FISHERY MANAGEMENT PLAN UPDATE
ESTUARINE STRIPED BASS
AUGUST 2025

STATUS OF THE FISHERY MANAGEMENT PLAN

Fishery Management Plan History

Original FMP Adoption:	January 1994	
First FMP post FRA:	May 2004	
Amendments:	Amendment 1	May 2013
	Amendment 2	November 2022
Revisions:	Revision to Amendment 1	November 2014
	Revision to Amendment 1	November 2020
	Revision to Amendment 2	2024
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 plan jointly developed 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 the term 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 implemented March 29, 2019, consisted of the following:

- Commercial and recreational no possession measure for striped bass (including hybrids) in internal coastal and joint 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 MFC 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 MFC to review the desirability of directing the fisheries director to issue a proclamation. Once the MFC 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 MFC decision. In these cases, under existing law, the decision of the MFC 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 stock 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 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 efforts, 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 an 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.

Amendment 2 management measures for the Tar-Pamlico and Neuse rivers stocks carried forward the Supplement A no-possession measure to Amendment 1. Amendment 2 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).

The 2024 Revision to Amendment 2 was required based on results of the 2022 update to the Albemarle-Roanoke (A-R) striped bass benchmark stock assessment that indicates overfishing is still occurring in the terminal year (2021) of the assessment and the stock continues to be overfished. (Lee et al. 2022). An additional concern is the eight consecutive years (2017–2024) of very poor A-R stock spawning success. The DMF and an external peer review panel of experts concluded the stock assessment update is suitable for management use and represents the current stock status. The peer review panel recognized factors in addition to fishing mortality are likely contributing to the chronic poor recruitment observed since the early 2000s and the current low abundance of the stock. Contributing factors may include river flow, water quality, water temperatures, habitat conditions, predation (i.e. blue catfish), and competition for food.

The 2024 Revision to Amendment 2 implemented a harvest moratorium effective January 1, 2024, until the population improves to a level capable of supporting sustainable harvest. The revision and all other management strategies contained in Amendment 2 will remain in effect until further changes are implemented through the adaptive management framework of the North Carolina Estuarine Striped Bass FMP Amendment 2 and its Revisions or another Amendment is adopted.

Management Unit

There are two geographic management units and four striped bass stocks included in Amendment 2 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 FMPs 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 make extensive seasonal ocean migrations 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 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 update 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 update 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 (Figure 2).

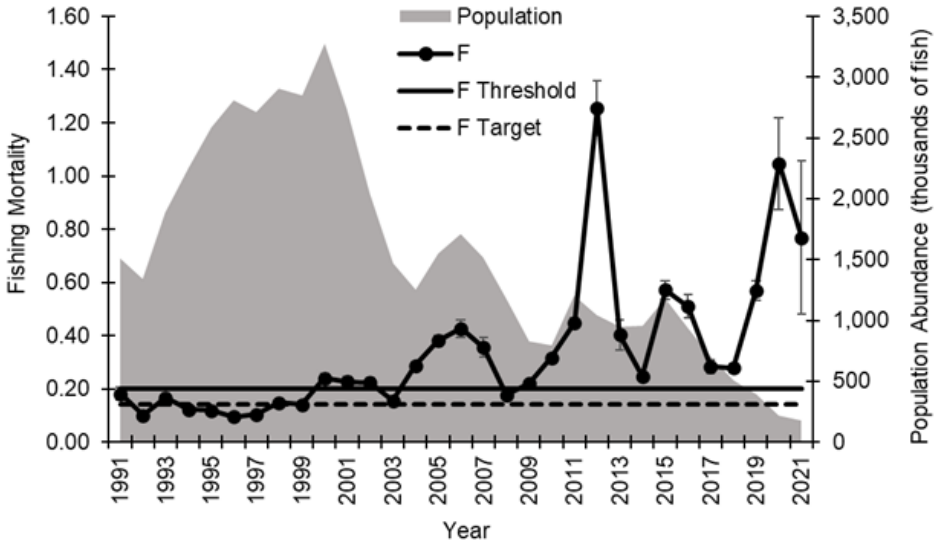

Figure 1. Estimates of fishing mortality (F) Albemarle-Roanoke striped bass stock, 1991–2021. Error bars represent ± two standard errors. Source: Lee et al. 2022.

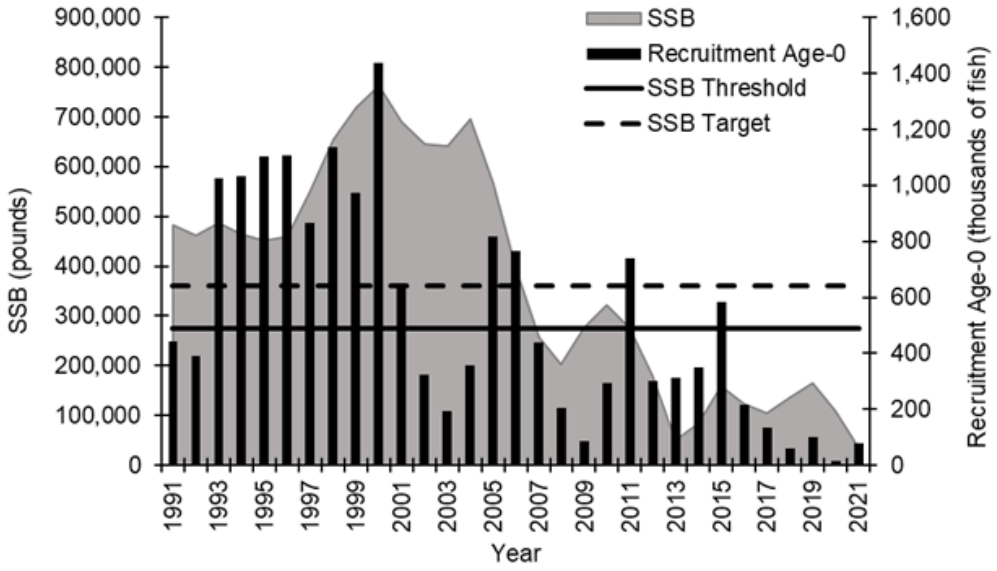

Figure 2. Estimates of spawning stock biomass (SSB) each year for the Albemarle-Roanoke striped bass stock, 1991–2021. Error bars represent ± two standard errors. Source: Lee et al. 2022

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 was closed in 2024. An 18–25 inch total length (TL) harvest slot limit began in 2023. The commercial fishery is prosecuted as a non-directed bycatch fishery, with most landings occurring in large mesh (≥ 5-inch stretched mesh) floating gill nets during the spring American shad fishery. Pound nets and flounder nets account for the remainder of the harvest. 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 1–November 30 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 was closed in 2024. The recreational sector also has an 18–25-inch TL harvest slot limit and a one fish per person daily possession limit. The allowable harvest seasons are the same as the commercial sector, but the actual length of the season depends on available quota. 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.

Commercial harvest in the RRMA is prohibited. The harvest season was also closed in the RRMA in 2024. The harvest season can be open March 1–April 30, but the actual length of the season depends on the available quota. There is an 18–22-inch TL harvest slot limit. 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.

The 2024 Revision to Amendment 2 implemented a harvest moratorium in the ASMA and RRMA effective January 1, 2024, until the population improves to a level capable of supporting sustainable harvest (NCDMF 2024).

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 3–7 years of age. From 1990 through 1997 the TAL was set at 98,000 pounds because the A-R stock was at historically 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. The 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 2023 is presented in Figure 4. Length at age for all commercial samples collected 1972–2023 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 size limit. 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.

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, 1990–2024.

	ASMA Recreational			RRMA Recreational			ASMA Commercial	
Year	Number Landed	Number Released	Weight Landed (lb)	Number Landed	Number Released	Weight Landed (lb)	Weight Landed (lb)	Total Weight Landed (lb)
1990	-	-	-	-	-	-	103,757	103,757
1991	14,395	23,540	35,344	26,934	-	72,529	108,460	216,333
1992	10,542	19,981	30,758	13,372	-	36,016	100,549	167,323
1993	11,404	13,241	36,049	14,325	-	45,145	109,475	190,669
1994	8,591	-	30,217	8,284	-	28,089	102,370	160,676
1995	7,343	-	30,564	7,471	52,698	28,883	87,836	147,283
1996	7,433	-	29,186	8,367	163,452	28,178	90,133	147,497
1997	6,901	30,771	26,581	9,364	291,765	29,997	96,122	152,700
1998	19,566	91,888	64,580	23,109	189,978	73,541	123,927	262,048
1999	16,967	40,321	61,338	22,479	163,555	72,967	162,870	297,175
2000	38,085	78,941	116,158	38,206	93,148	120,091	214,023	450,272
2001	40,127	61,418	118,506	35,231	71,003	112,805	220,233	451,544
2002	27,896	51,555	92,649	36,422	55,775	112,698	222,856	428,203
2003	15,124	25,281	51,794	11,157	38,256	39,170	323,337	414,301
2004	28,004	41,041	97,097	26,506	187,331	90,191	273,565	460,853
2005	17,954	21,220	63,477	34,122	157,697	107,530	232,693	403,700
2006	10,711	9,455	35,997	25,355	65,524	84,521	186,399	306,917
2007	7,143	13,599	26,633	19,306	52,501	62,492	171,682	260,807
2008	10,048	36,975	31,628	10,541	189,638	32,725	74,890	139,243
2009	12,069	40,563	37,313	23,248	135,964	69,581	95,794	202,688
2010	3,504	16,200	11,470	22,445	123,910	72,037	199,829	283,336
2011	13,341	21,572	42,536	22,102	107,693	71,561	136,266	250,363
2012	22,345	24,971	71,456	28,847	63,018	88,271	115,605	275,332
2013	4,299	16,381	14,897	7,718	74,221	25,197	68,338	108,432
2014	5,529	23,086	16,867	11,058	165,539	33,717	70,989	121,573
2015	23,240	49,534	70,008	20,031	108,240	58,962	114,488	243,458
2016	4,794	10,352	14,487	21,260	52,644	65,218	123,147	202,852
2017	4,214	24,659	15,480	9,899	78,447	32,569	75,991	124,040
2018	3,465	25,639	11,762	8,741	187,214	26,796	116,144	154,702
2019	8,502	34,968	29,005	16,582	187,192	53,379	137,555	219,939
2020*	6,849	50,009	22,951	20,376	10,999	27,243	123,933	174,122
2021	2,258	7,782	8,258	7,795	57,188	27,546	27,930	63,728
2022	2,789	6,166	8,417	1,949	123,704	6,069	24,026	38,512
2023	2,101	24,148	10,249	2,778	56,085	9,477	20,283	39,169
2024	0	6,467	0	0	32,378	0	0	0
Mean	12,682	31,164	41,302	18,042	111,225	55,915	131,041	225,398

*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.

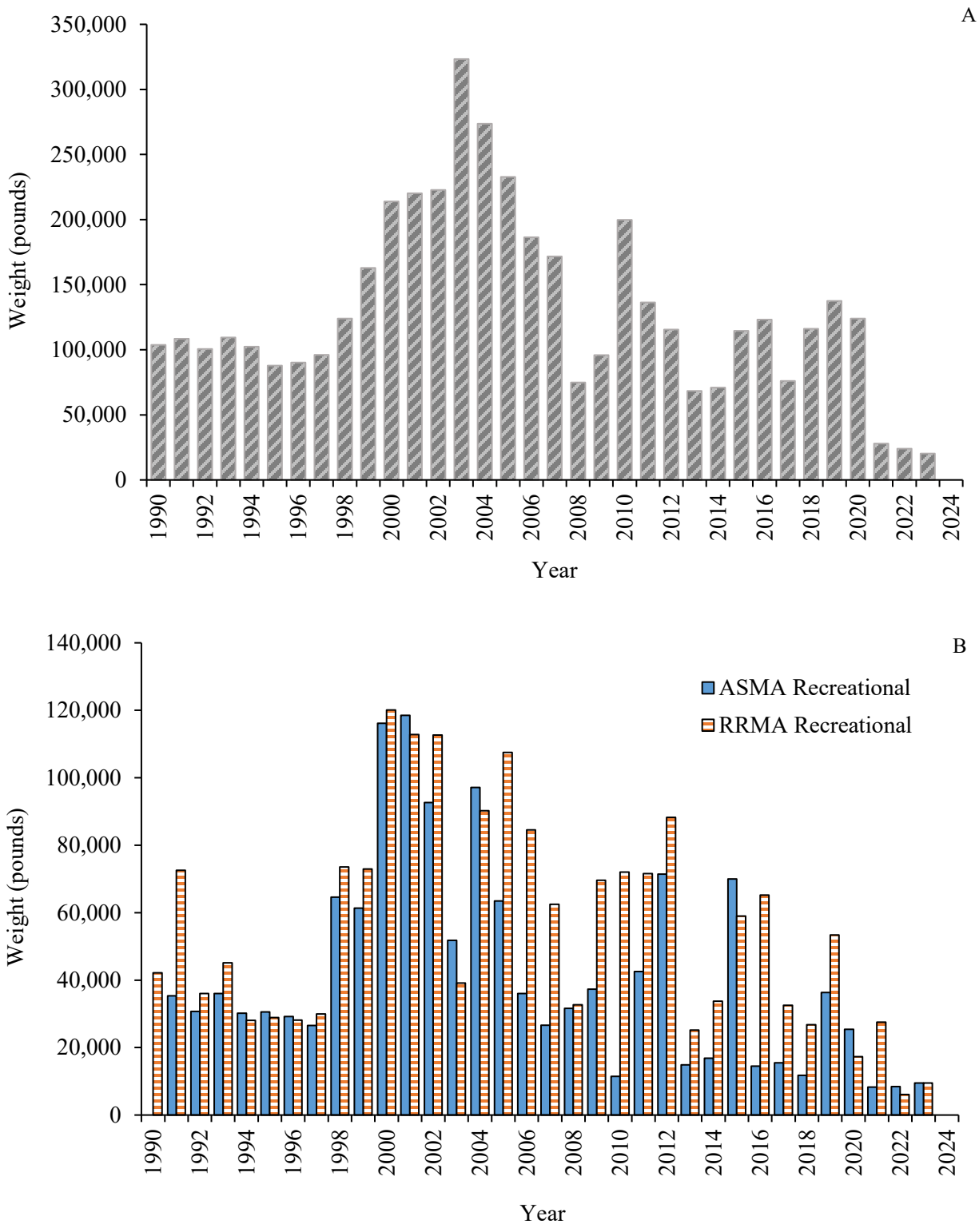

Figure 3. ASMA commercial (A), ASMA recreational (Blue) (B), and RRMA recreational (Orange stripes) (B) striped bass landings in pounds, NC, 1990–2024. RRMA 2020 recreational landings are for March only. ASMA 2020 landings are from January–March.

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. Releases are usually greater than harvest and are dominated by fish less than the 18-inch minimum length limit (Table 2). Length frequency distribution in 2023 is presented in Figure 4. ASMA recreational length frequencies for 1996–2023 are presented in Figure 7.

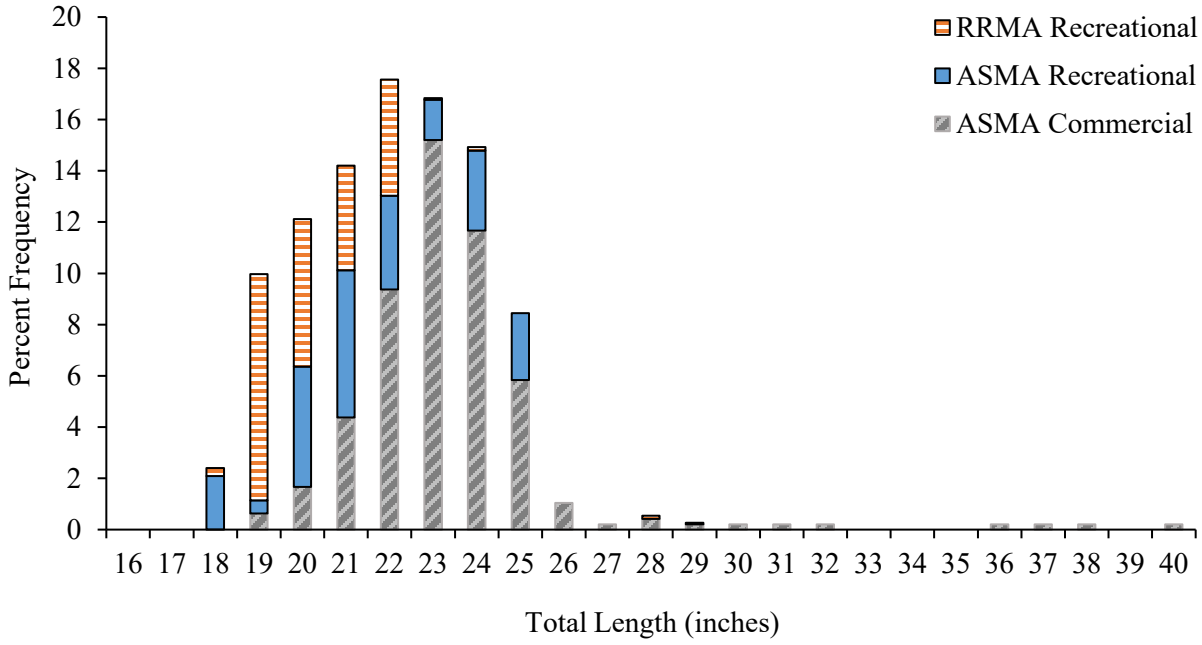

Figure 4. ASMA commercial, ASMA recreational, and RRMA recreational length frequency distribution from striped bass harvested in 2023.

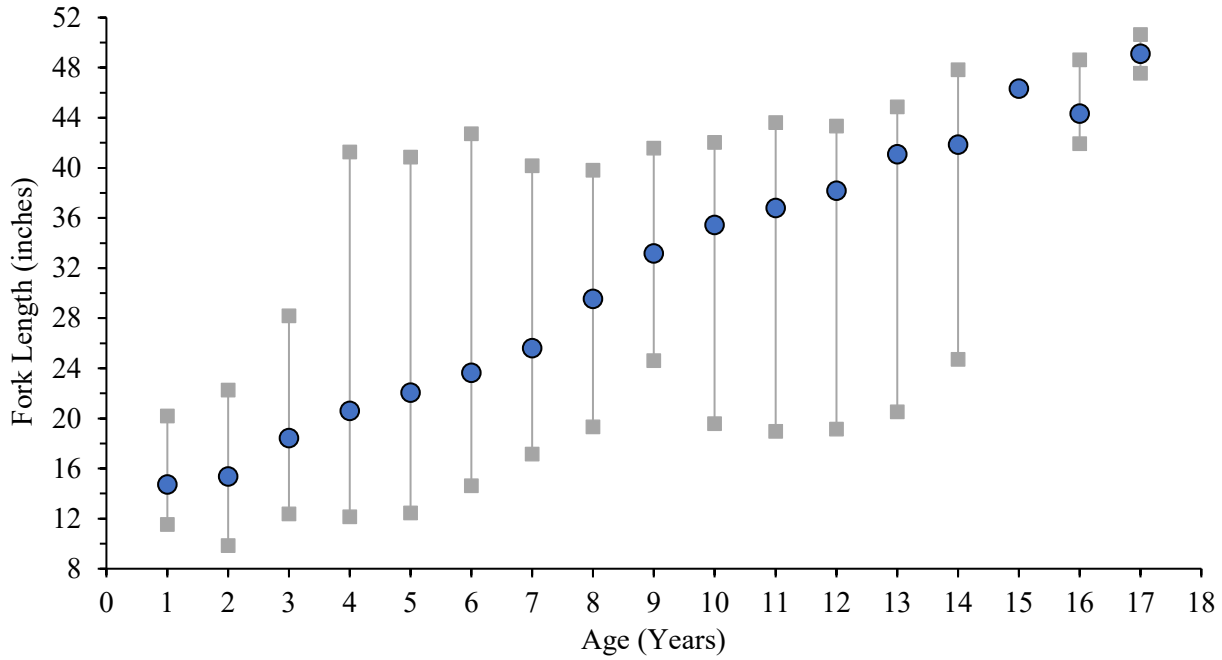

Figure 5. Striped bass length at age based on all commercial samples, 1972–2023. Blue circles represent the mean size at a given age while the grey squares represent the minimum and maximum observed size for each age.

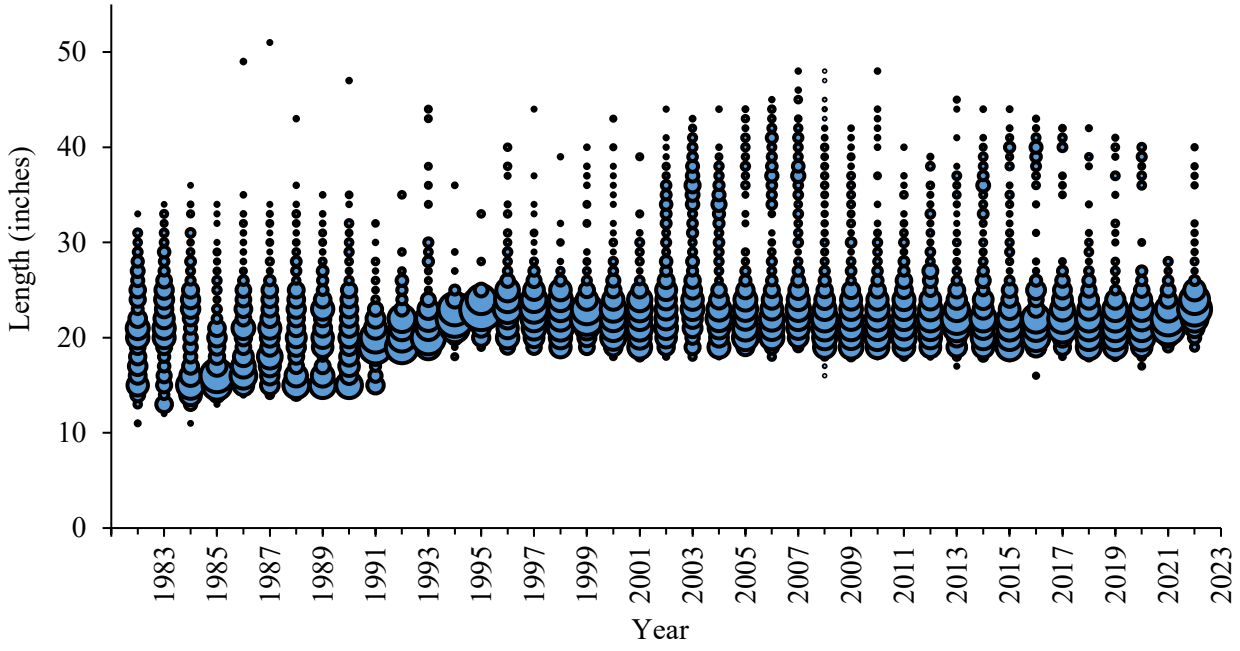

Figure 6. Commercial length frequency (total length, inches) of striped bass harvested in the ASMA, NC, 1982–2023. Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length.

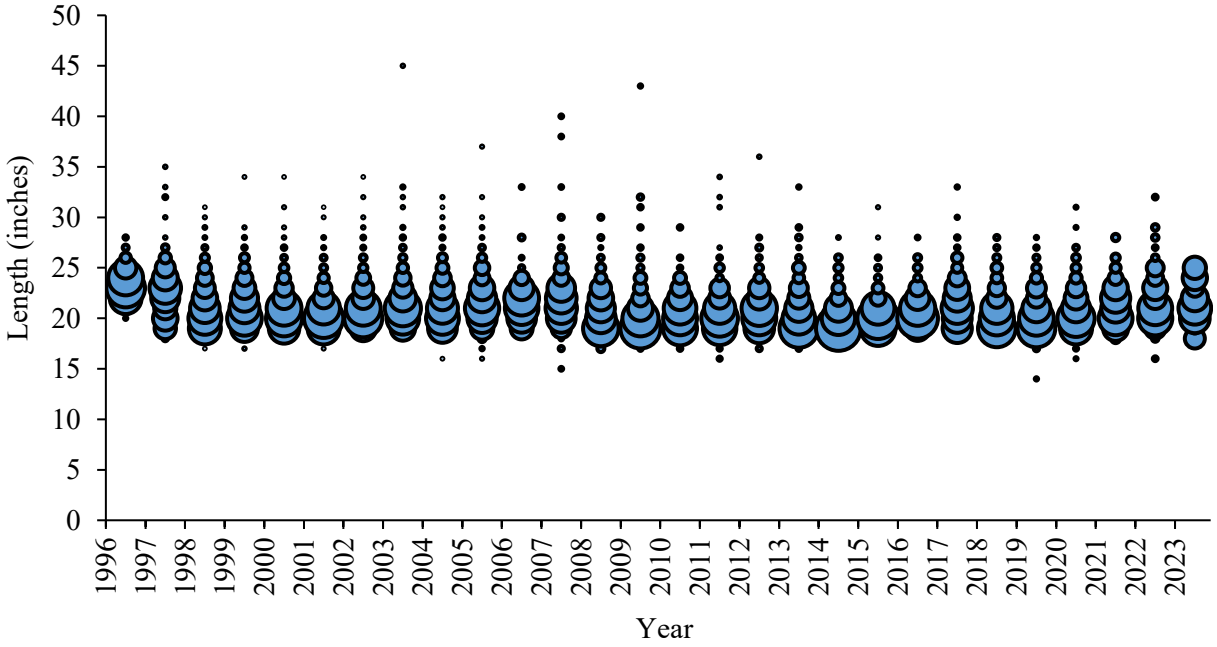

Figure 7. Recreational length frequency (total length, inches) of striped bass harvested in the ASMA, NC, 1996–2023. Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length.

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 2021–2023 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. Harvest and discard statistics for the harvest and post-harvest season are presented in Table 3.

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.

Table 2. Estimates of striped bass angling effort, harvest, and numbers caught and released from the Albemarle Sound Management Area, 1991–2024. Dashes (-) indicate estimates were not generated in that year. Estimates of discards are not available during the closed harvest period (May–September).

Year	Fishing Angler Trips	Effort Angler Hours	Number Harvested	Pounds Harvested	Discard (#over-creel)	Discard (#under-sized)	Discard (#legal-sized)	Discard (#over-slot)	Total Discards
1991	-	-	14,395	35,344	-	-	-	-	23,540
1992	-	-	10,542	30,758	-	-	-	-	19,981
1993	-	-	11,404	36,049	-	-	-	-	13,241
1994	-	-	8,591	30,217	-	-	-	-	-
1995	-	-	7,343	30,564	-	-	-	-	-
1996	-	6,349	7,433	29,186	-	-	-	-	-
1997	-	13,656	6,901	26,724	-	-	-	-	30,771
1998	-	90,820	19,566	64,761	-	-	-	-	91,888
1999	-	64,442	16,967	61,447	-	-	-	-	40,321
2000	-	100,425	38,085	116,414	-	-	-	-	78,941
2001	-	109,687	40,127	118,645	-	-	-	-	61,418
2002	-	97,480	27,896	92,649	-	-	-	-	51,555
2003	-	87,292	15,124	51,794	-	-	-	-	25,281
2004	-	102,505	28,004	97,097	9,877	28,859	2,305	-	41,041
2005	13,735	86,943	17,954	63,477	11,333	7,032	2,855	-	21,220
2006	10,707	65,757	10,711	35,985	2,490	6,339	626	-	9,455
2007	9,629	61,679	7,143	26,633	1,148	12,259	192	-	13,599
2008	11,793	72,673	10,048	31,628	391	36,324	260	-	36,975
2009	11,326	72,021	12,069	37,313	20	38,683	1,860	-	40,563
2010	9,660	66,893	3,504	11,470	569	15,398	233	-	16,200
2011	13,114	85,325	13,341	42,536	317	20,114	1,141	-	21,572
2012	14,490	102,787	22,345	71,456	1,024	19,977	3,970	-	24,971
2013	7,053	50,643	4,299	14,897	31	16,034	316	-	16,381
2014	7,264	40,478	5,529	16,867	18	22,558	510	-	23,086
2015	11,132	75,009	23,240	70,008	1,573	45,559	2,402	-	49,534
2016	7,023	42,276	4,794	14,486	252	8,822	1,278	-	10,352
2017	8,822	41,371	4,214	15,479	55	24,003	599	-	24,657
2018	9,057	34,764	3,465	11,763	281	21,388	3,970	-	25,639
2019	19,864	61,645	8,502	34,968	2,301	34,452	1,625	-	38,378
2020*	20,559	84,584	6,849	22,951	32,805	15,256	1,947	-	50,008
2021	8,080	29,174	2,258	8,258	689	5,684	1,408	-	7,781
2022	14,175	49,949	2,789	8,417	967	4,626	573	-	6,166
2023	5,211	26,653	2,101	10,249	1,793	11,663	10,456	235	24,148
2024	3,366	16,264	0	0	0	2,604	3,863	0	6,467
Total	229,657	1,889,640	418,511	1,372,751	68,704	399,187	39,730	235	944,558

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

Table 3. Estimates of striped bass angling effort, harvest, and numbers caught and released from the Roanoke River Management Area, 1988–2024. Dashes (-) indicate data was not collected in that year. **For 1989–2009 number of trips was calculated by dividing the angler hours by 4.75 (assumes each trip was 4.75 hours long). Since 2010, number of trips were estimated based on creel survey data sampling probabilities.

	Open Season (Harvest Estimates)					Post-Harvest Period (Catch and Release Only)		
Year	Number harvested	Weight (lb)	Effort Angler Hours	Angler Trips	Number released	Number released	Effort Angler Hours	Fishing Angler Trips
1988	-	74,639	-	-	-	-	-	-
1989	8,753	32,107	46,566	9,803	-	-	-	-
1990	15,694	42,204	56,169	11,825	-	-	-	-
1991	26,934	72,529	74,596	15,704	-	-	-	-
1992	13,372	36,016	49,277	10,374	-	-	-	-
1993	14,325	45,145	52,932	11,144	-	-	-	-
1994	8,284	28,089	44,693	9,409	-	-	-	-
1995	7,471	28,883	56,456	11,885	-	52,698	20,639	4,345
1996	8,367	28,178	46,164	9,719	-	148,222	32,743	6,893
1997	9,364	29,997	23,139	4,871	-	271,328	47,001	9,895
1998	23,109	73,541	72,410	15,244	-	102,299	26,367	5,551
1999	22,479	72,967	72,717	15,309	-	113,394	30,633	6,449
2000	38,206	120,091	95,622	20,131	-	-	-	-
2001	35,231	112,805	100,119	21,078	-	-	-	-
2002	36,422	112,698	122,584	25,807	-	-	-	-
2003	11,157	39,170	77,863	16,392	-	-	-	-
2004	26,506	90,191	145,782	30,691	-	-	-	-
2005	34,122	107,530	130,755	27,527	-	68,147	24,146	5,083
2006	25,355	84,521	120,621	25,394	-	24,719	15,235	3,207
2007	19,305	62,492	141,874	29,868	-	11,622	9,254	1,948
2008	10,541	32,725	110,608	23,286	-	47,992	17,764	3,740
2009	23,248	69,581	120,675	25,405	-	-	-	-
2010	22,445	72,037	125,495	24,347	77,882	46,028	31,281	5,111
2011	22,102	71,561	122,876	27,311	80,828	26,865	15,110	2,707
2012	28,847	88,539	110,982	27,151	40,772	22,246	8,935	1,881
2013	7,718	25,197	100,391	19,539	49,148	25,074	12,423	2,246
2014	11,058	33,717	80,256	15,960	93,471	72,068	17,542	2,972
2015	20,031	58,962	111,419	22,827	78,401	29,839	12,229	2,207
2016	21,260	65,218	129,132	25,036	34,753	17,891	11,291	2,087
2017	9,899	32,569	101,565	19,688	68,693	9,754	7,446	1,317
2018	8,741	26,797	95,447	18,280	121,969	65,245	14,499	2,462
2019	16,582	53,379	99,259	20,633	117,550	69,642	26,867	5,283
2020†	20,376	27,243	131,565	26,648	10,999	-	-	-
2021	7,795	27,546	69,281	12,976	25,775	31,413	21,778	4,513
2022	1,949	6,069	17,014	3,373	25,427	98,278	34,449	6,657
2023	2,778	9,477	27,352	5,403	13,149	42,936	35,668	6,111
2024	0	0	18,794	3,644	32,378	-	-	-

† Creel estimate for the spring survey is for the period March 1–March 18, 2020 with data imputed for April based on harvest in April 2015 and 2016. The number released is only for March 1–March 18.

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 2023 is presented in Figure 4. RRMA recreational length frequencies for 2005–2023 are presented in Figure 8. Since 2005, abundance of older fish in the recreational creel survey has decreased.

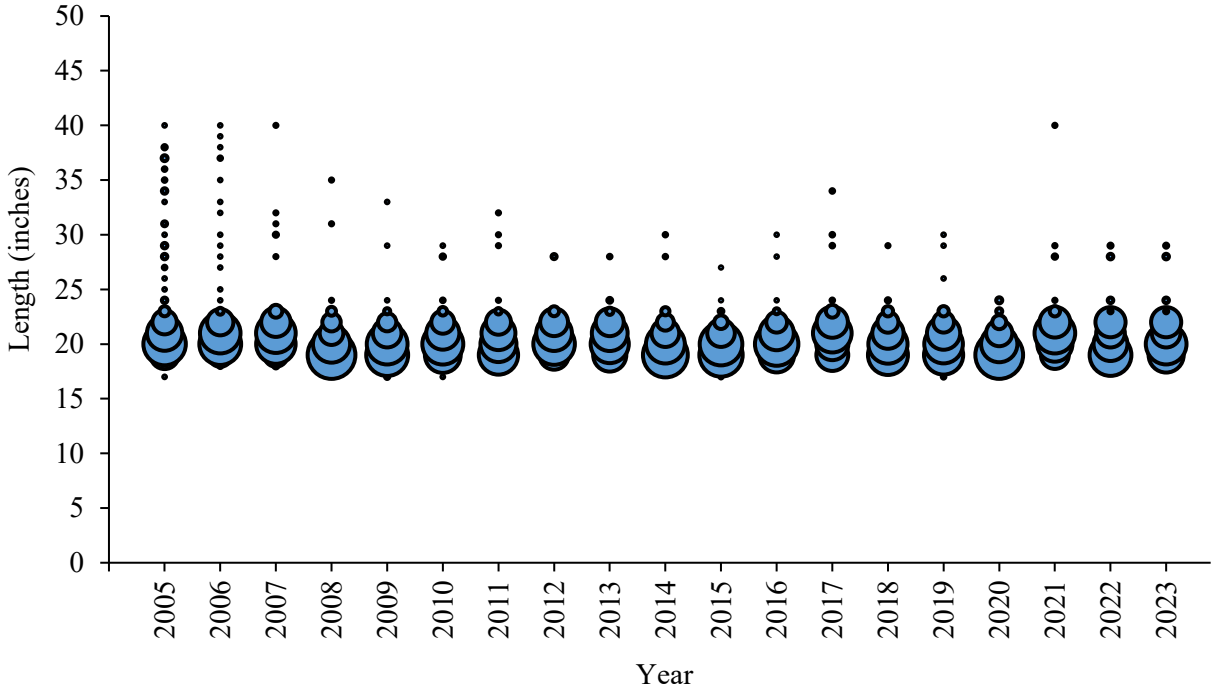

Figure 8. Recreational length frequency (total length, inches) of striped bass harvested in the RRMA, NC, 2005–2023. Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length.

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 4).

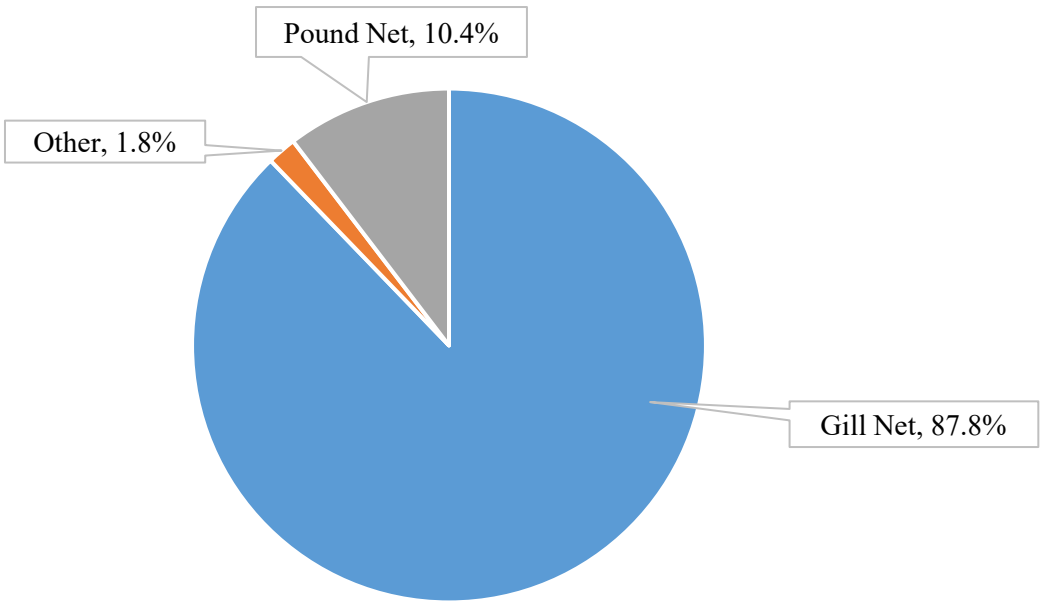

Figure 9. Commercial striped bass landings by gear in the ASMA, NC, 1994–2023.

Table 4. Striped bass total length (inches) data from commercial fish house sampling from the Albemarle Sound Management Area (ASMA), North Carolina, 2005–2023.

Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured
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
2023	22	18	26	339

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 5 and 6). Age data from the dependent and independent surveys in the ASMA are presented in Table 7. The minimum and maximum age for the independent and dependent surveys are 1 and 17 years respectively with an average age of 5.

Table 5. Striped bass total length (inches) data from recreational landings from the Albemarle Sound Management Area (ASMA), North Carolina, 2014–2023.

Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured
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
2023	23	19	26	46

Table 6. Striped bass total length (inches) data from recreational landings from the Roanoke River Management Area (RRMA), North Carolina, 2014–2023.

Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured
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
2023	20	18	29	464

Table 7. Striped bass age data from dependent (commercial) and independent (independent gill net survey) surveys from the ASMA, North Carolina, 2014–2024. Aging not complete for 2024

Year	Modal Age	Minimum Age	Maximum Age	Total Number Aged
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
2023	3	1	11	599
2024	-	-	-	-

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 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 2018–2023 averaged 0.51 and are all below the spawning failure threshold of 1.33 (ASMFC 2010). The JAI in 2024 increased slightly to 2.16 (Figure 10).

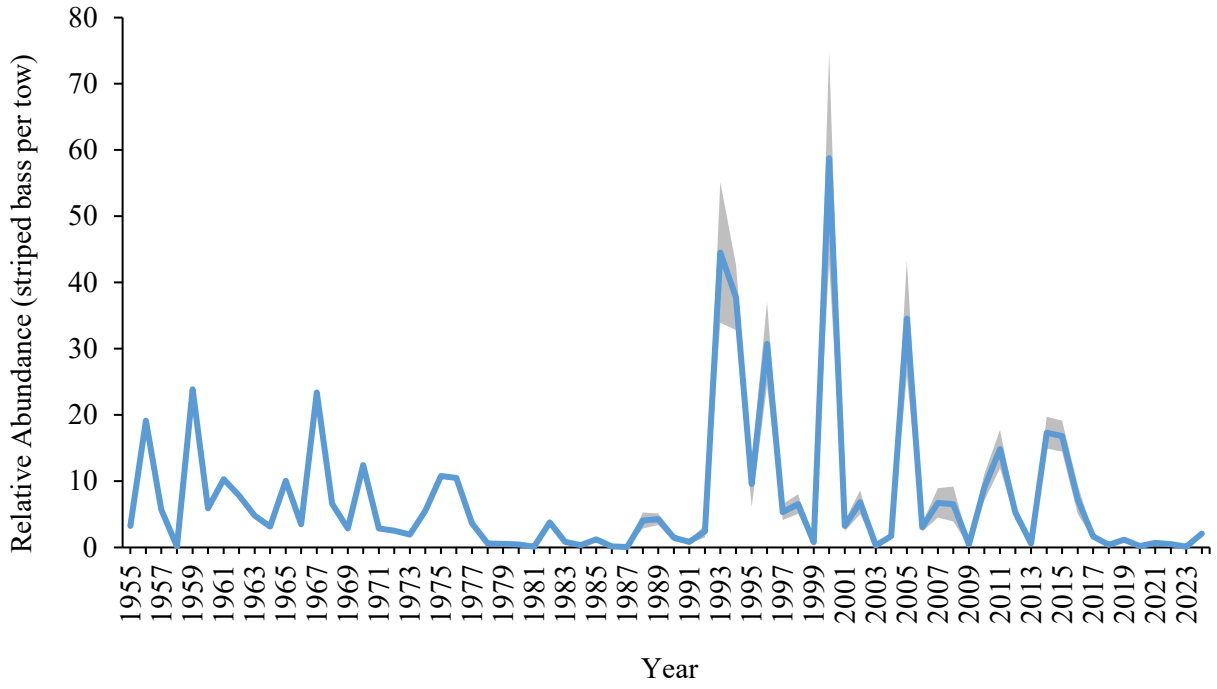

Figure 10. Juvenile abundance index (JAI) of Albemarle-Roanoke striped bass from the DMF juvenile trawl survey, western Albemarle Sound, NC, 1955–2024.

A fall/winter fishery independent gill-net survey (IGNS) 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 2024 the fall/winter survey increased slightly, while the spring survey decreased from the 2023 value (Figure 11).

It should be noted that beginning in November of 2022, required changes were made to the independent gill-net survey that have the result of increasing the relative abundance of striped bass compared to previous years, making the relative abundance values derived from the survey from 2022 forward not directly comparable to previous years.

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 has been on a relative decline since. The abundance of fish in 2024 was 18 fish per hour, the lowest value in the 34 year time-series of the survey (Figure 12). 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.

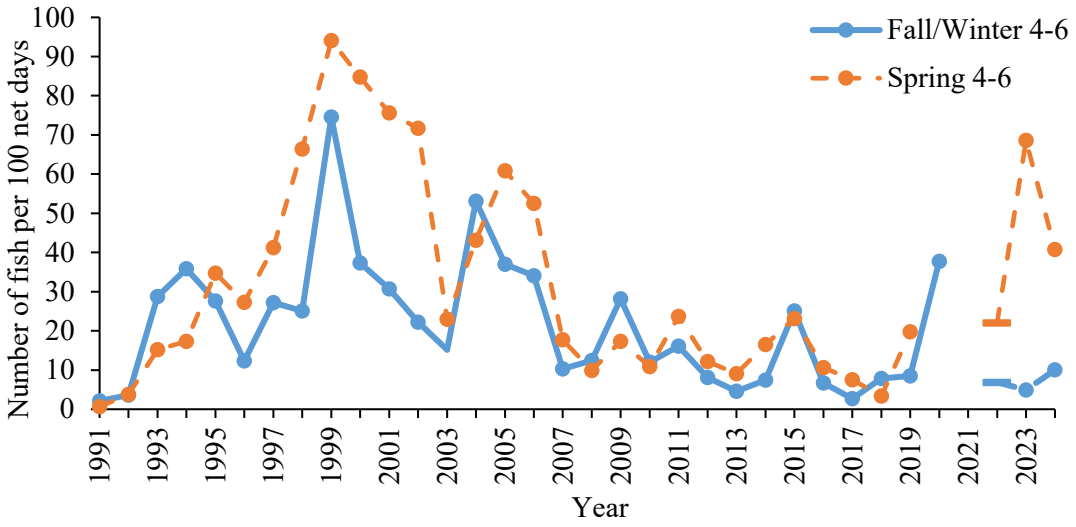

Figure 11. Relative abundance of age 4–6 Albemarle-Roanoke striped bass from the DMF fall/winter and spring independent gill net surveys, Albemarle Sound area, NC, 1991–2023. **It should be noted that beginning in November of 2022, required changes were made to the independent gill-net survey that have the result of increasing the relative abundance of striped bass compared to previous years, making the relative abundance values derived from the survey from 2022 forward not directly comparable to previous years.**

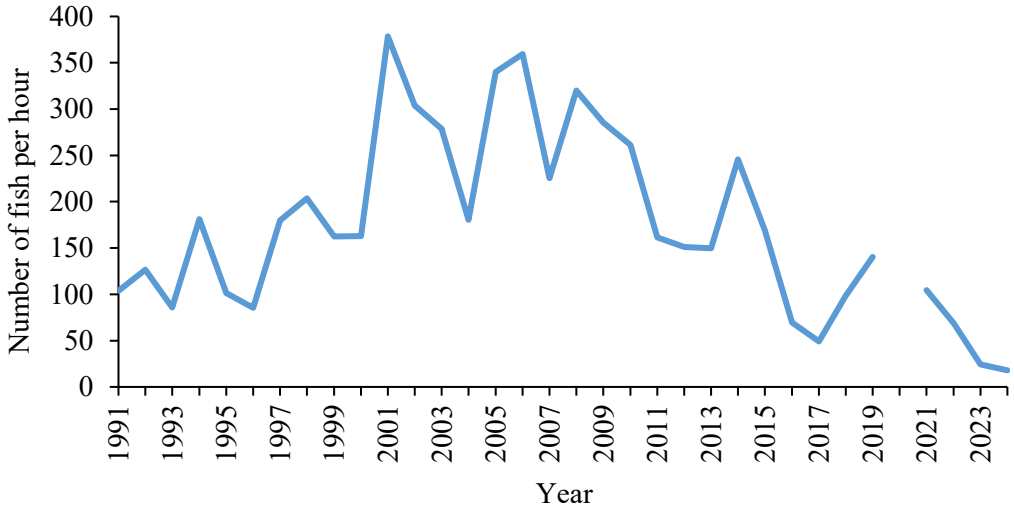

Figure 12. Relative abundance of Albemarle-Roanoke striped bass from the WRC spawning grounds electrofishing survey, Roanoke River at Weldon, NC, 1991–2024.

The electrofishing survey does a better job at tracking the abundance of the age 9+ group compared to the IGNS, 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 during 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 2016–2024 is similar to the abundance levels seen in the early to mid-90's.

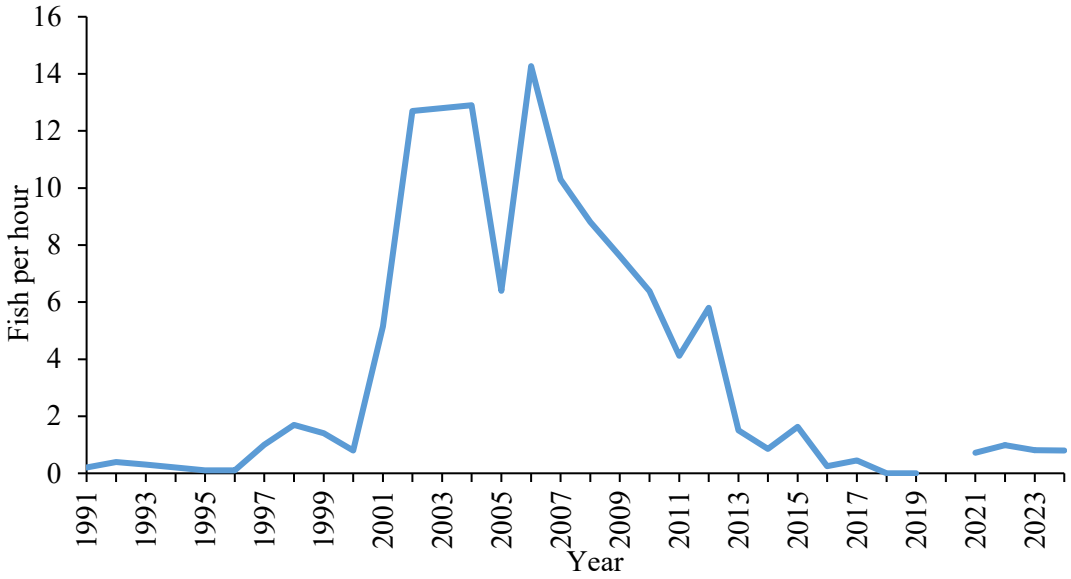

Figure 13. Relative abundance of age 9+ Albemarle-Roanoke striped bass from the WRC spawning grounds electrofishing survey, Roanoke River at Weldon, NC, 1991–2024.

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 8; Figure 14). The time series average was 203 days at large with an average distance travelled of 61 miles (Table 8). 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). The maximum days between release and recapture was 1,905 days or just over five years (Table 8). 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.

Table 8. Summary of ASMA/RRMA striped bass tagging and recapture data, 2015–2024. Tagging for 2024 includes Phase II hatchery fish stocked into the Albemarle Sound.

Year Tagged	Total Fish Tagged (n)	Total Fish Recaptured (n)	Average Days At Large	Max Days At Large	Average Distance Traveled (miles)	Max Distance Traveled (miles)
2015	2,330	281	278	1,905	76	279
2016	1,177	107	192	1,538	43	242
2017	1,094	101	185	1,311	57	189
2018	1,494	194	165	1,829	42	165
2019	1,814	256	194	1,082	57	272
2020	336	44	284	1,130	64	217
2021	1,208	130	228	948	65	579
2022	1,235	79	130	486	67	378
2023	484	18	61	204	56	135
2024	3,392	7	68	213	108	327

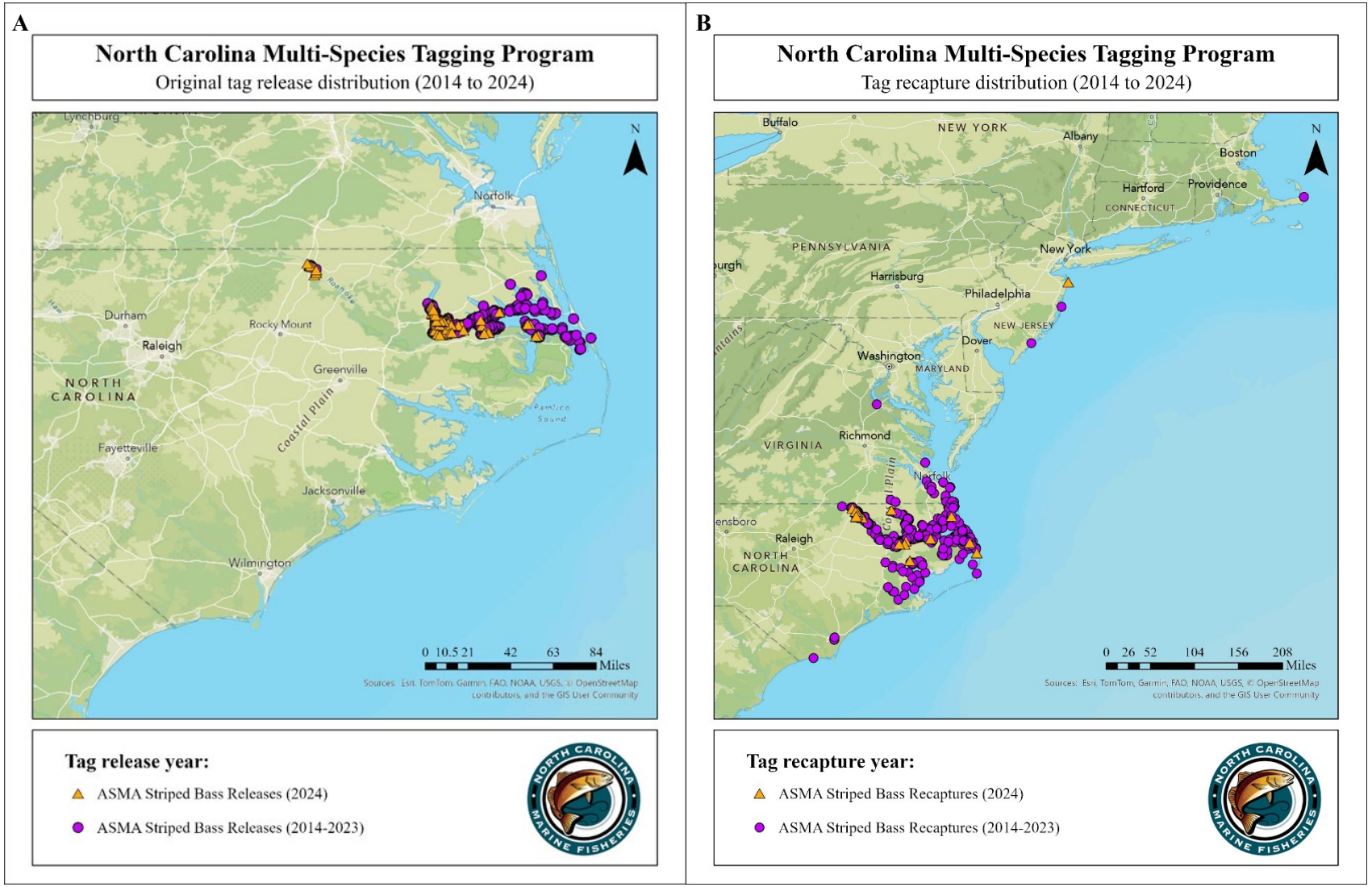

Figure 14. ASMA (Roanoke River and Albemarle Sound) striped bass tagging release (A) and recapture (B) locations, 2014–2023.

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

- 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 (initiated 2024).
- Investigate relationship between river flow and striped bass recruitment for consideration of input into future stock assessment models.

Medium

- Improve estimates of discard mortality rates and discard losses from the ASMA commercial gill-net fisheries (ongoing through observer program).
- 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) (WRC conducted study in the RRMA in 2024).
- Investigate the potential impact of blue catfish on the A-R striped bass population (e.g., habitat, predation, forage).

MANAGEMENT: 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 2 to the Striped Bass FMP required a reduction

in TAL to reduce fishing mortality (F) to the target level. The new TAL required to reduce F is 8,349 pounds.

A TAL of 8,349 pounds divided among three harvest sectors is too low to effectively manage and emphasizes the need to prioritize stock recovery over a very limited recreational fishery and commercial bycatch fishery. At such a low allowable TAL, either sector could harvest their entire TAL in one day. In addition, any harvest season for striped bass will result in additional dead discards from both the commercial and recreational sectors. With the stock abundance at the lowest level in the stock assessment time series, compounded by the recent consecutive years of recruitment failure, it is necessary to reduce fishing mortality on the stock to provide the greatest potential for stock recovery and allow as many females to return to the spawning grounds each year.

Therefore, effective January 1, 2024, a harvest moratorium is required until the population improves to a level capable of supporting sustainable harvest. This revision and all other management strategies contained in Amendment 2 will remain in effect until further changes are implemented through the adaptive management framework of the North Carolina Estuarine Striped Bass FMP Amendment 2 and its Revisions. Adaptive management in Amendment 2 provides the management framework to reopen the fishery when a stock assessment indicates a TAL that allows for harvest between the three sectors (NCDMF 2024).

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 scenarios for striped bass in all three CSMA river systems. Results from the matrix model indicate 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 9; Figure 15A). 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.

Table 9. 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, 1994–2024.

	Recreational			Commercial	
Year	Number Landed	Number Released	Weight Landed (lb)	Weight Landed (lb)	Total Weight Landed (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	23,199	0	0	0
2022	0	30,026	0	0	0
2023	0	13,536	0	0	0
2024	0	9,794	0	0	0
Mean	2,727	31,019	9,820	21,074	27,726

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 2023. Recreational landings fluctuated during 2004–2018, ranging from lows in 2008 and 2009 to a high of 26,973 pounds in 2017 (Table 9; Figure 15B).

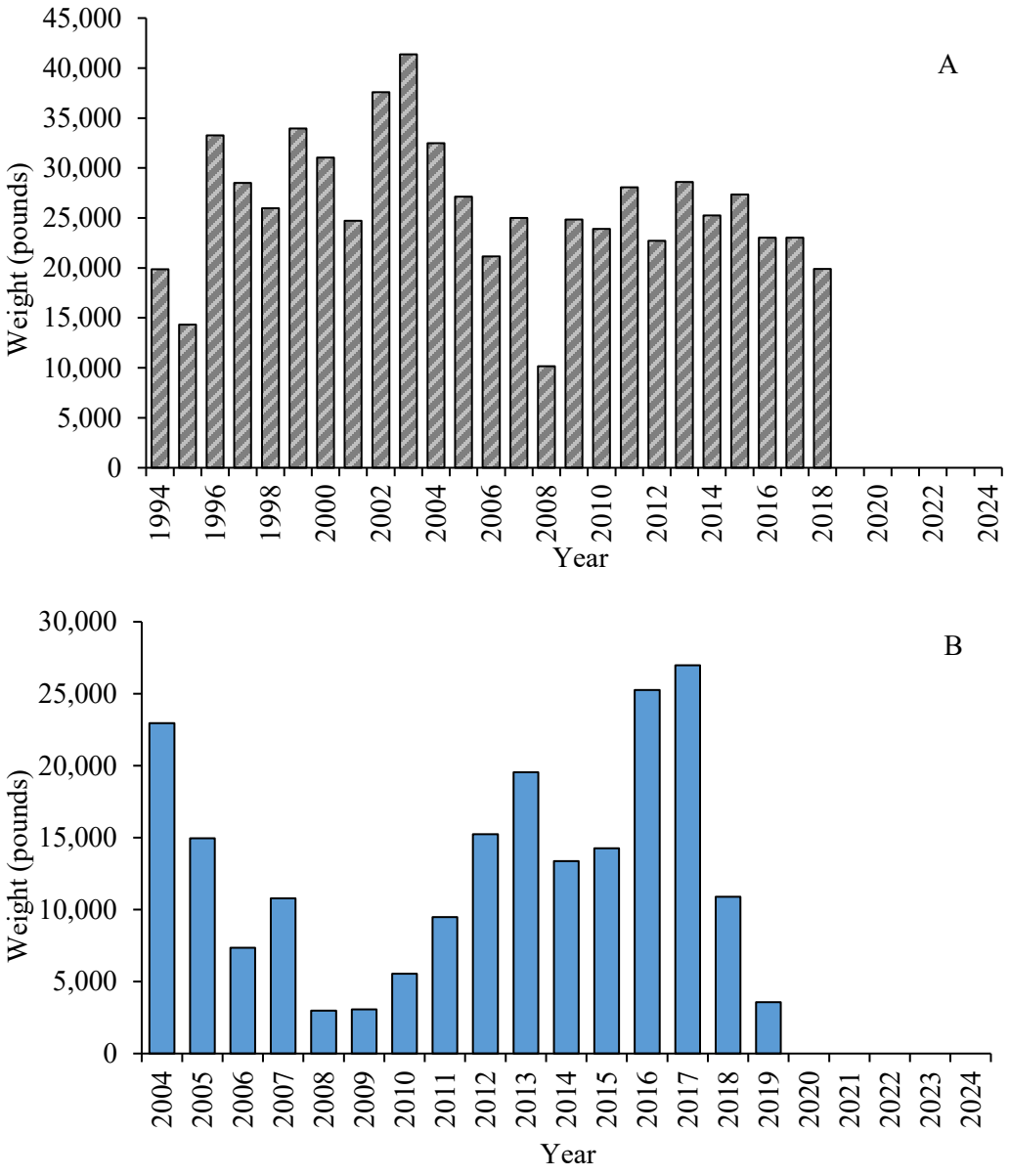

Figure 15. Annual commercial landings (pounds) reported through the North Carolina Trip Ticket Program, 1994–2024 (A), and recreational landings (pounds) estimated from the CSMA Recreational Creel Survey, 2004–2024 (B). There was no commercial season and a limited recreational season in 2019, lasting from January 1 to March 19, 2019. Commercial and recreational seasons remained closed in 2024.

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 9). 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 10).

Table 10 Recreational striped bass effort (trips and hours), harvest, and discards from the CSMA (2004–2024). 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 2024.

					Striped Bass Discards				
Year	Angler Trips	Angler Hours	Number Harvested	Pounds Harvested	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	19,698
2005	16,414	69,370	3,832	14,965	152	15,609	1,016	77	20,671
2006	10,611	42,066	2,481	7,352	33	12,548	2,314	0	17,376
2007	10,971	46,655	3,597	10,794	147	21,673	1,707	0	27,124
2008	6,621	28,413	843	2,990	2,838	11,721	3,316	91	18,809
2009	5,642	26,611	895	3,061	7	4,471	1,769	718	7,860
2010	6,559	25,354	1,757	5,537	29	5,200	2,401	360	9,747
2011	12,606	51,540	2,728	9,474	9	16,659	5,397	2,123	26,916
2012	18,338	71,964	3,922	15,240	439	26,343	13,621	2,910	47,236
2013	20,394	86,918	5,467	19,537	539	19,302	10,619	2,357	38,283
2014	15,682	70,316	3,301	13,368	1,449	19,185	7,934	1,641	33,510
2015	18,159	79,398	3,934	14,269	217	22,272	8,052	813	35,287
2016	23,675	110,453	6,697	25,260	215	57,874	10,593	6,779	82,157
2017	26,125	119,680	7,334	26,973	549	101,787	26,501	2,293	138,464
2018	16,393	69,917	3,371	10,884	871	34,128	12,232	1,890	52,493
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	10,440	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
2023**	3,118	11,276	0	0	0	5,268	6,439	1,829	13,536
2024**	1,697	8,110	0	0	0	944	4,796	4,055	9,794
Total	247,425	1,071,811	57,259	206,224	8,503	441,773	162,849	38,293	708,661

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

** closed harvest season

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 past ten years (2015–2024) have averaged 44,143 fish annually (Table 10; Figure 16). In 2024, the number of striped bass caught and released as discards was 9,794 fish which was a decrease from 13,356 fish in 2023, and well below the ten-year average.

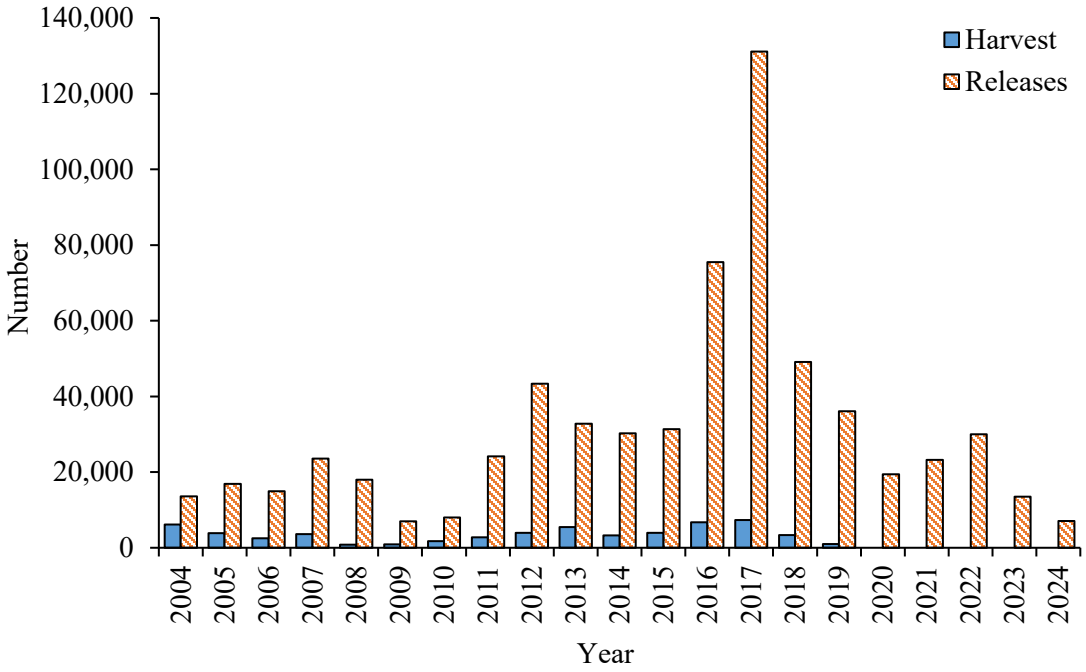

Figure 16. Annual recreational catch (harvested and/or released) of striped bass in the CSMA, 2004–2024. There was a limited recreational harvest season in 2019 prior to the closure, lasting from Jan 1 to Mar 19, 2019. The harvest season remained closed in 2024.

Undersized discards peaked in 2017 mainly due to the large number of undersized striped bass available in the Tar-Pamlico River system and have continued a declining trend since then. In 2024, undersized discards decreased by over 82% (n=944) compared to the 2023 value and remained below the ten-year average of 27,733 fish. Legal-sized striped bass discards decreased from 6,439 in 2023 to 4,796 striped bass in 2024 after a high of 26,501 fish in 2017. Striped bass released 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 10). In 2024, there were approximately 4,055 discarded striped bass that were within the slot limit.

Recreational length frequencies of CSMA striped bass harvested in the Tar-Pamlico/Pungo and Neuse rivers (2004−2019) are presented in Figure 17. In 2018, the last full year open to harvest, 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 18). Commercial length frequencies of CSMA striped bass harvested in the Tar-Pamlico/Pungo and Neuse rivers (2004−2018) are presented in Figure 18. In 2018, the last full year open to harvest, the modal length of striped bass in the commercial harvest from the Tar-Pamlico/Pungo rivers was 20 inches with few fish over 25 inches harvested, and the modal length from the Neuse River was 23 inches with few fish over 27 inches harvested (Figure 18).

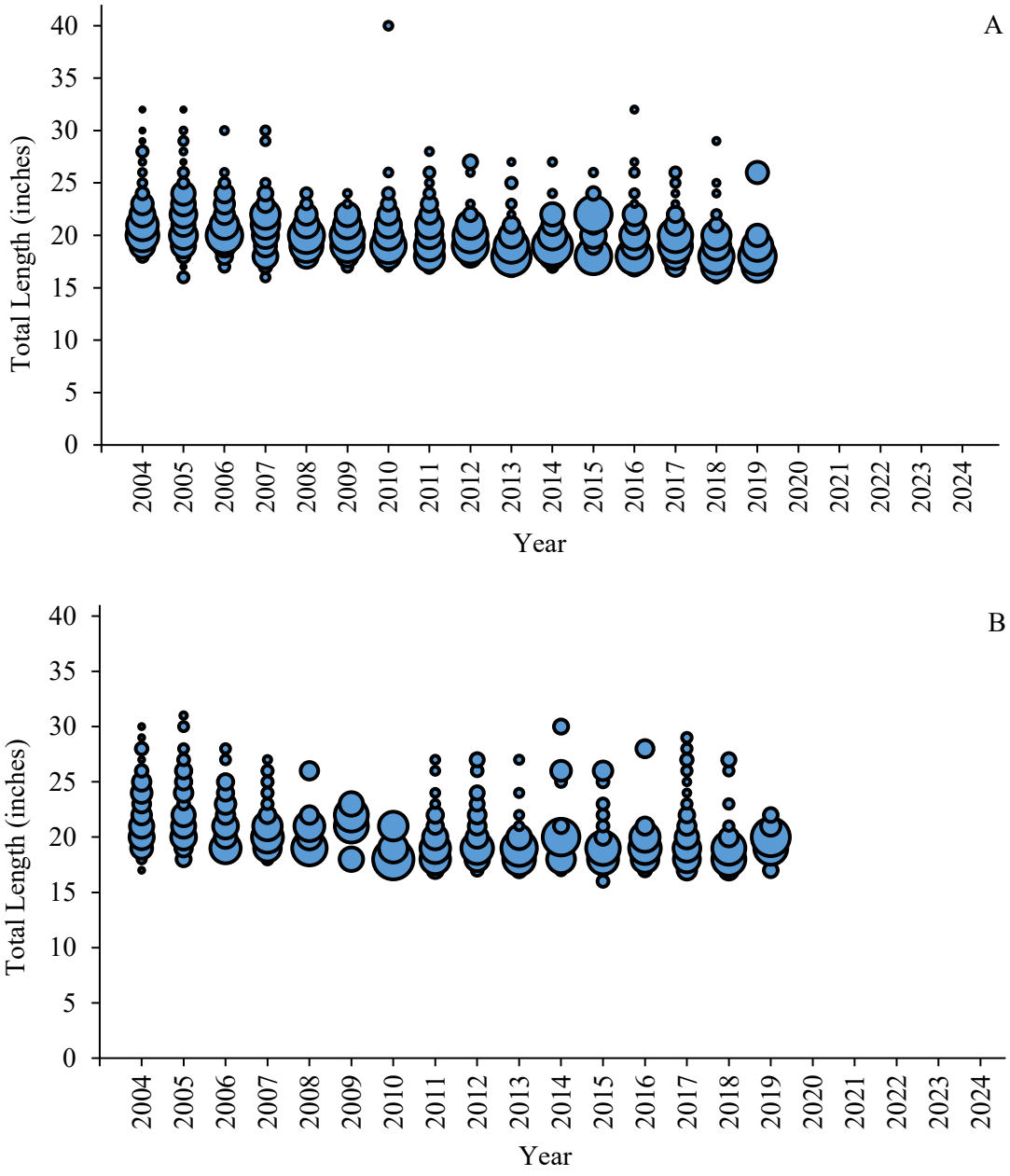

Figure 17. Recreational length frequency of CSMA striped bass harvested in the Tar-Pamlico/Pungo rivers (A), and the Neuse River (B), 2004–2024. Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length. There was a limited recreational season in 2019 prior to the closure, lasting from Jan 1 to Mar 19, 2019. The recreational season remained closed in 2024.

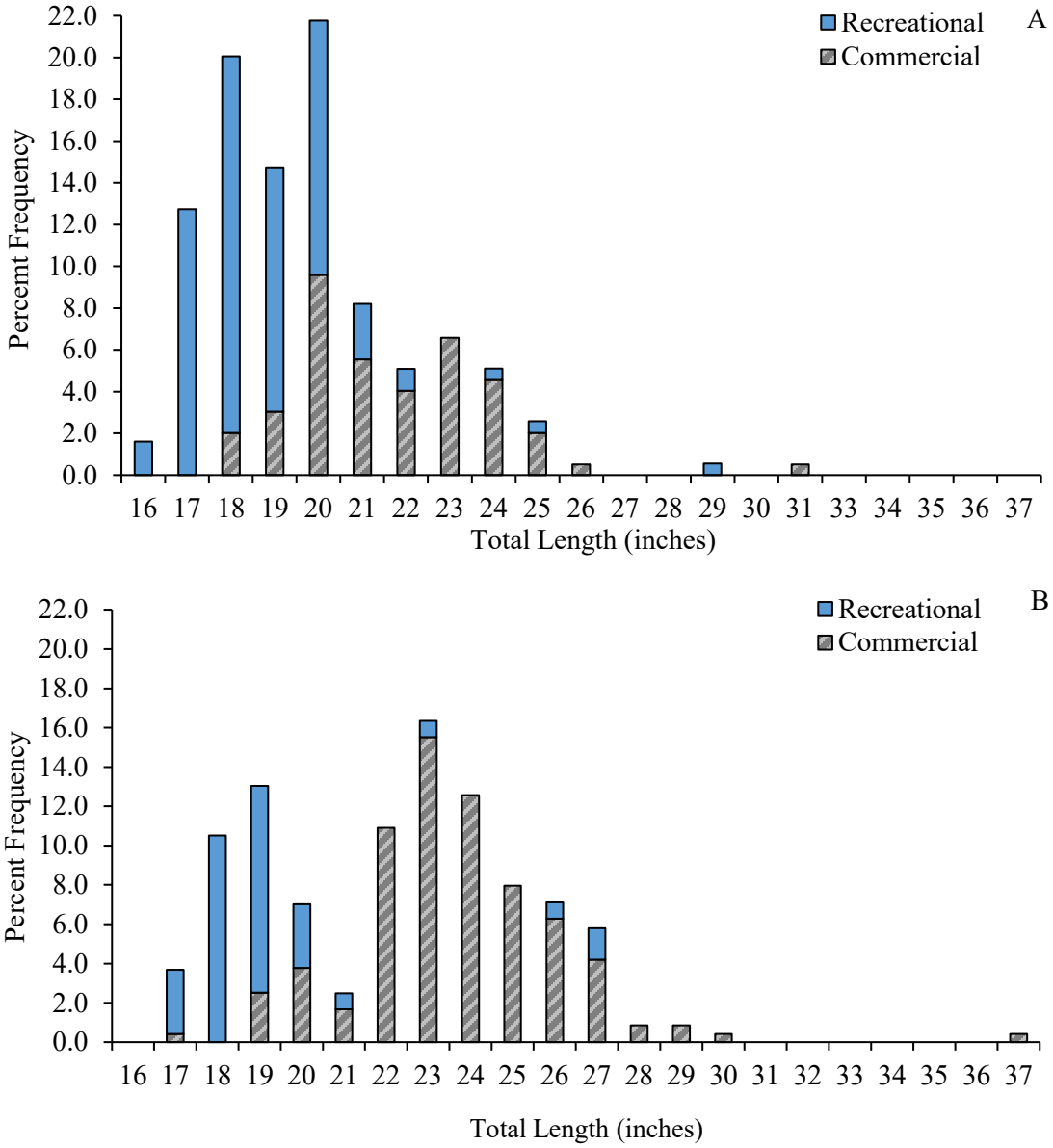

Figure 18. Commercial and recreational length frequency distributions from CSMA striped bass harvested in 2018 from the Tar-Pamlico/Pungo rivers (A) and the Neuse/Bay rivers (B).

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 11). Additionally, maximum lengths are generally larger in the Neuse and Bay rivers compared to the Tar-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 18). CSMA commercial length frequencies are represented in Figure 19 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.

Table 11. Mean, minimum, and maximum length of striped bass (total length – inches) and number (N) collected from the commercial harvest, 2000–2024.

	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	-	-	-	-	-	-	-	-
2023	-	-	-	-	-	-	-	-
2024	-	-	-	-	-	-	-	-

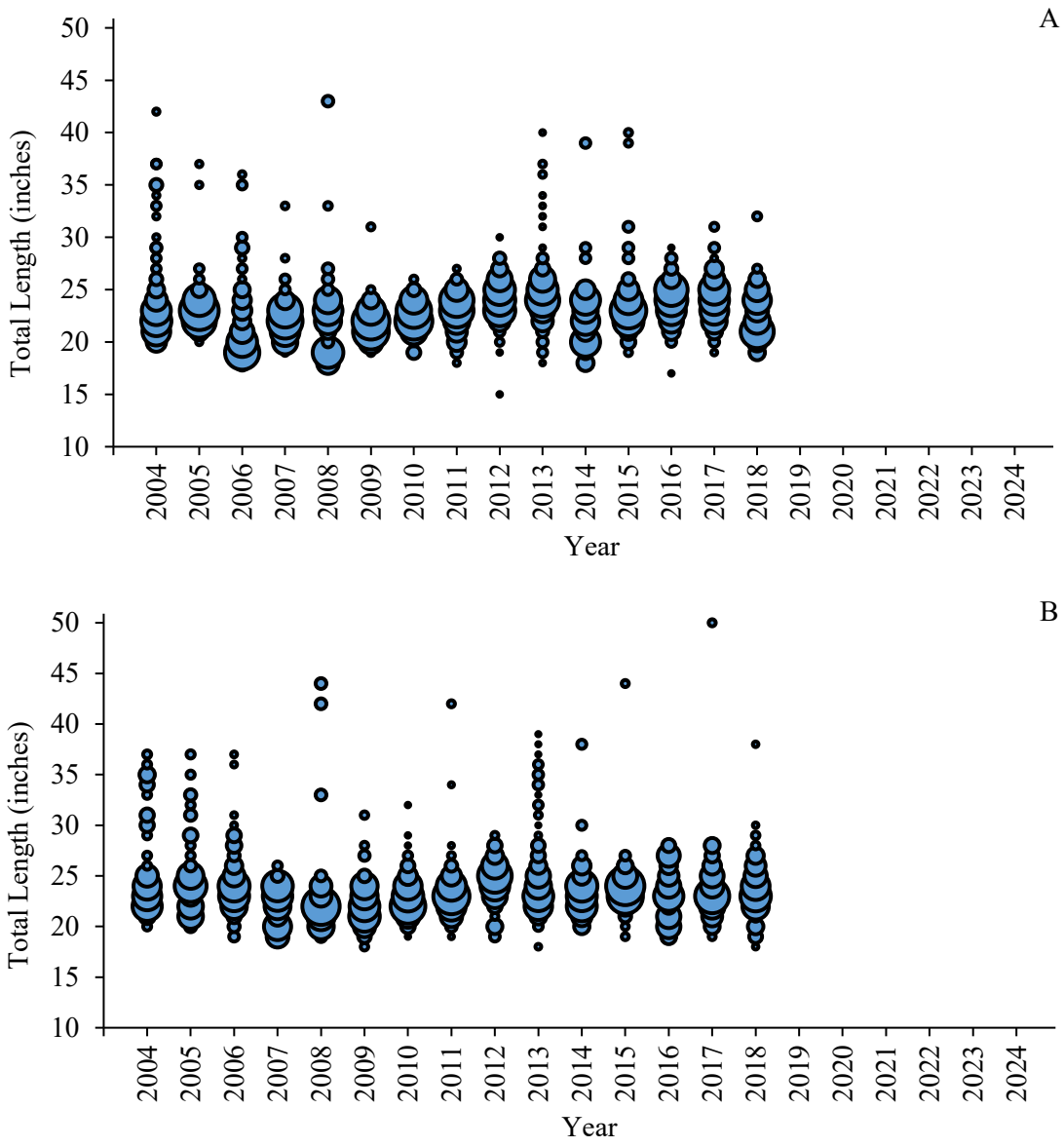

Figure 19. Commercial length frequency of CSMA striped bass landed in the Tar-Pamlico/Pungo rivers (A), and the Neuse/Bay rivers (B) from 2004–2024. Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length. The commercial season remained closed in 2024.

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 12).

Table 12. Mean, minimum and maximum length of striped bass (total length; inches) and number collected from the recreational harvest, 2004–2024 (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 2024.

Year	Mean Length	Minimum Length	Maximum 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	-	-	-	-
2023	-	-	-	-
2024	-	-	-	-

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 twenty years (2004–2024), 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 13). 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 13). In 2024, striped bass relative abundance in the Tar-Pamlico River (1.28 fish per set) was well below the time series average of 3.8 striped bass per set (Table 13; Figure 20). In the Neuse River, striped bass relative abundance was 0.79 fish per set, the second lowest value in the time series and well below the time series average of 3.4 striped bass per set (Table 13; Figure 21). In 2024, relative abundance in the Cape Fear River (0.01 fish per set) was below the time series average of 0.10 striped bass per set (Table 13; Figure 22).

Table 13. 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 (2004–2024), and in the Cape Fear River (February–December, all sets; 2008–2024) 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			
Year	Index	Striped Bass	N	PSE	Index	Striped Bass	N	PSE	Index	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	0.1	3	30	100
2009	2.78	50	18	36	2.13	51	24	41	0.07	3	43	71
2010	5.67	102	18	26	6.25	150	24	39	0.03	1	40	100
2011	7.72	139	18	32	4.75	114	24	30	0.08	3	40	75
2012	3.28	59	18	39	2.25	54	24	36	0.08	3	40	75
2013	3.22	58	18	36	2.54	61	24	31	0.05	2	40	60
2014	4.56	82	18	20	6.75	162	24	28	0	0	40	-
2015	2.67	48	18	33	5.33	128	24	27	0.35	14	40	37
2016	2.44	44	18	27	2.04	49	24	24	0.3	12	40	43
2017	2.44	44	18	29	3.21	77	24	24	0.23	9	40	43
2018	9.00	162	18	29	3.75	90	24	31	0.08	3	37	75
2019	5.06	91	18	33	4.21	101	24	32	0.01	1	80	100
2020	-	-	-	-	-	-	-	-	-	-	-	-
2021	0.92	11	12	43	4.25	68	16	38	0.07	3	44	71
2022	0.83	15	18	73	1.17	28	24	82	0.05	4	80	40
2023	0.44	8	18	45	0.21	5	24	64	0.01	1	79	100
2024	1.28	23	18	52	0.79	19	24	39	0.01	1	80	100

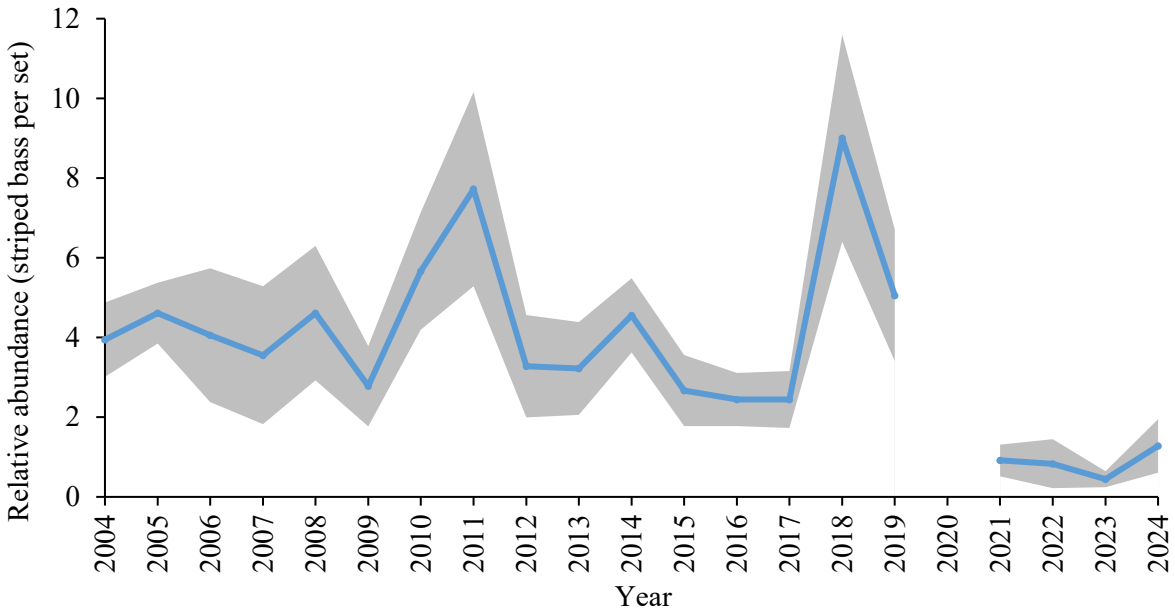

Figure 20. Annual index of adult striped bass relative abundance from the Fisheries Independent Gill Net Survey (P915) in the Tar-Pamlico River during April, and October–November, in shallow water sets, 2004–2024. No sampling occurred in 2020, and limited sampling occurred in 2021 (July–December). Shaded error bars represent ± 1 standard error.

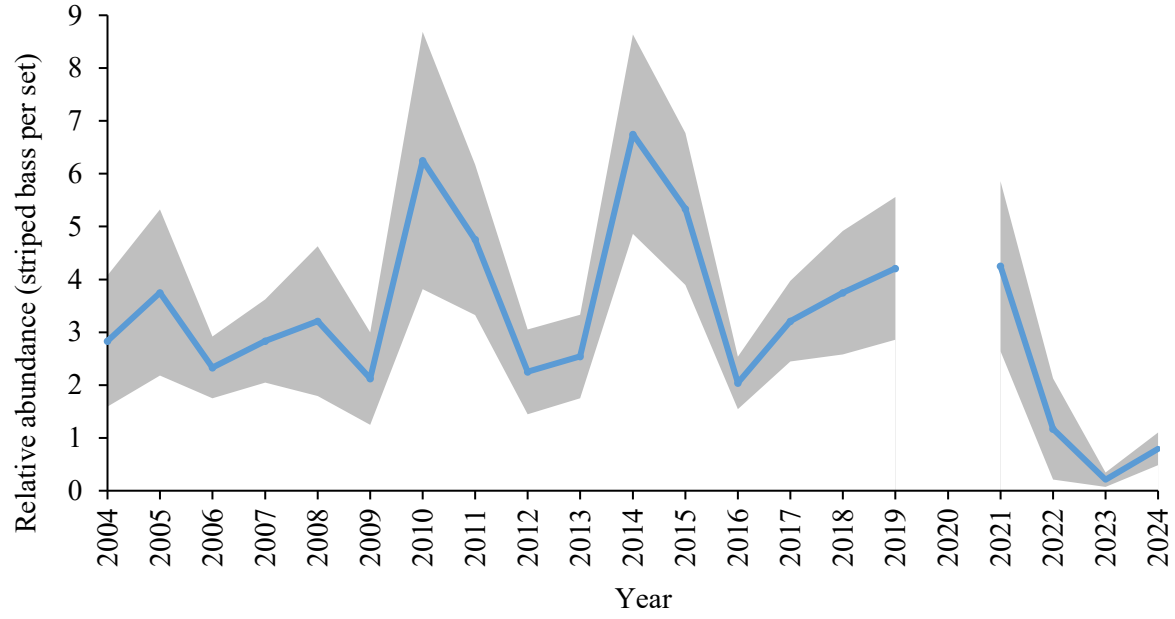

Figure 21. Annual index of adult striped bass relative abundance in the Fisheries Independent Gill Net Survey (P915) in the Neuse River during April, and October–November, in shallow water sets, 2004–2024. No sampling occurred in 2020, and limited sampling occurred in 2021 (July–December). Shaded error bars represent ± 1 standard error.

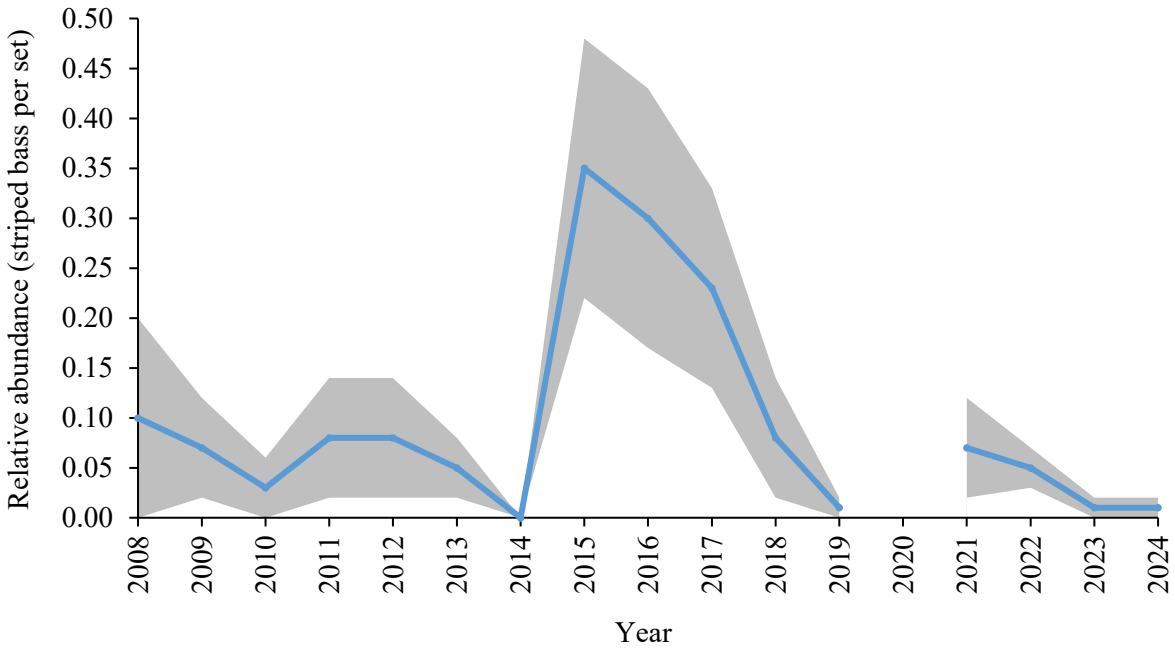

Figure 22. Annual index of adult striped bass relative abundance in the Fisheries Independent Gill Net Survey (P915) in the Cape Fear and New rivers, 2008–2024. No sampling occurred in 2020 and limited sampling occurred in 2021 (July–December). Shaded error bars represent ± 1 standard error.

Length frequencies from P915 are represented in Figure 23. 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 two year classes of striped bass thought to be the result of successful natural reproduction in 2014 and 2015. In 2023, catch was composed of high percentages of fish greater than 20 inches which could be tracking continued growth and perpetuation of the 2014 and 2015 year classes (Figure 23). During 2021–2023 there were few smaller fish, less than 15 inches, in the gill net survey catch. In 2024, there was an even distribution of striped bass lengths in the Tar-Pamlico River ranging from 12−29 inches TL, while lengths in the Neuse River were centered around 20 inches TL. The decrease in the proportion of larger fish may be reflective of A-R fish from the 2014 and 2015 year classes leaving the rivers and entering the Atlantic Ocean migratory stock. Due to the low numbers of striped bass captured (N=17 during April, and October–November from shallow water sets), the length-frequency distribution may not be reflective of the populations size distribution. 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.

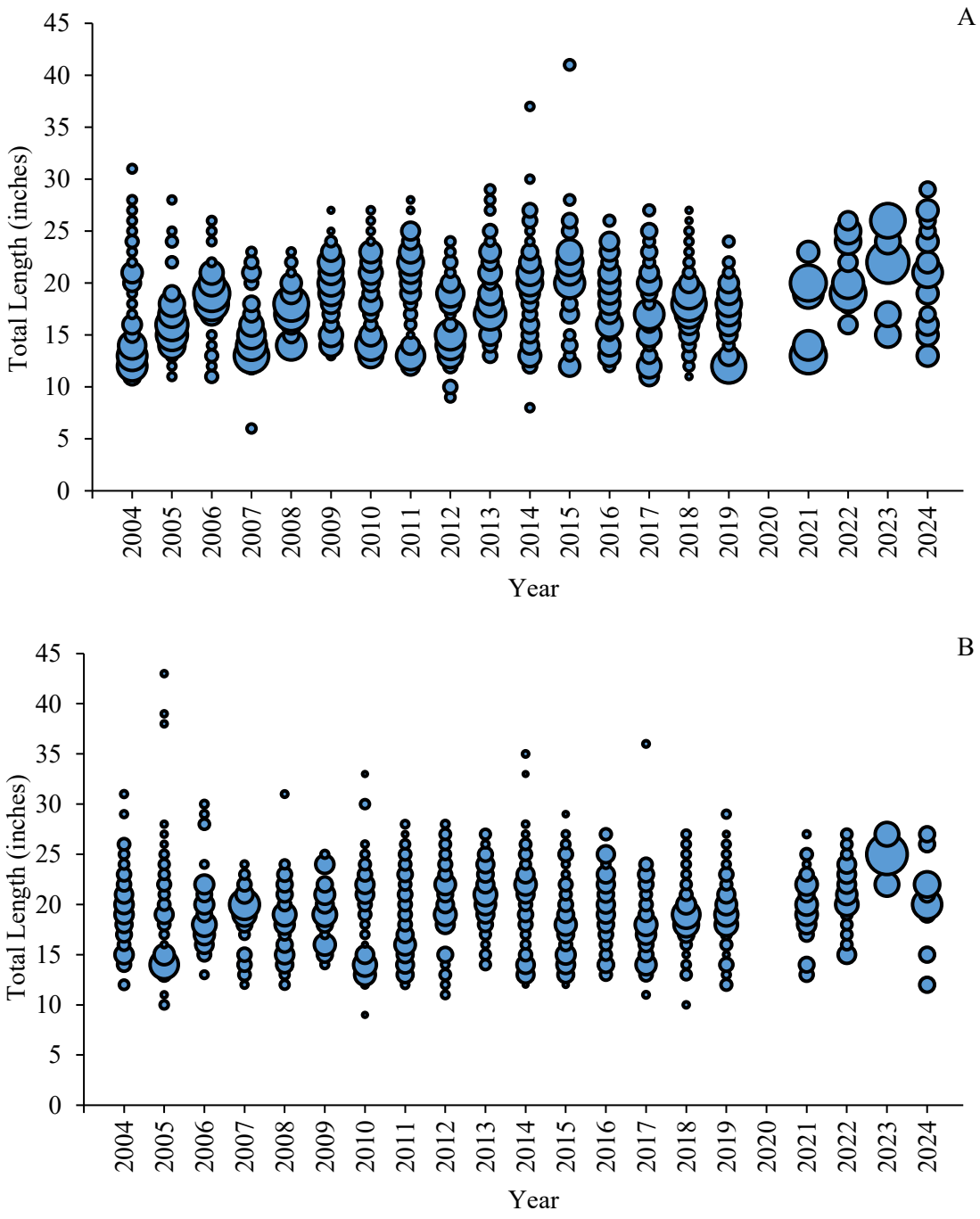

Figure 23. Length frequency of striped bass captured in the Fisheries Independent Gill Net Survey (P915) in the Tar-Pamlico River (A), and the Neuse River (B) during April, and October–November, in shallow water sets (2004–2024). No sampling occurred in 2020, and limited sampling occurred in 2021 (July–December). Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length.

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 14). 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 these fish were hatchery origin released as phase-I size (25–50 mm; 1–2 in) striped bass fingerlings. In 2023, 18 juvenile striped bass were captured in the Tar-Pamlico and Neuse rivers, and similar to 2022, all were hatchery origin released as phase-I size striped bass fingerlings. No juvenile striped bass were captured in the Tar-Pamlico or Neuse rivers in 2024 (Table 14).

No juvenile striped bass have been captured in the Cape Fear River since the start of the survey in 2017. In the Northeast Cape Fear River, 24 juvenile striped bass were captured in 2018, four in 2019, and one in 2020 (Table 15). 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. From 2021–2023 no juvenile striped bass were collected; however, in 2024, one 'wild' juvenile striped bass was captured in the Northeast Cape Fear River (Table 15).

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 Tar-Pamlico and Neuse rivers, 2017–2024. Trawl sampling was discontinued in 2023.

Year	Tar-Pamlico River						Neuse River					
	Seine			Trawl			Seine			Trawl		
	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
2023†	14	71	0.20	-	-	-	4	70	0.06	-	-	-
2024†	0	63	0.00	-	-	-	0	64	0.006	-	-	-
Total	37	398	0.09	0	264	0.00	8	398	0.02	0	264	0.00

* PBT analysis: natural reproduction ‘wild’
† PBT analysis: hatchery origin

Table 15. 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, 2017–2024.

Year	Cape Fear River						Northeast Cape Fear River					
	Seine			Trawl			Seine			Trawl		
	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
2023	0	23	0.00	0	21	0.00	0	20	0.00	0	28	0.00
2024*	0	43	0.00	0	24	0.00	0	25	0.00	1	32	0.03
Total	0	285	0.00	0	174	0.00	5	189	0.03	24	257	0.10

* PBT analysis: natural reproduction ‘wild’ (n=5 of 24 striped bass analyzed; 2018)

Age data are presented in Table 16 and Figure 24; from 2004 to 2024, a total of 2,648 otolith samples were aged and from 2016 to 2024, 1,374 genetic samples were collected to provide striped bass ages and hatchery origin (Table 16). Figure 24 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 have been collected since 2018. Otolith age data in 2024 had a modal age of four and a maximum age of ten. Genetic ages for 2024 are not currently available.

Table 16. CSMA striped bass otolith and genetic age data from fishery dependent (commercial and recreational creel survey) and independent (independent gill net survey) surveys, 2004–2024. Genetic ages (*) for 2024 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	-	1	-	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	4	1	1	9	9	147	99
2021	3	3	1	1	10	10	352	109
2022	3	4	1	0	11	11	114	128
2023	3	3	1	0	9	8	95	84
2024	4	-	1	-	11	-	67	45*

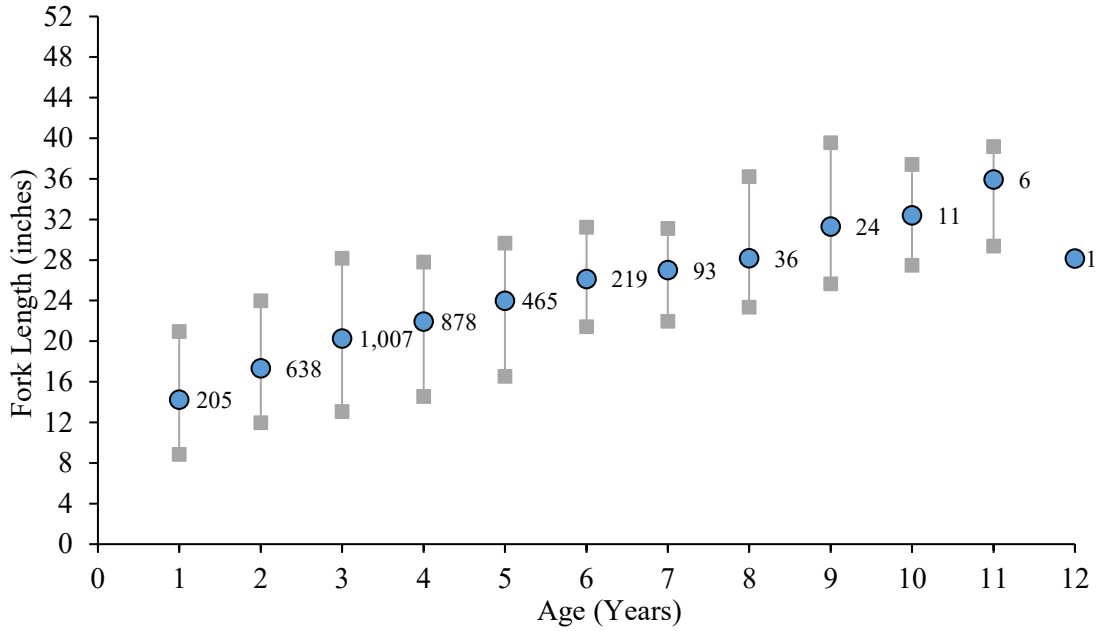

Figure 24. CSMA striped bass length at age based on otolith and genetic age samples collected, 2004–2024. Blue circles represent the mean size at a given age with the number of samples. The grey squares represent the minimum and maximum observed size for each age. Genetic ages from 2024 are not currently available.

Electrofishing surveys have been conducted by the WRC on CSMA spawning grounds since 1996 (Figure 25; Tar-Pamlico River), 1994 (Figure 26; Neuse River), and 2003 (Figure 27; 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 25). In 2024, the relative abundance was 44.7 fish, which was above the time series average of 39.2 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 26). In 2024, Neuse River striped bass relative abundance was 3.1 fish, which was below the time-series average of 11 fish per hour. 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 27). In 2024, relative abundance was 7.3 fish per hour which was a decrease from the 2023 relative abundance value and was below the time series average of 12.3 fish per hour.

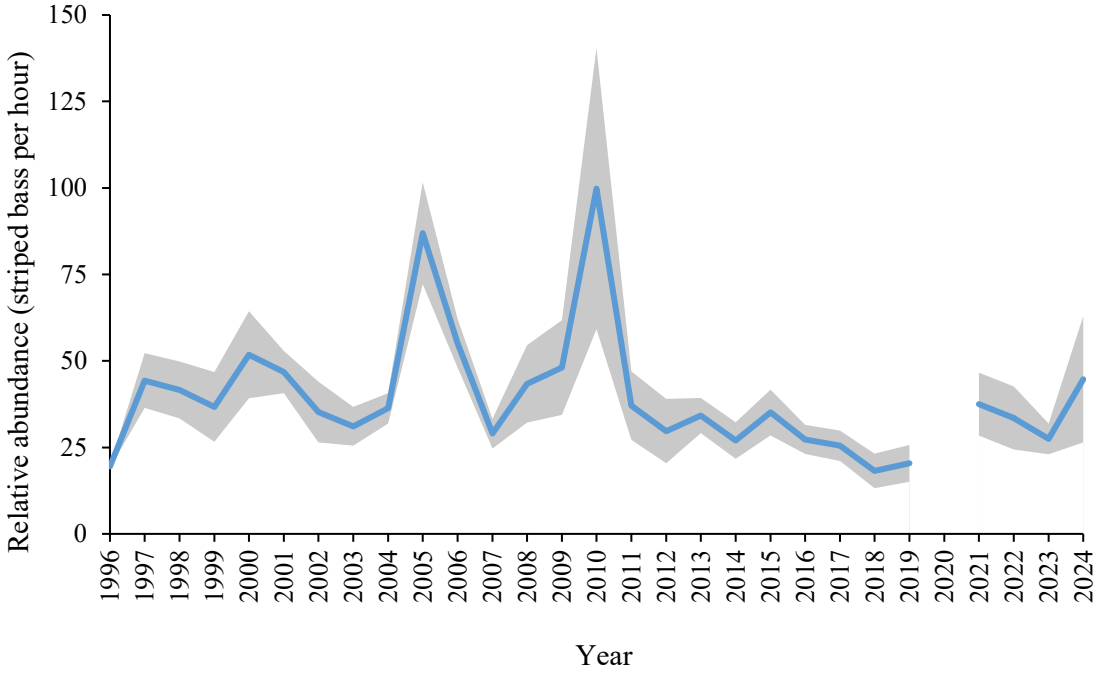

Figure 25. Relative abundance of Tar-Pamlico River striped bass from the WRC spawning grounds electrofishing survey, 1996–2024. No sampling occurred in 2020. Shaded error bars represent ± 1 standard error.

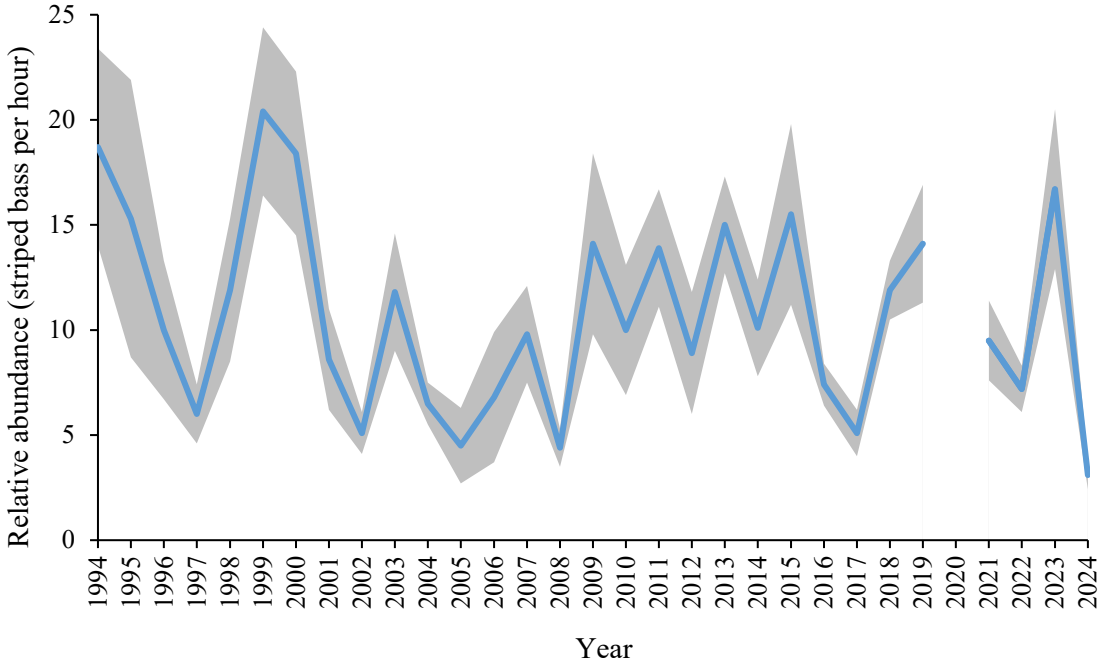

Figure 26. Relative abundance of Neuse River striped bass from the WRC spawning grounds electrofishing survey, 1994–2024. No sampling occurred in 2020. Shaded error bars represent ± 1 standard error.

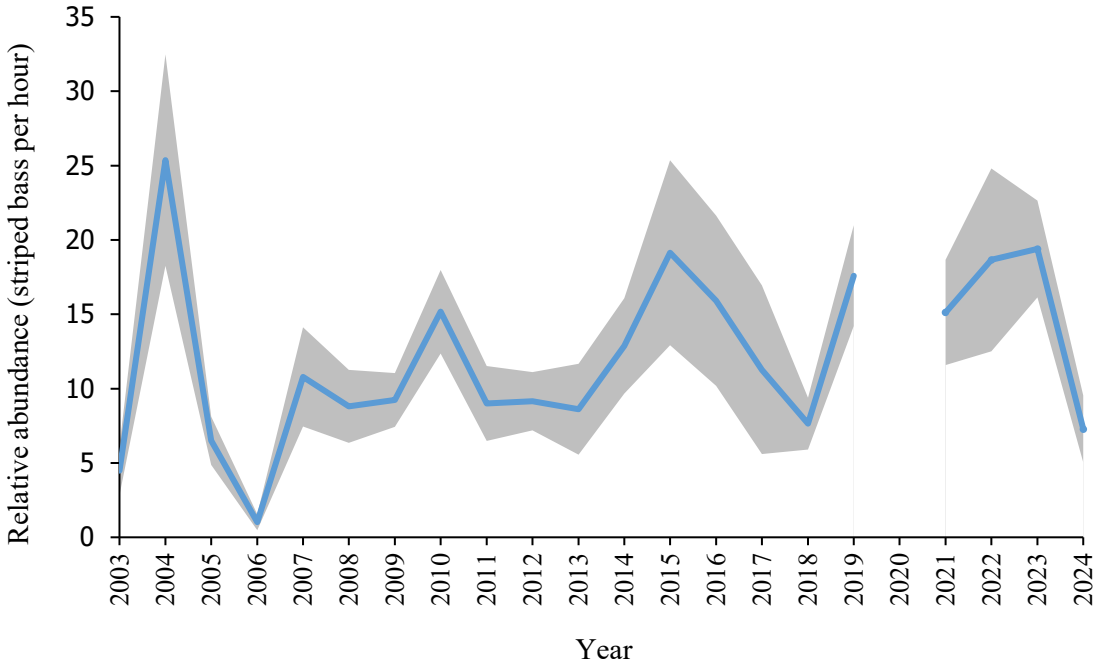

Figure 27. Relative abundance of Cape Fear River striped bass from the WRC spawning grounds electrofishing survey, 2003–2024. No sampling occurred in 2020. Shaded error bars represent ± 1 standard error.

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 2024 from CSMA systems, excluding the Cape Fear River, was 430 resulting in 39 recaptures (Table 17; Figure 28A). The time series average was 296 days at large with an average distance travelled of 28 miles (Table 17). Most recaptures occur within the state of North Carolina, however, the maximum distance travelled was 527 miles off the coast of Rhode Island (Figure 28B). The maximum days between release and recapture was 2,192 days or just under six years (Table 17).

In the Cape Fear River, the total number of striped bass tagged in 2024 was 247 resulting in 20 recaptures (Table 18; Figure 29A). The time series average was 332 days at large with an average distance travelled of 19 miles (Table 18). Most recaptures occur within the state of North Carolina; however, the maximum distance travelled was 566 miles into Long Island Sound, Connecticut (Figure 29B). The maximum days between release and recapture was 2,474 days or over six and a half years (Table 18). 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, movement and migration patterns, as well as age determination. For instance, two hatchery produced Tar-Pamlico River striped bass that were tagged as phase-II size striped bass fingerlings in 2008 were recaptured in November 2023 in Washington, N.C. The 15-year-old striped bass represent the oldest known striped bass in the CSMA.

Table 17. Summary of CSMA striped bass tagging and recapture data, excluding Cape Fear River, 2014 – 2024.

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	6,229	46	556	2,129	37	133
2015	6,738	153	369	1,643	29	527
2016	6,614	154	336	1,848	44	223
2017	6,973	234	256	2,077	32	180
2018	6,884	130	228	1,002	33	203
2019	6,738	155	356	1,690	35	248
2020	6,707	185	257	1,401	21	208
2021	6,935	173	322	1,145	28	177
2022	6,643	116	226	1,098	23	201
2023	6,713	148	277	767	8	89
2024	430	39	179	454	9	87
Total	67,604	1,533	296	2,129	28	527

Table 18. Summary of Cape Fear River striped bass tagging and recapture data, 2014 – 2024.

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	489	1,382	22	129
2015	3,693	159	483	1,944	17	281
2016	3,600	155	368	1,328	15	566
2017	3,367	75	291	2,474	11	98
2018	3,422	64	237	1,443	14	78
2019	3,279	74	394	1,763	16	157
2020	3,265	95	266	1,325	15	138
2021	3,323	84	253	1,297	16	270
2022	536	115	278	1,077	13	194
2023	324	49	260	779	17	122
2024	247	20	194	428	19	154
Total	28,103	903	332	2,474	15	566

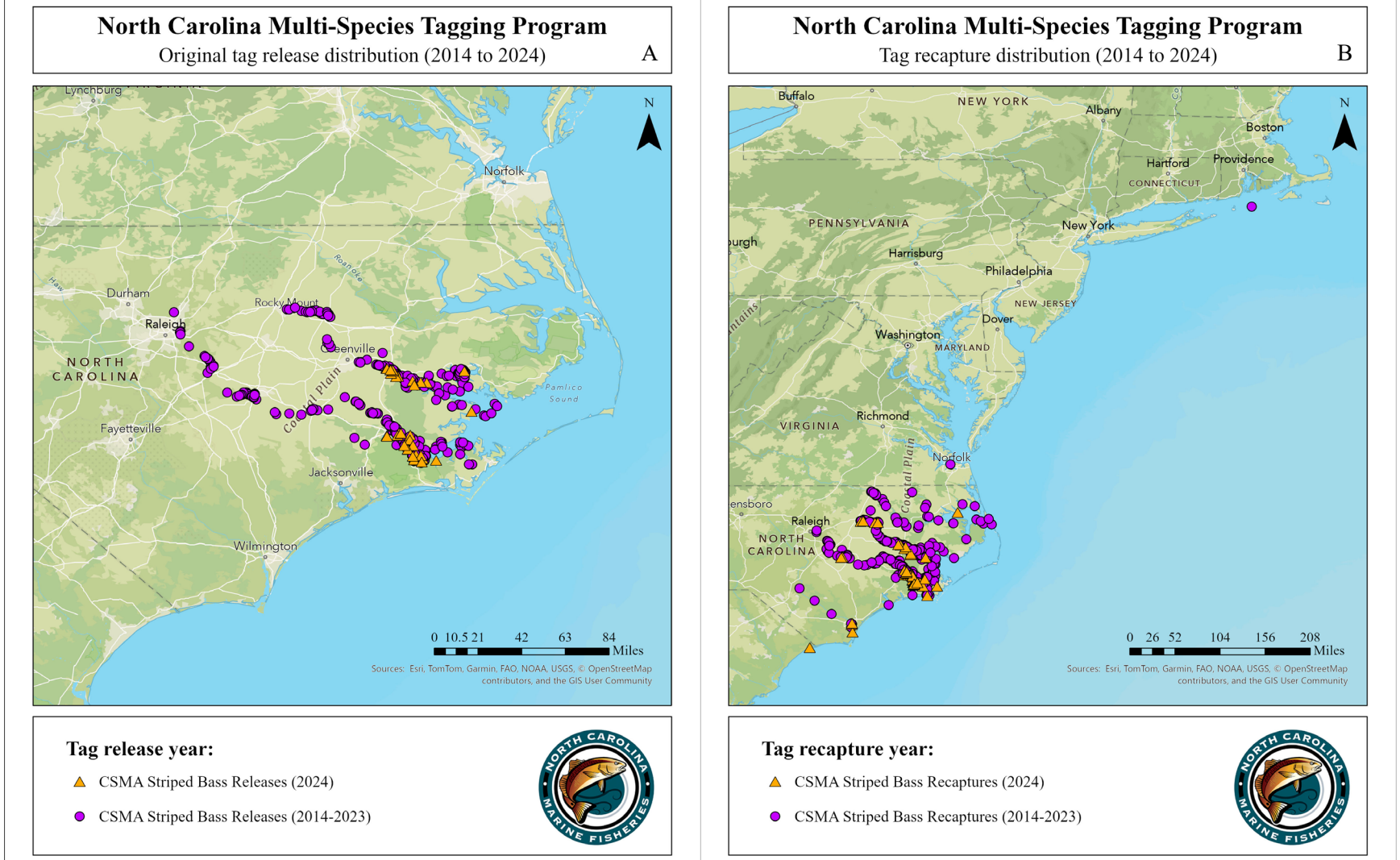

Figure 28. CSMA striped bass tagging release (A) and recapture (B) locations, excluding Cape Fear River, 2014-2024.

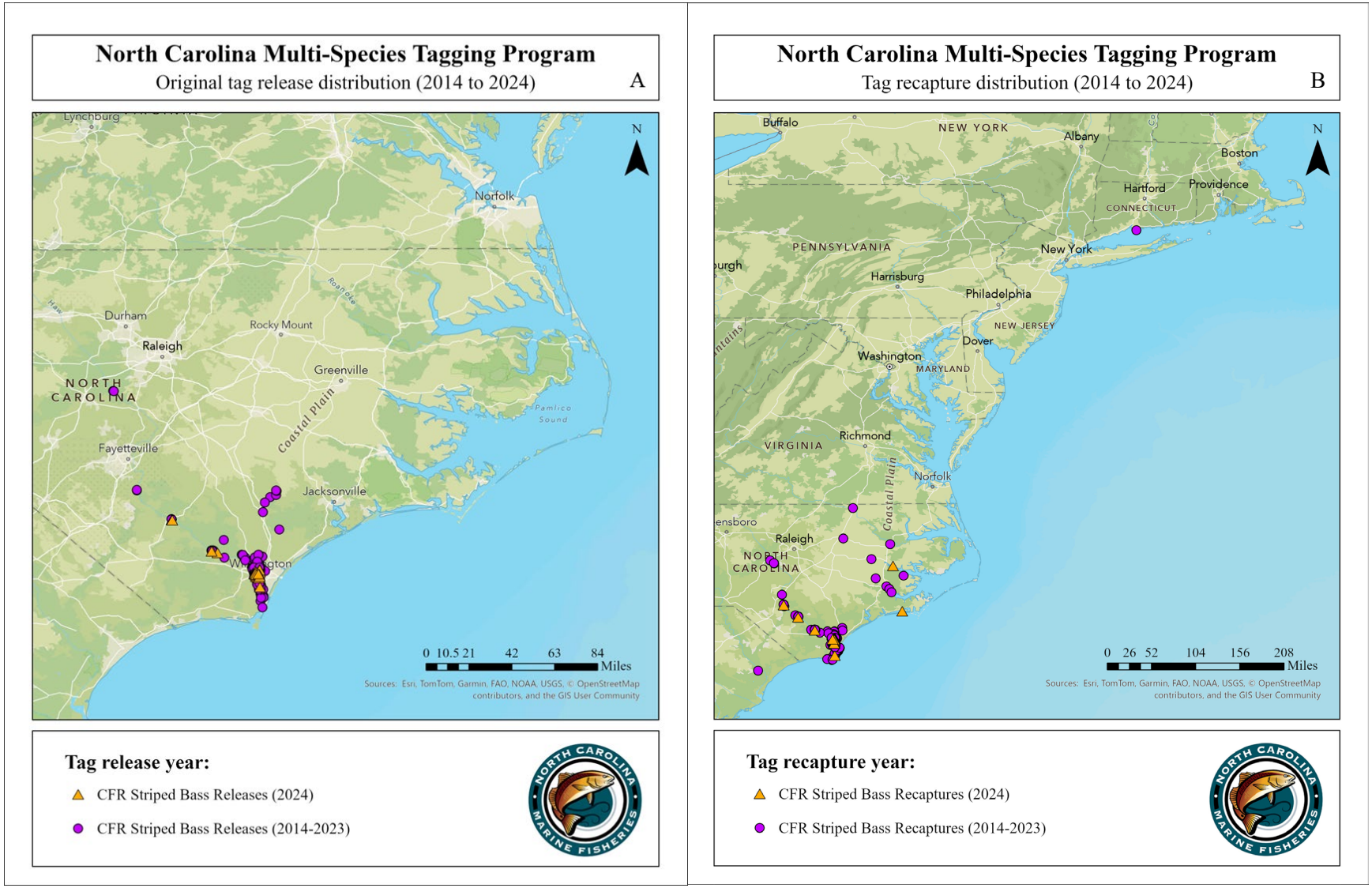

Figure 29. CSMA (Cape Fear River) striped bass tagging release (A) and recapture (B) locations, 2014-2024.

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: 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 to begin 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.

LITERATURE CITED

ASMFC (Atlantic States Marine Fisheries Commission). 2003. Amendment # 6 to the Interstate Fishery Management Plan for Atlantic Striped Bass. ASMFC, Washington, DC. Fisheries Management Report No. 41.

ASMFC. 2010. Addendum II to Amendment # 6 to the Interstate Fishery Management Plan for Atlantic Striped Bass. ASMFC, Washington, DC.

ASMFC (Atlantic States Marine Fisheries Commission). 2022. Amendment 7 to the Interstate Fishery Management Plan for Atlantic Striped Bass. ASMFC, Washington, DC.

ASMFC. 2023. Addendum I to Amendment 7 to the Interstate Fishery Management Plan for Atlantic Striped Bass. ASMFC, Washington, DC.

Boyd, J. 2011. Maturation, Fecundity, and Spawning Frequency of the Albemarle/Roanoke Striped Bass Stock. (Under the direction of Dr. Roger Rulifson). Department of Biology, December 2011. 132 pp.

Bradley, C., J. Rice, and D. Aday. 2018. Modeling the Effects of Vital Rate Manipulation and Management Scenarios to Predict the Population Impact of Restoration Programs on an Unrecovered Coastal Population of Striped Bass.

Callihan, J., J. Harris, and J. Hightower. 2015. Coastal Migration and Homing of Roanoke River Striped Bass. North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University, Raleigh, NC. 15 pp.

Buckley, C., L. Kelsey, K. Rachels, and B. Ricks. 2019. Striped Bass Ichthyoplankton Surveys in the Neuse River, 2016–2017. Federal Aid in Sport Fish Restoration Project F-108. North Carolina Wildlife Resources Commission, Inland Fisheries Division, Raleigh, NC. 17 pp.

Cushman, B., T. O'Donnell, and D. Farrae. 2018. South Carolina Department of Natural Resources. 2017 Striped Bass Genotyping and Parentage Analysis Final Report for the North Carolina Wildlife Resources Commission. 39 pp.

Farrae, D., and T. Darden. 2018. South Carolina Department of Natural Resources. 2017 Striped Bass Genotyping Report for the North Carolina Division of Marine Fisheries. 9 pp.

Flowers, J., S. Darsee, L. Lee, and C. Godwin. 2016. Stock status of Albemarle Sound-Roanoke River striped bass: update 1982–2014. North Carolina Division of Marine Fisheries, NCDMF SAP-SAR-2016-01, Morehead City, NC. 88 pp.

Knight, E.H. 2015. Maturation and Fecundity of the Neuse and Tar-Pamlico Rivers Striped Bass (Morone saxatilis) Stocks in Coastal North Carolina. Master's Thesis, East Carolina University, Greenville, NC. 59 pp.

Laney, R.W., J.C. Benton, L.T. Henry, H. Johnson, J.W. Kornegay, K.L. Nelson, S.D. Taylor, and S.E. Winslow. 1993. North Carolina Estuarine Striped Bass Fishery Management Plan. North Carolina Division of Marine Fisheries and North Carolina Wildlife Resources Commission in cooperation with the U.S. Fish and Wildlife Service under Cooperative Agreement number 14-0004-87-904.

Lee, L.M., T.D. Teears, Y. Li, S. Darsee, and C. Godwin (editors). 2020. Assessment of the Albemarle Sound-Roanoke River striped bass (Morone saxatilis) in North Carolina, 1991–2017. North Carolina Division of Marine Fisheries, NCDMF SAP-SAR-2020-01, Morehead City, North Carolina. 171 pp.

Lee, L.M., C.J.C. Schlick, N. Hancock. C.H. Godwin, and J. McCargo (editors). 2022. Assessment of the Albemarle Sound-Roanoke River Striped Bass (Morone saxatilis) stock in North Carolina, 1991–2021. North Carolina Division of Marine Fisheries, NCDMF SAP-SAR-2022-03, Morehead City, North Carolina. 98 pp.

Lee, L.M., C.J.C. Schlick, N. Hancock. C.H. Godwin, and J. McCargo (editors). 2022. Assessment of the Albemarle Sound-Roanoke River Striped Bass (Morone saxatilis) stock in North Carolina, 1991–2021. North Carolina Division of Marine Fisheries, NCDMF SAP-SAR-2022-03, Morehead City, North Carolina. 98 p

Mathes, T., Y. Li, T. Teears, and L.M. Lee (editors). 2020. Central Southern Management Area striped bass stocks in North Carolina, 2020. North Carolina Division of Marine Fisheries, NCDMF SAP-SAR-2020-02, Morehead City, North Carolina. 161 pp. + appendices.

Mroch, R., and C.H. Godwin. 2014. Stock Status of Albemarle Sound-Roanoke River Striped Bass. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 236 pp.

NCDMF (North Carolina Division of Marine Fisheries). 1994. North Carolina Estuarine Striped Bass Fishery Management Plan. Prepared by the North Carolina Division of marine Fisheries and North Carolina Wildlife Resources Commission, Division of Boating and Inland Fisheries, in cooperation with the U.S. Fish and Wildlife Service, South Atlantic Fisheries Coordination office under Cooperative Agreement number 14-0004-87-904.

NCDMF. 2004. North Carolina Estuarine Striped Bass Fishery Management Plan. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 375 pp.

NCDMF. 2010. Application for an Individual Incidental Take Permit under the Endangered Species Act of 1973. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries. 52 pp.

NCDMF. 2010. Catch Curve Exploitation Estimates for Neuse River and Tar-Pamlico River Striped Bass Stocks. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 79 pp.

NCDMF. 2013. Amendment 1 to the North Carolina Estuarine Striped Bass Fishery Management Plan. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 826 pp.

NCDMF. 2014. November 2014 Revision to Amendment 1 to the North Carolina Estuarine Striped Bass Fishery Management Plan. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 15 pp.

NCDMF. 2015. Fishery Management Plan for Interjurisdictional Fisheries: Information Update. North Carolina Department of Environmental Quality. North Carolina Division of Marine Fisheries. Morehead City, North Carolina. 85 pp.

NCDMF. 2019. Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan. Implementation of a Striped Bass No-Possession Limit in the Internal Coastal and Joint Fishing Waters of the Central Southern Management Area. North Carolina Department of Environmental Quality. Division of Marine Fisheries. Morehead City, NC. 37 p.

NCDMF. 2020. November 2020 Revision to Amendment 1 to the North Carolina estuarine striped bass fishery management plan. North Carolina Department of Environmental and Natural Resources, Division of Marine Fisheries, Elizabeth City, North Carolina.

NCDMF. 2022. North Carolina Estuarine Striped Bass Fishery Management Plan, Amendment 2. North Carolina Division of Marine Fisheries, Morehead City, North Carolina. 149 p.

NCDMF. 2024. 2024 Revision to the North Carolina Estuarine Striped Bass Fishery Management Plan Amendment 2. North Carolina Department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 12 pp.

O'Donnell T., and D. Farrae. 2017. South Carolina Department of Natural Resources. North Carolina Wildlife Resources Commission 2016 Striped Bass Genotyping and Parentage Analyses 2016 Final Report.

Rachels, K.T and B.R. Ricks. 2015. Neuse River Striped Bass Monitoring Programs, Population Dynamics, and Recovery Strategies. North Carolina Department of Environmental Quality, Wildlife Resources Commission, Raleigh, N.C. 47 pp.

Rock, J., D. Zapf, C. Wilson, and D. Mumford. 2016. Improving Estimates of Striped Bass Discards in the Central Southern Management Area (CSMA) Through a Recreation Access Site Survey and an Expanded Observer Program. North Carolina Department of Environmental Quality, Division of Marine Fisheries. Morehead City, NC. CRFL Grant 2011-F-001 Final Report. 76 pp.

Rock, J., D. Zapf. J. Facendola, and C. Stewart. 2018. Assessing critical habitat, movement patterns, and spawning grounds of anadromous fishes in the Tar/Pamlico, Neuse, and Cape Fear rivers using telemetry tagging techniques. North Carolina Department of Environmental Quality, Division of Marine Fisheries. Morehead City, NC. CRFL Grant 2013-F-013 Final Report. 120 pp.

SCDNR (South Carolina Division of Natural Resources). 2018. North Carolina Wildlife Resources Commission 2018 Striped Bass Genotyping and Parentage Analyses. 2018 Final Report. 47 pp.

USFWS (U.S. Fish and Wildlife Service). 1992. Report to Congress for the North Carolina Striped Bass Study Albemarle Sound Roanoke River Basin.