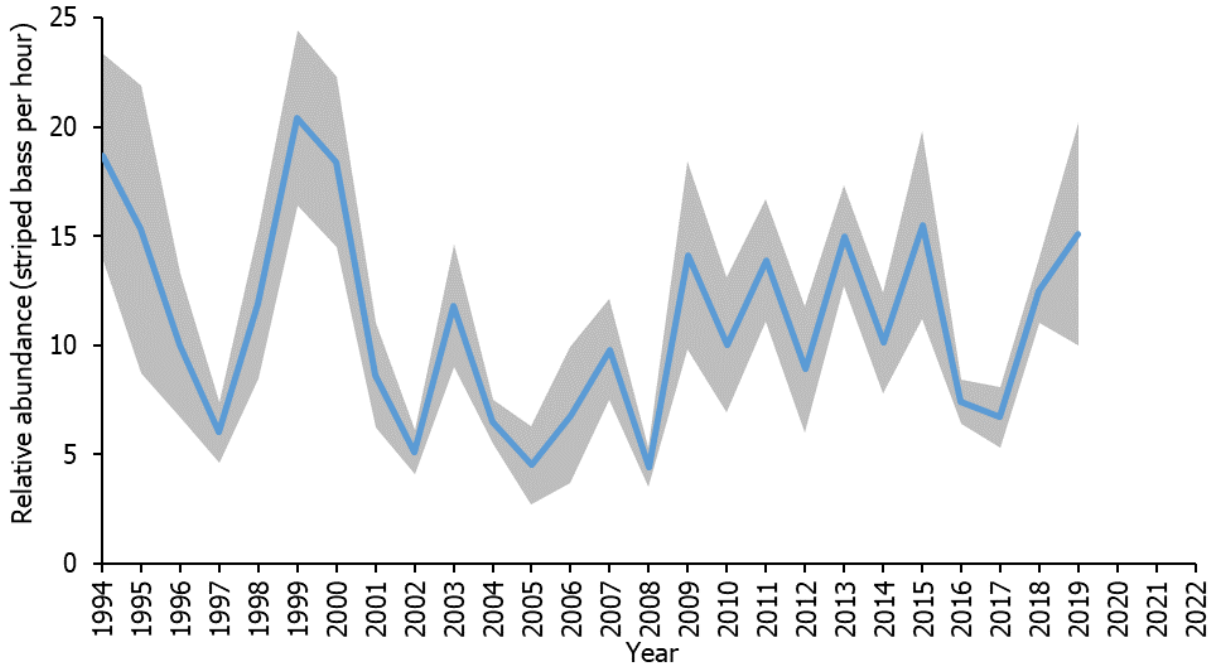
Figure 27. Relative abundance of Neuse River striped bass from the WRC spawning grounds electrofishing survey, 1994–2022. No sampling occurred in 2020, Data are not currently available for 2021 and 2022. Error bars represent ± 1 standard error.
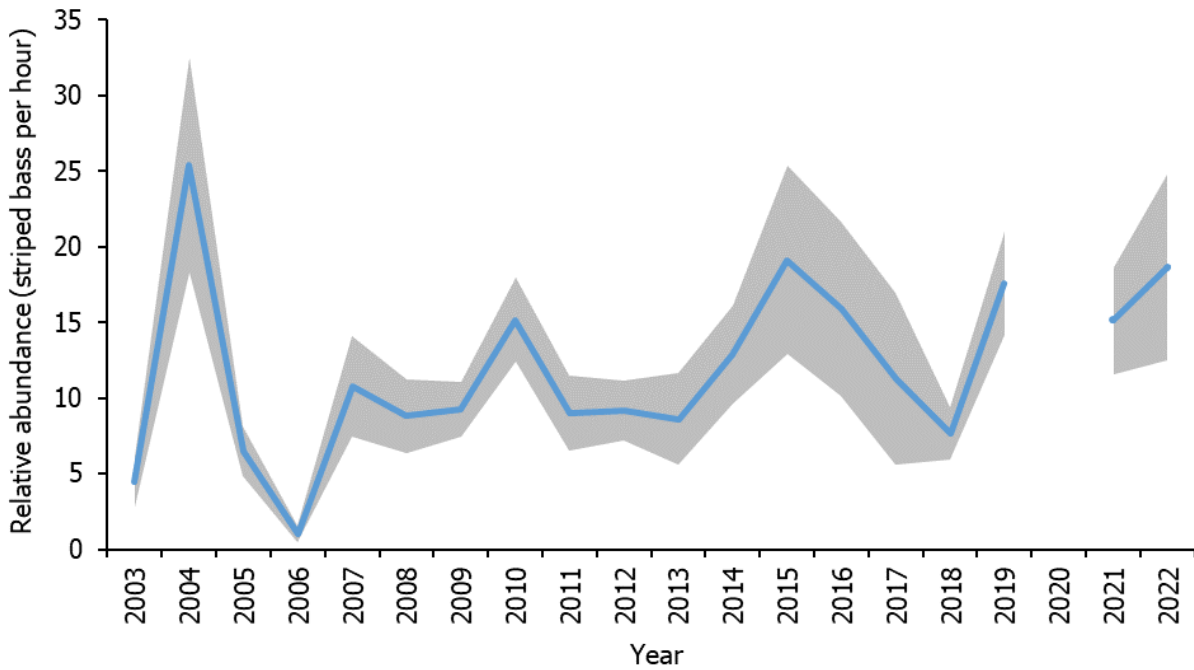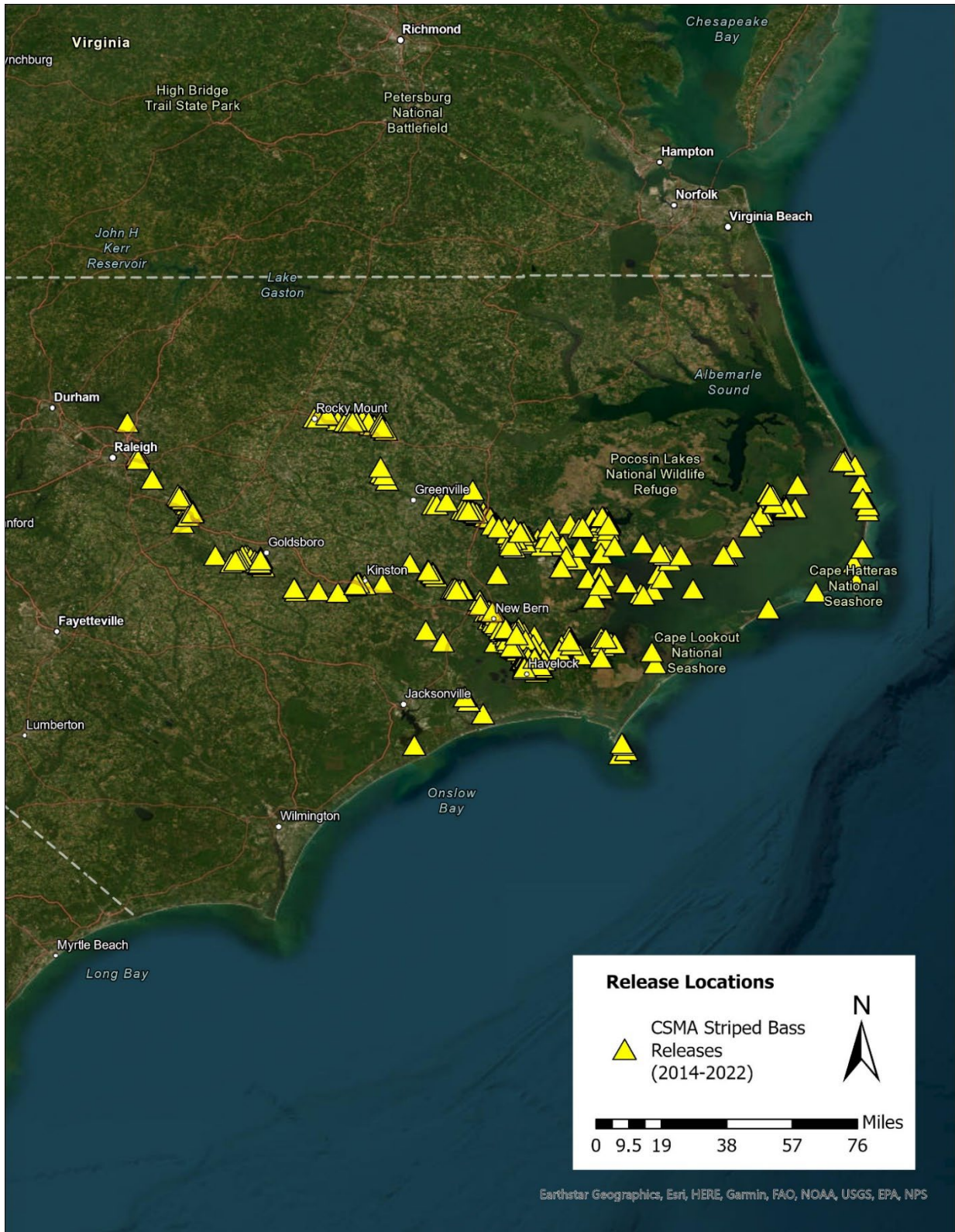

Figure 28. Relative abundance of Cape Fear River striped bass from the WRC spawning grounds electrofishing survey, 2003–2022. No sampling occurred in 2020. Error bars represent ± 1 standard error.

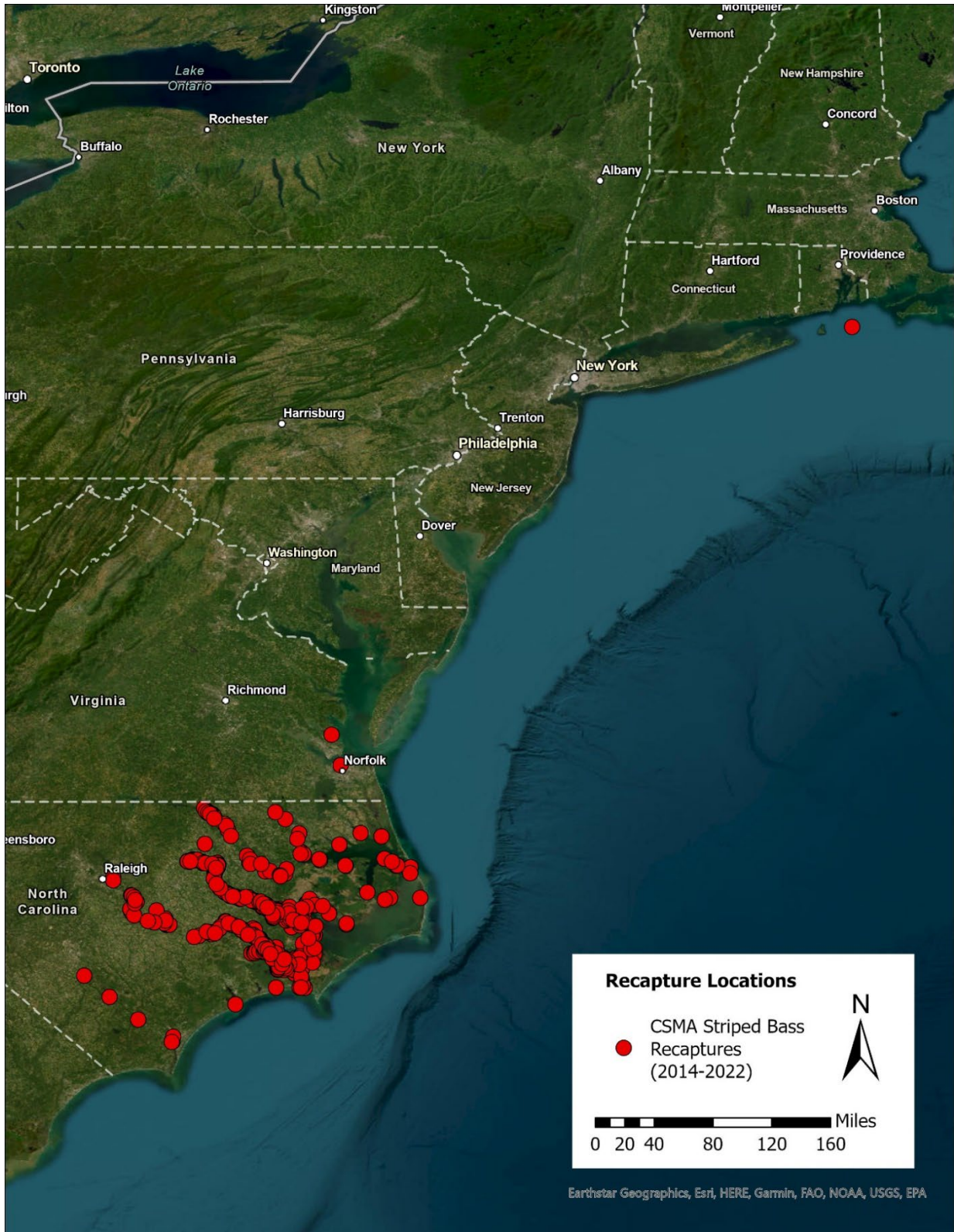Figure 29. CSMA striped bass tagging release locations, 2014-2022.

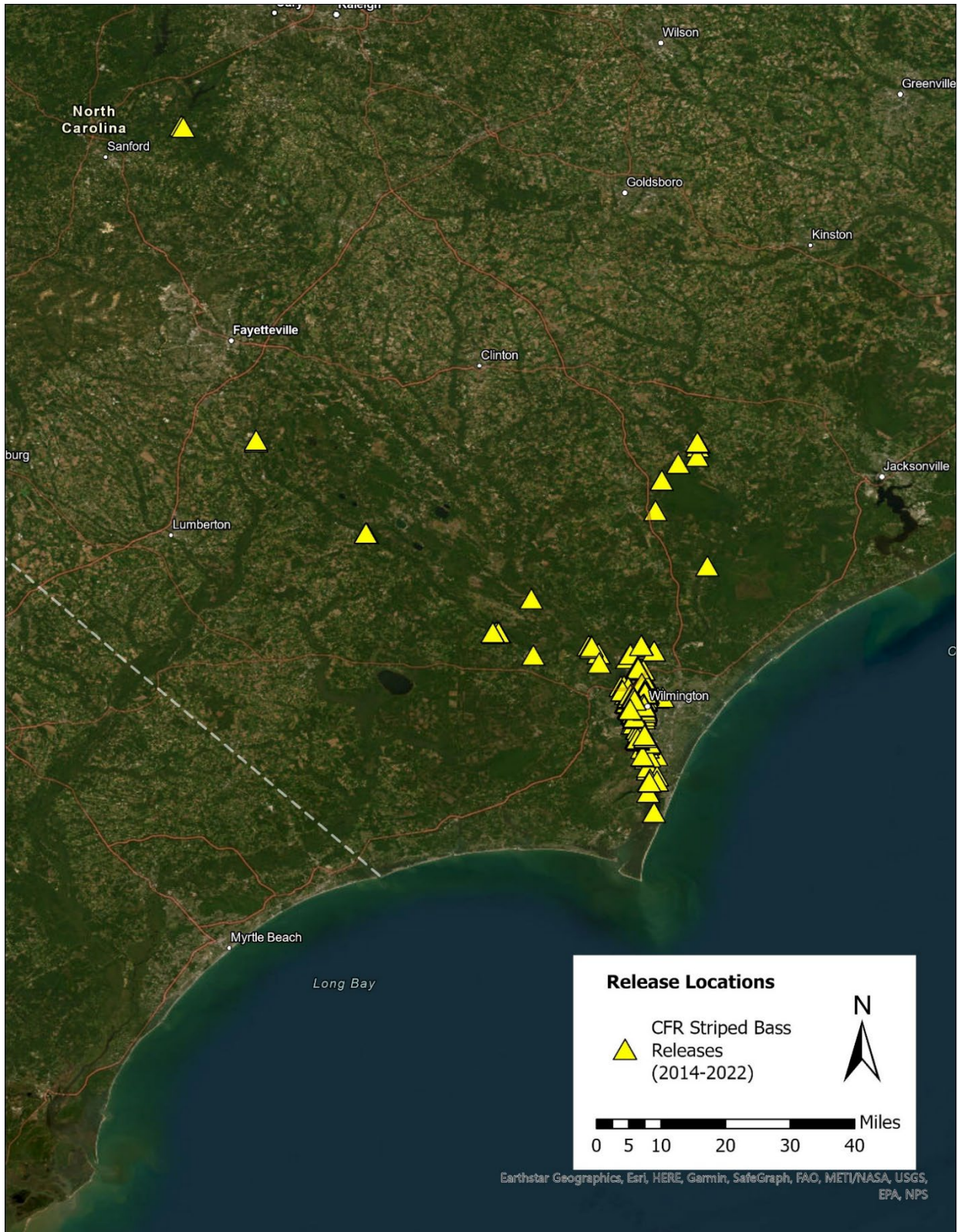Figure 30. CSMA striped bass tagging recapture locations, 2014-2022.

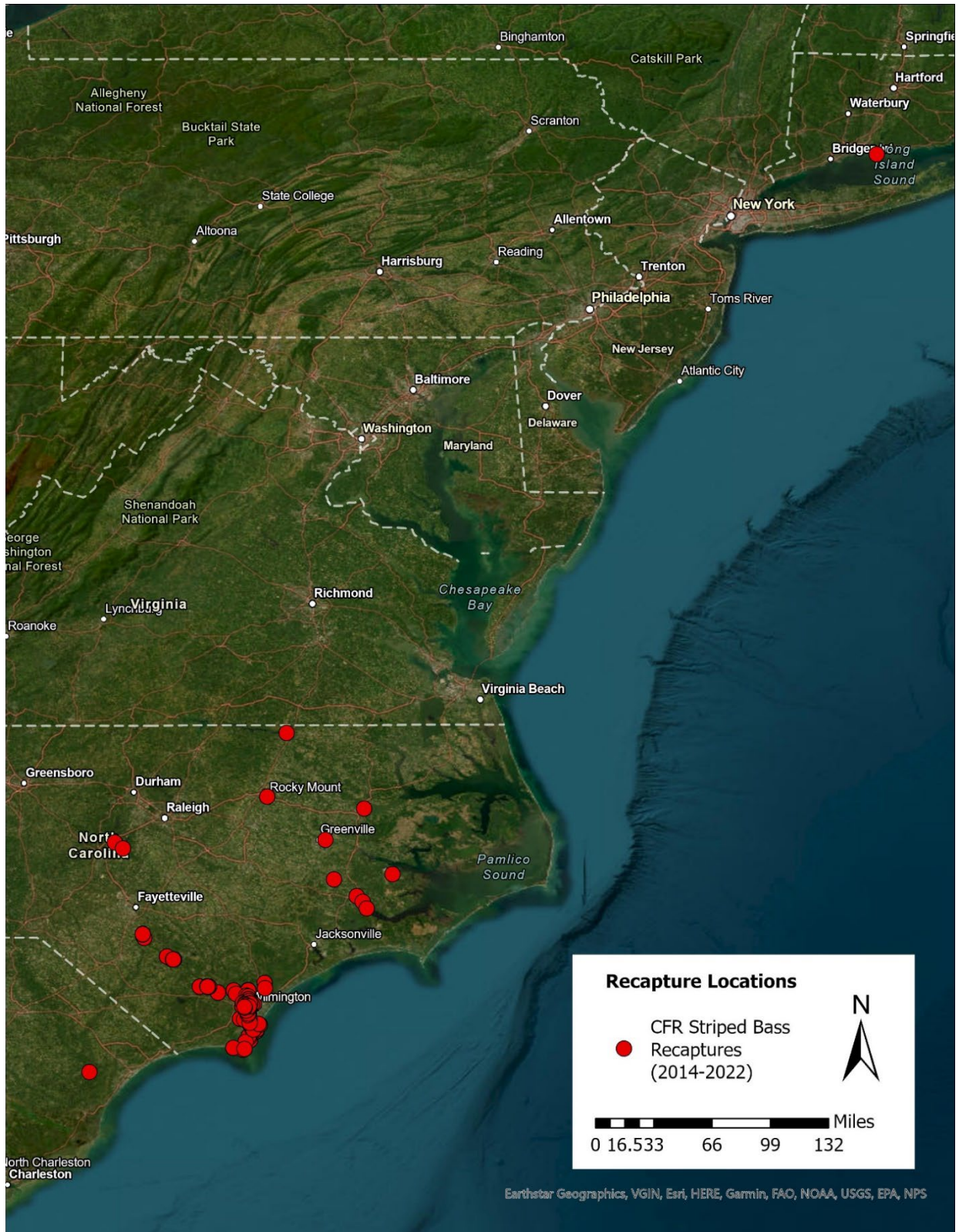Figure 31. CSMA (Cape Fear River) striped bass tagging release locations, 2014-2022.

Figure 32. CSMA (Cape Fear River) striped bass tagging recapture locations, 2014-2022.