NC Marine Fisheries Commission

# Fishery Management Plans

**August 2025 Quarterly Business Meeting**

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NC Marine Fisheries Commission

# Fishery Management Plan Annual Review

**August 2025 Quarterly Business Meeting**

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**Annual Fishery Management Plan Update**
**Division of Marine Fisheries**
**August 1, 2025**

## Authority and Process

The Fisheries Reform Act of 1997 and its amendments established the requirement to create fishery management plans (FMPs) for all of North Carolina's commercially and recreationally significant species or fisheries. Plan contents are specified, advisory committees are required, and oversight by the Department of Environmental Quality (DEQ) secretary, Joint Legislative Oversight Committee on Agriculture and Natural and Economic Resources (AgNER), and legislative Fiscal Research Division are mandated.

Annually, the Division of Marine Fisheries (division) reviews all State, Federal (Fishery Management Councils), and Atlantic States Marine Fisheries Commission (ASMFC) managed FMPs where North Carolina is directly involved. Stock conditions and management are monitored and reported through annual FMP updates. This information is used to determine if the State FMP Review Schedule remains appropriate or if it should be revised. The full 2024 FMP review and individual species FMP Annual Updates can be found at http://deq.nc.gov/fishery-management-plans.

## Status of State FMPs

Out of 13 State FMPs, Southern flounder is under review and both red drum and kingfish begin review this year. A summary of State FMPs is provided below in order of the date of the last action. No schedule change is being requested at this time.

**Southern Flounder (*under review*):** Amendment 3 was adopted by the Marine Fisheries Commission (MFC) in May 2022. At the August 2024 MFC business meeting, the MFC passed a motion "*to ask the DMF Director to ask the DEQ Secretary to modify the Annual FMP Review Schedule to amend the Southern Flounder FMP for the review of the plan to begin in 2024. The intent is to allow for more recreational access while maintaining the rebuilding requirements of the North Carolina Southern Flounder FMP Amendment 3*". The DEQ Secretary approved the schedule change in November 2024, which included development of Amendment 4 to give the MFC the opportunity to consider implementing the 50/50 sector allocation in 2025 instead of 2026 as prescribed in Amendment 3. Additionally, the Secretary approved concurrent development of Amendment 5 to comprehensively explore long-term solutions to the issue of recreational access while maintaining Amendment 3 rebuilding requirements. The MFC is scheduled to take final action on Amendment 4 at the August 2025 MFC business meeting. Development of Amendment 5 will continue regardless of whether Amendment 4 is adopted.

**Kingfishes (*review begins 2025*):** Management strategies continue to be maintained as outlined in the State Kingfishes FMP. The FMP prescribes that if two or more of the seven triggers are activated in two consecutive years then data will be evaluated further and the need for management changes will be considered. Two or more triggers have been activated for the last two years (2023 and 2024). However, the data used to inform the three triggers activated in 2024 were from the SEAMAP-SA Coastal Trawl Survey, which has undergone recent survey changes that likely affect calculation of kingfish indices of relative

abundance. The scheduled review of the plan will begin in 2025 and will include a comprehensive review of available data. Triggers will also be reevaluated as changes to the SEAMAP-SA Coastal Trawl Survey and the DMF's Program 195 Pamlico Sound Trawl Survey limit their suitability as triggers.

**Red Drum (*review begins 2025*):** Red drum in North Carolina are managed under Amendment 1 to the North Carolina Red Drum FMP and Amendment 2 to the Atlantic States Marine Fisheries Commission (ASMFC) Interstate FMP for Red Drum. A benchmark stock assessment was completed by ASMFC in 2024 with data through fishing year 2021. Results indicate the northern red drum stock (which includes North Carolina) is not overfished and overfishing is not occurring, though concerning trends are developing. In response to stock assessment results, the ASMFC Sciaenid's Management Board initiated development of Addendum II to Amendment 2 to the Interstate FMP for Red Drum, which is tentatively scheduled for adoption in October 2025. Any changes to the State FMP must consider compliance requirements of the ASMFC plan. Review of the State's Red Drum FMP was originally scheduled to begin in 2024, but in 2024 the DEQ Secretary approved the division's request to delay the review one year to provide time for completion of the ASMFC's red drum stock assessment and align with the ASMFC's tentative adoption of Addendum II.

**Blue Crab (*review begins 2026*):** Amendment 3 was adopted by the MFC in February 2020 to address the overfished status and end overfishing, indicated by the 2018 benchmark stock assessment. All available information suggests the blue crab stock has continued to decline since adoption of Amendment 3 and management changes are needed. As prescribed by the Amendment 3 adaptive management framework, the division developed and presented management options and initial recommendations to the MFC's Northern, Southern, and Shellfish/Crustacean advisory committees in March 2025. The MFC is tentatively scheduled to take final action on Amendment 3 adaptive management in November 2025. Any management changes will be implemented as a Revision to Amendment 3. In 2024, the DEQ Secretary approved the division request to delay the plan review one year to afford time to implement Amendment 3 adaptive management. As a result, the next scheduled review of this plan will begin in 2026.

**Bay Scallop (*review begins 2026*):** Management continues to be maintained as outlined in the State FMP. After many years of low abundance, the season was opened in specific regions in 2021, 2022, and 2023 at the lowest allowed harvest levels but was not opened in 2024. In 2024, the DEQ Secretary approved the division request to delay the plan review one year to reduce overlap in ongoing plan reviews and upon identification of no immediate need for management changes. As a result, the next scheduled review of this plan will begin in 2026.

**Shrimp (*review begins 2027*):** Amendment 2 was adopted by the MFC in February 2022 and management has been implemented through proclamations. The May 2024 Revision to the Shrimp FMP Amendment 2 documents the rationale of the MFC for not pursuing further action to address Submerged Aquatic Vegetation (SAV) protection under Amendment 2, but instead recommending the examination of issues and development of management actions related to the broader conservation of SAV habitat consistent with the Coastal Habitat Protection Plan (CHPP). Amendment 2 includes a motion by the MFC that they will seek additional methods and funding sources for a long-term shrimp observer program. The next scheduled review of the plan will begin in 2027.

**River Herring (*review begins 2027*):** River herring in North Carolina are currently managed under two separate North Carolina FMPs, Amendment 2 to the North Carolina River Herring FMP and the North Carolina FMP for Interjurisdictional Fisheries, as well as ASMFC's Amendment 2 to the Interstate FMP for Shad and River Herring. The 2024 ASMFC Atlantic coast-wide stock assessment update indicated that river herring remain depleted and at near historic lows on a coast-wide basis. All management strategies will be maintained as outlined in the two State FMPs and ASMFC FMP. The Division recommends transitioning management from the North Carolina River Herring FMP and maintaining their management

solely through the North Carolina FMP for Interjurisdictional Fisheries with the ASMFC. As outlined below, the North Carolina FMP for Interjurisdictional Fisheries adopts FMPs approved by the ASMFC or Councils by reference. This action will achieve efficiencies by addressing any redundancy in management between the ASMFC Interstate FMP and two separate North Carolina FMPs. The DMF will begin taking the appropriate steps to facilitate this transfer, whereby river herring management would be addressed solely through the North Carolina FMP for Interjurisdictional Fisheries.

**Estuarine Striped Bass (*review begins 2027*):** Amendment 2 was jointly developed with the N.C. Wildlife Resources Commission and adopted by the MFC in November 2022. The FMP includes four stocks: the Albemarle-Roanoke (A-R) stock, the Tar-Pamlico River stock, the Neuse River stock, and the Cape Fear River stock. The 2022 A-R stock assessment update indicated the stock has continued to decline since the previous assessment and remains overfished with overfishing occurring. Based on stock assessment results, the 2024 Revision to Amendment 2 implemented a harvest moratorium in the Albemarle Sound and Roanoke River Management Areas. No stock status is available for the other three stocks; however, a population model indicates the stocks are depressed to a level where sustainability is unlikely. As prescribed in Amendment 2, in 2025 the division began a review of striped bass data through 2024 for the Tar-Pamlico and Neuse rivers to determine if populations are self-sustaining, if sustainable harvest can be determined, and to assess performance of the ferry line gill net prohibition at increasing striped bass abundance. Results of the evaluation and recommendations will be presented to the MFC in August 2025. The next scheduled review of the plan will begin in 2027.

**Interjurisdictional Fisheries (*review begins 2028*):** The goal of the FMP for Interjurisdictional Fisheries is to adopt FMPs, consistent with N.C. law, approved by the ASMFC or Councils 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. In 2024, the DEQ Secretary approved the division request to delay the plan review one year to reduce overlap in ongoing plan reviews. As a result, the next scheduled review of the plan will begin in 2028.

**Striped Mullet (*review begins 2029*):** Amendment 2 was adopted by the MFC in May 2024. The MFC adopted regulations intended to reduce striped mullet harvest with a goal of ending overfishing and rebuilding the stock. The regulations included commercial day of week harvest closures and reduced recreational possession limits. Adaptive management allows for adjustment to season closures, day of week closures, trip limits, and gill net yardage and mesh size restrictions to ensure management targets are being met, based on results of stock assessment updates, concerning stock conditions, or fishery trends. While commercial landings increased in 2024, fishery-independent indices also increased suggesting increased landings are related to increased stock abundance. Adaptive management action is not recommended at this time, but stock and fishery trends will continue to be monitored. The next scheduled review of the plan will begin in 2029.

**Spotted Seatrout (*review begins 2030*):** Amendment 1 to the Spotted Seatrout FMP was adopted by the MFC in March 2025. The MFC adopted regulations that are intended to reduce spotted seatrout harvest and end overfishing of the stock. Adopted regulations include commercial day of week harvest closures (that mirror striped mullet closures), a recreational slot limit, and a lower recreational bag limit. Adaptive management allows for adjustment to season closures, day of week closures, size limits, trip, bag or vessel limits, and gear restrictions to ensure management targets are being met. Amendment 1 also changed the adaptive management framework for cold stun events. The next scheduled review of the plan will begin in 2030.

**Eastern Oyster and Hard Clam (*review begins 2030*):** Amendment 5 to the Eastern Oyster FMP and Amendment 3 to the Hard Clam FMP were adopted by the MFC in May 2025. With issues related to shellfish leases, aquaculture, and franchises now being addressed by the Shellfish Lease and Aquaculture

Program, the amendments only address wild harvest. Additionally, stock assessments have not been completed for these species due to data limitations; therefore, population size and rate of removals are unknown. Amendment 5 to the Eastern Oyster FMP balances the value of oysters as a fishery resource and essential habitat by implementing deep-water oyster recovery areas (DORAs), cultch supported harvest, and rotational harvest cultch sites. Amendment 3 to the Hard Clam FMP phases out the use of mechanical harvest methods by 2028. Both plans adopted a strategy for the division to further explore options to estimate recreational shellfish participation and landings, and to distribute Shellfish Sanitation and Recreational Water Quality health and safety information. The next scheduled review of the plans will begin in 2030.

| N.C. FISHERY MANAGEMENT PLAN REVIEW SCHEDULE (July 2025–June 2030)<br>Revised November 12, 2024 | | | | | |
|---|---|---|---|---|---|
| SPECIES (Date of Last Action) | 2025–2026 | 2026–2027 | 2027–2028 | 2028–2029 | 2029–2030 |
| SOUTHERN FLOUNDER (5/22) * | | | | | |
| RED DRUM (8/17) ** | | | | | |
| KINGFISHES (8/20) | | | | | |
| BLUE CRAB (2/20) + | | | | | |
| BAY SCALLOP (8/20) ++ | | | | | |
| SHRIMP (2/22) | | | | | |
| ESTUARINE STRIPED BASS (11/22) | | | | | |
| RIVER HERRING (8/22) | | | | | |
| INTERJURISDICTIONAL (5/22) ++ | | | | | |
| STRIPED MULLET (5/24) | | | | | |
| SPOTTED SEATROUT (3/25) | | | | | |
| EASTERN OYSTER (5/25) | | | | | |
| HARD CLAM (5/25) | | | | | |

* In 2024 the DEQ Secretary approved an early FMP review to consider alternate options for managing the recreational flounder fishery, while maintaining Amendment 3 rebuilding requirements.

** In 2024 the DEQ Secretary approved the division request to delay the plan review one year to afford time for completion of the Atlantic States Marine Fisheries Commission's red drum stock assessment which will inform management

\+ In 2024 the DEQ Secretary approved the division request to delay the plan review one year to afford time to implement Amendment 3 adaptive management

++ In 2024 the DEQ Secretary approved the division request to delay the plan review one year to reduce overlap in ongoing plan reviews

This schedule assumes no rulemaking is required to implement plan amendments.

NC Marine Fisheries Commission

# Blue Crab Fishery Management Plan

**August 2025 Quarterly Business Meeting**

# Documents

## Blue Crab FMP Amendment 3 Decision Document

# DECISION DOCUMENT

## Blue Crab Fishery Management Plan

## Amendment 3 Adaptive Management

This document was developed to help the MFC track previous activity and prepare for upcoming actions for Blue Crab FMP Amendment 3 Adaptive Management.

August 2025

# Summary

Amendment 3 to the N.C. Blue Crab Fishery Management Plan (FMP) was adopted in February 2020 and is nearly halfway through the legislatively mandated 10-year stock rebuilding period with little evidence suggesting management measures have been successful in ending overfishing or achieving sustainable harvest. The intent of the Amendment 3 adaptive management framework is to allow for management changes if measures are or are not meeting objectives. Because Amendment 3 management measures have been unsuccessful in ending overfishing or achieving sustainable harvest, the adaptive management framework will be used to implement management measures projected to reduce fishing mortality (*F*) closer to the *F* target and rebuild the spawning stock closer to the spawner abundance target with greater than 50% probability of success.

# Amendment 3 Background

As part of Amendment 3 to the North Carolina Blue Crab FMP a benchmark stock assessment was undertaken using data from 1995–2016. Based on assessment results, the N.C. blue crab stock was overfished and overfishing was occurring in 2016.

The North Carolina Fishery Reform Act of 1997 requires the State specify a time period not to exceed two years to end overfishing and achieve a sustainable harvest within 10 years of the date of adoption of the plan. To meet this requirement, a minimum harvest reduction of 0.4% (in numbers of crabs) was projected to end overfishing and a harvest reduction of 2.2% was projected to achieve sustainable harvest and rebuild the blue crab spawning stock within 10 years with a 50% probability of success (Table 1).

Table 1. Catch reduction projections for varying levels of fishing mortality (*F*) and the probability of achieving sustainable harvest within the 10-year rebuilding period defined in statute. Bolded row is minimum required harvest reduction.

| *F* (yr-1) | Catch Reduction (%) | Probability of achieving sustainable harvest within 10 years (%) | Comments |
|---|---|---|---|
| 1.48 | 0.0 | 31 | 2016 average *F* from stock assessment |
| 1.46 | 0.4 | 45 | Catch reduction to meet *F* threshold and end overfishing |
| 1.40 | 1.7 | 46 | Catch reduction to meet spawner abundance threshold and end overfished status |
| **1.38** | **2.2** | **50** | **Catch reduction to meet minimum statutory requirement for achieving sustainable harvest** |
| 1.30 | 3.8 | 67 | |
| 1.22 | 5.9 | 90 | Catch reduction to meet *F* target |
| 1.10 | 9.3 | 96 | |
| 1.00 | 12.3 | 100 | |
| 0.90 | 15.7 | 100 | |
| 0.80 | 19.8 | 100 | Catch reduction to meet spawner abundance target |
| 0.70 | 24.3 | 100 | |

At their February 2020 business meeting the MFC adopted Amendment 3 to the FMP with the following management strategies to end overfishing and achieve sustainable harvest in the blue crab fishery:

- North of the Highway 58 Bridge: A January 1 through January 31 closed season.
- South of the Highway 58 Bridge: A March 1 through March 15 closed season.
- A 5-inch minimum size limit for mature female crabs statewide.
- Replacing the current pot closure period and remaining closed in entirety (could not be reopened early).
- Maintain the prohibition on harvest of immature female hard crabs statewide.
- Maintain the 5% cull tolerance established in the 2016 Revision to Amendment 2.
- Adopt proposed adaptive management framework and allow measures to be relaxed if the assessment update indicated the stock was not overfished and overfishing was not occurring and recommend updating the stock assessment once 2019 data is available.

**The adopted management provided an estimated 2.4% harvest reduction with a 50% probability of achieving sustainable harvest.** This reduction was just above the statutorily required minimum (2.2% reduction), but below the harvest reduction level needed to reduce *F* to the target (5.9% reduction) and the reduction needed to increase spawner abundance to the target (19.8% reduction; Table 1).

Amendment 3 management strategies have been fully in place since January 2021. Amendment 3 also maintained all measures implemented with the May 2016 Revision to the Blue Crab FMP. A summary of all management measures in place through Amendment 3 can be found in Amendment 3, the annual FMP Update or in the Amendment 3 flyer.

## Amendment 3 Adaptive Management

1. Update the stock assessment at least once in between full reviews of the FMP, timing at the discretion of the division
    a. If the stock is overfished and/or overfishing is occurring or it is not projected to meet the sustainability requirements, then management measures shall be adjusted using the director's proclamation authority
    b. If the stock is not overfished and overfishing is not occurring, then management measures may be relaxed provided it will not jeopardize the sustainability of the blue crab stock
2. Any quantifiable management measure, including those not explored in this paper, with the ability to achieve sustainable harvest (as defined in the stock assessment), either on its own or in combination, may be considered
3. Use of the director's proclamation authority for adaptive management is contingent on:
    a. Consultation with the Northern, Southern, and Shellfish/Crustacean advisory committees
    b. Approval by the Marine Fisheries Commission

Upon evaluation by the division, if a management measure adopted to achieve sustainable harvest (either through Amendment 3 or a subsequent Revision) is not working as intended, then it may be revisited and either: 1) revised or 2) removed and replaced as needed provided it conforms to steps 2 and 3 above.

## Post Amendment 3 Stock Assessment Update

Following full implementation of Amendment 3 management measures in 2021, DMF monitoring programs continued to observe historically low commercial landings, coupled with continued low abundance of all blue crab life stages (e.g., male and female juveniles, male and female adults, mature females). In response to stock concerns expressed by commercial crabbers and continued poor trends in abundance since adoption of Amendment 3, the DMF began updating the stock assessment with data through 2022. Results of the model update indicate the magnitude and trends for estimated recruitment, female spawner abundance, and fishing mortality were similar to the benchmark assessment (Figure 1); however, the Maximum Sustainable Yield (MSY) based reference points used to determine stock status for both female spawner abundance and fishing mortality changed drastically (Figures 2-3).

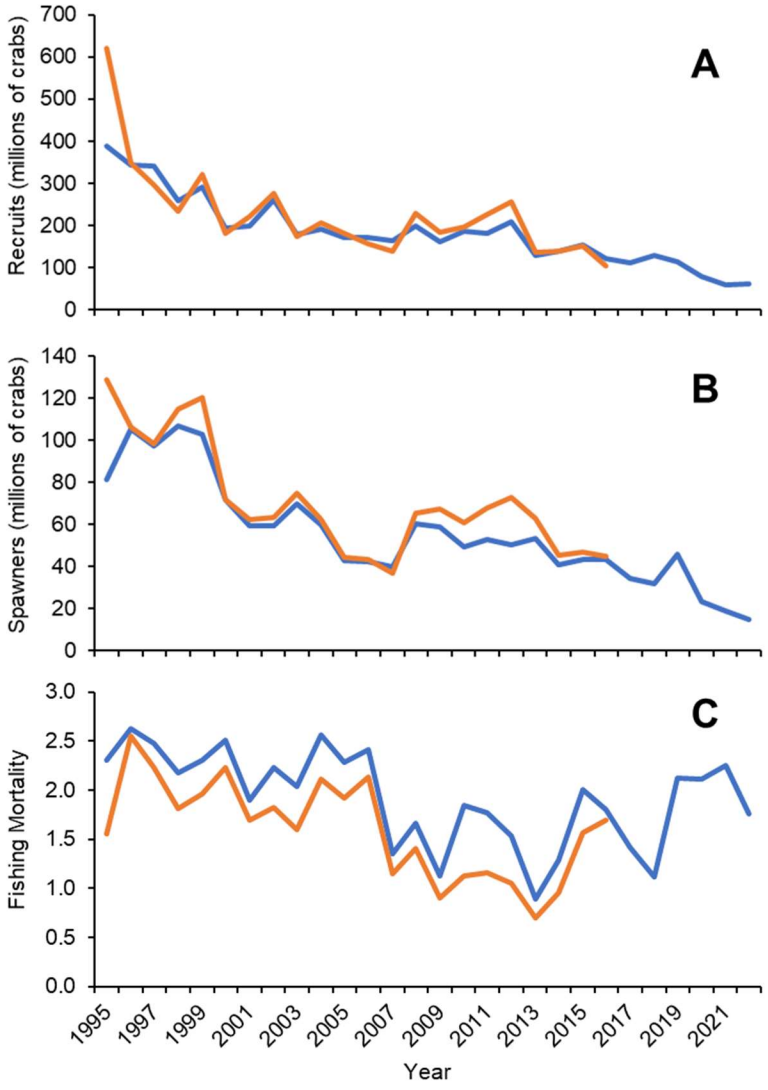


Figure 1. Comparison of estimates of (A) total recruitment, (B) female spawner abundance, and (C) fishing mortality between the 2023 stock assessment update (blue line) and the 2018 benchmark stock assessment (orange line).

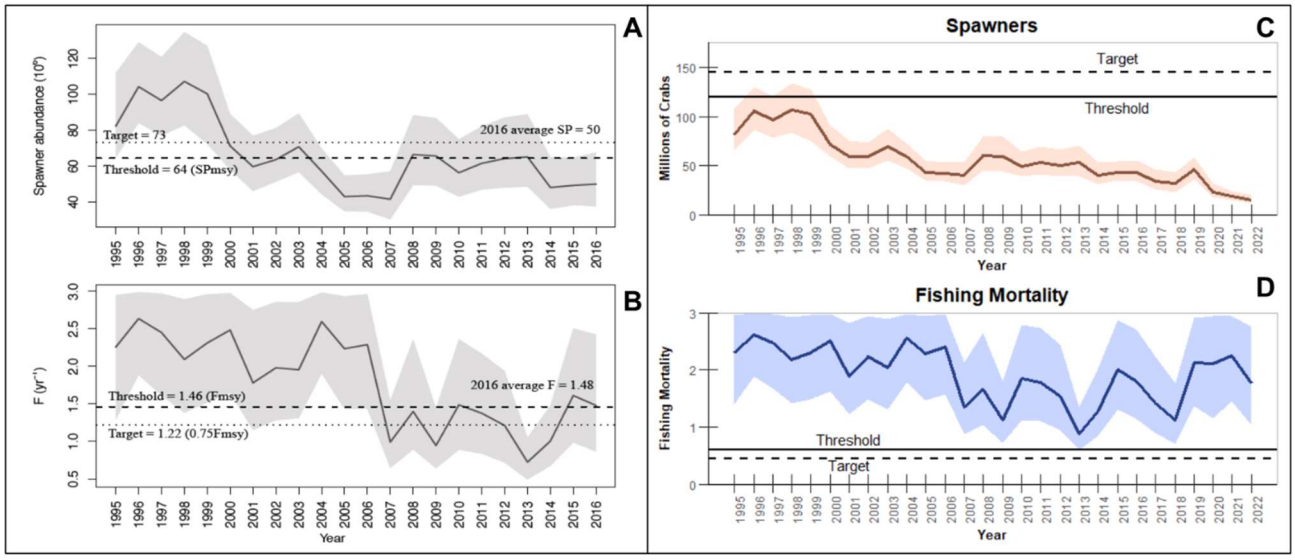


Figure 2. Annual estimates of (A) mature female spawner abundance and (B) fishing mortality relative to associated reference points from the 2018 benchmark stock assessment. Annual estimates of (C) mature female spawner abundance and (D) fishing mortality relative to associated reference points from the 2023 stock assessment update.

Due to the magnitude of the change in reference points, an external review of the assessment update was completed in late December 2023. Reviewers identified concerns with model specifications and results and strongly recommended resolving these issues before basing any management decisions solely on the assessment update. Suggestions provided by reviewers can only be incorporated with a new benchmark stock assessment. Given concerns with the assessment update identified by the DMF and external peer reviewers, the DMF does not recommend using results of the 2023 stock assessment update to inform management. Recommending against using the stock assessment update for management purposes does not invalidate the benchmark stock assessment or the data sources used in the model.

Declines in the North Carolina blue crab stock are not unique, as blue crab stocks in other Atlantic coast states have declined similarly. In January 2023 the South Carolina Department of Natural Resources released a status report for the South Carolina blue crab fishery. The report concluded the South Carolina blue crab stock has been in decline for nearly two decades and provided recommendations to prevent overharvesting, gradually reduce fishing pressure, prevent overexploitation, and strengthen enforcement capabilities. Concerns for the Chesapeake Bay blue crab stock have also persisted. While the Chesapeake Bay blue crab stock is not depleted and overfishing is not occurring, juvenile abundance remains low. Precautionary management, focusing on protecting mature females and juveniles, has been recommended for the Chesapeake Bay stock and a benchmark stock assessment has been started to better understand the population.

## Management Measures and Preliminary Recommendations

**Size limits** are used to rebuild or protect a portion of the spawning stock. Currently, male and mature female hard crabs are subject to a 5-inch minimum carapace width (CW) statewide (harvest of immature females is prohibited).

Because a minimum size limit is already in place for blue crabs, and because achieving necessary harvest reductions through size limit changes alone is unlikely, management options for increasing the minimum size limit or establishing a maximum size limit were not developed.

**Prohibiting Crab Trawling** prevents harvest from a gear that primarily harvests female crabs prior to the spawning season. Most crab trawl harvest occurs from December through April and is highly variable from year to year. Due to location and time of year crab trawls operate, most crabs harvested by crab trawls are females of lower market value that are caught just prior to spawning. Even at its peak, crab trawls accounted for a small percentage of overall blue crab landings. For example, in 2023 crab trawls accounted for 0.6% of all hard blue crab landings. There is often conflict between the crab trawl and crab pot fisheries and while the crab trawl fishery does not currently have a lot of participants, further growth of this fishery may be detrimental to the crab stock.

**Seasonal Closures** can be used to reduce overall harvest by restricting harvest during specific times of the year. Amendment 3 implemented a January 1–31 closure in areas north of the Highway 58 bridge to Emerald Isle and a March 1–15 closure in areas south of the Highway 58 bridge to Emeral Isle.

**Life Stage Closures and Limits** are used to limit harvest of specific life stages (e.g., immature females, sponge crabs, etc.). Amendment 3 maintained the prohibition on harvest of immature female hard blue crabs and harvest of dark sponge crabs from April 1–30. The intent of prohibiting harvest of immature female blue crabs is to allow immature females the opportunity to mature and spawn before being subject to harvest. Prioritizing the reproductive potential of female crabs through life-stage closures serves as a proactive investment to the sustainability of the blue crab population. This strategy not only fosters increased abundance within the crab population but likely contributes to higher recruitment.

**Trip or Bushel Limits** limit catch while continuing to allow harvest opportunities. Maryland and Virginia each manage blue crab harvest with some form of a trip limit in combination with other measures.

**Preliminary Recommendations**

Current management of the North Carolina blue crab fishery recognizes the conservation value of protecting mature female crabs by prohibiting harvest of dark sponge crabs from April 1–30 and by establishing crab spawning sanctuaries (CSS) at all coastal inlets. The purpose of the CSS is to protect mature females in these areas prior to and during the spawning season, though sanctuary size and other factors limit their effectiveness. Season closures and life stage harvest limits can be used to enhance the effectiveness of the existing CSS by providing broader protections.

The comprehensive blue crab management program in Chesapeake Bay prioritizes protection of mature female blue crabs. Virginia has implemented extensive blue crab spawning sanctuaries where the harvest of blue crab is seasonally prohibited, and Maryland has implemented seasonal bushel limits for mature female crabs. Preferentially protecting mature female blue crabs in the Chesapeake Bay, allowed for recovery of the blue crab stock from low levels in the 2000s while allowing for consistent commercial harvest. While the Chesapeake Bay blue crab stock has declined recently, it is not depleted and overfishing is not occurring, though continued protection of mature females as well as immature blue crabs has been recommended.

Given these considerations, initial management options focus on limiting harvest of blue crabs during biologically important times of year (e.g., mating and spawning seasons), and specifically limiting harvest of mature females. Initial management options only included those projected to rebuild spawner abundance to a higher level with a much higher probability of success (Table 1).

**Options 1, 2, and 3** implement 10-, 15-, or 20-bushel limits on all hard blue crabs year-round (**Option 1**), from September-December (**Option 2**), or from September–November (**Option 3**; Table 2a). **Option 3** implements seasonal bushel limits in combination with statewide season closures.

**Option 4** implements a 10-, 15-, or 20-bushel limit on mature female blue crabs from September–October, a five-bushel limit on mature female mature female crabs from November–December, and no harvest of mature female blue crabs from January–May (Table 2b). **Option 5** is the same as **Option 4** but extends the period for no harvest of mature female crabs from January–May. **Option 6** implements a 10-, 15-, or 20-bushel limit on mature female blue crabs from September–November, a complete closure for all blue crabs from December–January and no harvest of mature female crabs from February–May. **Option 7** implements a 10-, 15-, or 20-bushel limit on mature female crabs from September–December and prohibits harvest of mature female crabs from January–May. **Option 8** is the same as **Option 7** but implements the 10-, 15-, or 20-bushel limit on mature female crabs from June–December.

In consideration of blue crab life history and blue crab fishery characteristics, the preliminary DMF recommendation presented to the Advisory Committees in March 2025 was Option 8.a, 10-bushel limit for mature female blue crabs from June–December and no harvest of mature female blue crabs from January–May (Table 2b). The DMF also preliminarily recommended maintaining existing season closures and all other blue crab management measures currently in place. In combination, these management measures would effectively reduce harvest by an estimated 21.7 percent compared to average landings from 2019–2023, increase the spawning stock biomass, and promote increased recruitment.

Table 2a. Season closure and trip limit management options. Unless stated otherwise all options are in addition to existing management including existing season closures. Estimated harvest reductions are calculated from 2016, 2023, and 2019–2023 commercial hard blue crab landings.

| Option # | Measures | 2016 | 2023 | 2019–2023 |
|---|---|---|---|---|
| 1 | a. 10-bushel hard crab trip limit year-round | 48.3 | 51.6 | 45.6 |
| | b. 15-bushel hard crab trip limit year-round | 34.5 | 38.3 | 31.9 |
| | c. 20-bushel hard crab trip limit year-round | 25.2 | 28.5 | 22.6 |
| 2 | a. 10-bushel hard crab trip limit Sept–Dec | 25.1 | 32.0 | 21.6 |
| | b. 15-bushel hard crab trip limit Sept–Dec | 20.4 | 25.2 | 16.4 |
| | c. 20-bushel hard crab trip limit Sept–Dec | 16.6 | 19.7 | 12.4 |
| 3 | a. 10-bushel hard crab trip limit Sept–Nov, closed Dec–Mar | 32.8 | 36.3 | 27.0 |
| | b. 15-bushel hard crab trip limit Sept–Nov, closed Dec–Mar | 28.5 | 30.2 | 22.3 |
| | c. 20-bushel hard crab trip limit Sept–Nov, closed Dec–Mar | 25 | 25.2 | 18.6 |
| | d. 10-bushel hard crab trip limit Sept–Nov, closed Dec–Jan | 27.4 | 34.5 | 24.0 |
| | e. 15-bushel hard crab trip limit Sept–Nov, closed Dec–Jan | 23.1 | 28.4 | 19.3 |
| | f. 20-bushel hard crab trip limit Sept–Nov, closed Dec–Jan | 19.6 | 23.4 | 15.6 |

Table 2b. Mature female season closure and trip limits management options. Unless stated otherwise all options are in addition to existing management including existing season closures. Estimated harvest reductions are calculated from 2016, 2023, and 2019–2023 commercial hard blue crab landings.

| Option # | Measures | 2016 | 2023 | 2019–2023 |
|---|---|---|---|---|
| 4 | a. 10-bushel mature females Sept–Oct, 5-bushel mature females Nov–Dec, no mature females Jan–Mar | 17.5 | 19.4 | 14.4 |
| | b. 15-bushel mature females Sept–Oct, 5-bushel mature females Nov–Dec, no mature females Jan–Mar | 15.7 | 16.9 | 12.3 |
| | c. 20-bushel mature females Sept–Oct, 5-bushel mature females Nov–Dec, no mature females Jan–Mar | 14.3 | 15.1 | 10.9 |
| 5 | a. 10-bushel mature females Sept–Oct, 5-bushel mature females Nov–Dec, no mature females Jan–May | 22.1 | 21.8 | 18.8 |
| | b. 15-bushel mature females Sept–Oct, 5-bushel mature females Nov–Dec, no mature females Jan–May | 20.2 | 19.2 | 16.7 |
| | c. 20-bushel mature females Sept–Oct, 5-bushel mature females Nov–Dec, no mature females Jan–May | 18.9 | 17.5 | 15.3 |
| 6 | a. 10-bushel hard crabs limit Sept–Nov, complete closure Dec–Jan, no mature females Feb–May | 34.8 | 37.8 | 29.9 |
| | b. 15-bushel hard crabs limit Sept–Nov, complete closure Dec–Jan, no mature females Feb–May | 30.3 | 31.6 | 24.2 |
| | c. 20-bushel hard crabs limit Sept–Nov, complete closure Dec–Jan, no mature females Feb–May | 26.7 | 26.4 | 19.8 |
| 7 | a. 10-bushel mature females Sept–Dec, no mature females Jan–May | 20.6 | 19.4 | 17.1 |
| | b. 15-bushel mature females Sept–Dec, no mature females Jan–May | 17.6 | 15.1 | 13.9 |
| | c. 20-bushel mature females Sept–Dec, no mature females Jan–May | 15.3 | 12.0 | 11.6 |
| 8 | a. 10-bushel mature females June–Dec , no mature females Jan–May* | 25.0 | 23.1 | 21.7 |
| | b. 15-bushel mature females June–Dec, no mature females Jan–May | 19.8 | 17.2 | 16.4 |
| | c. 20-bushel mature females June–Dec, no mature females Jan–May | 16.5 | 13.2 | 13.0 |

* Division preliminary recommendation presented to the MFC Advisory Committees (Northern, Southern, Shellfish/Crustacean) in March 2025

## Advisory Committee Review

The Amendment 3 adaptive management framework requires "consultation" with the Northern, Southern, and Shellfish/Crustacean advisory committees before management changes can be approved by the MFC. To fulfill the "consultation" requirement, the advisory committees met the week of March 18–20, 2025 to discuss adaptive management and provide recommendations. DMF staff provided background information and the preliminary DMF recommendation. In addition, DMF staff were available prior to each meeting to answer questions and discuss blue crab science and management with the public.

Key takeaways from all meetings included:

- Concern about the economic impact of the preliminary DMF recommendation
- Concern about how the preliminary recommendation would disproportionately impact certain fishery segments and areas and the need for fair management between regions
- Distrust of stock assessment results and data
- Concern about the effects of water quality and predation on the blue crab stock
- Questions about authority to make management changes without an updated stock assessment
- Landings declines are the result of market conditions and participation declines, not a declining blue crab stock
- The need for cooperation with industry for data collection and formulating management
- Some acknowledgement the stock has declined since the 1990s even if it is not because of fishing
- Some concern about long-term declining trends

**Advisory Committee Recommendations**

Northern

Motion for the Marine Fisheries Commission to not take final action on Blue Crab Amendment 3 Adaptive Management until August 2025, instead of May 2023 (motion passes 10-0)

Motion for the Marine Fisheries Commission to remain status quo regarding the Blue Crab FMP Amendment 3 Adaptive Management (motion passes 7-2, with 1 abstention)

Southern

Motion to recommend the Marine Fisheries Commission to remain status quo regarding Blue Crab FMP Amendment 3 Adaptive Management and to move the Marine Fisheries Commission action on Blue Crab to the August 2025 meeting (motion passes 6-1, with 1 abstention)

Shellfish/Crustacean

Motion for the Marine Fisheries Commission to not take final action on Blue Crab Amendment 3 Adaptive Management until August 2025, instead of May 2025 (motion passes, 5-0, with 2 abstentions)

Motion to recommend to the Marine Fisheries Commission to remain status quo regarding Blue Crab FMP Amendment 3 (motion passes 4-0, with 3 abstentions)

## Amendment 3 Adaptive Management Next Steps and Timeline

Amendment 3 is nearly halfway through the required rebuilding timeline and while an updated stock assessment is not currently available to inform stock status, there is little evidence suggesting overfishing has ended or Amendment 3 sustainability objectives will be met. Because there are strong indicators the stock is not recovering, the **DMF remains concerned about the blue crab stock.** However, in consideration of advisory committee input the DMF intends to:

**Bring adaptive management options to the MFC for final action in November 2025**

Final MFC adaptive management action will occur in November 2025. Prior to the November meeting, the DMF will consider advisory committee input, re-evaluate preliminary recommendations and continue to explore additional options. At the November 2025 meeting, DMF will present additional options accounting for public and advisory committee input.

**Prioritize completing assessing the stock**

Potential avenues for assessing the stock have been explored but there is no anticipated completion date at this time. With the declining trends in all data sources, there is potential a new assessment will not show stock recovery and may indicate the stock requires significant harvest reductions for recovery.

The updated timeline for revision development is:

| | |
|---|---|
| May 2024 | DMF presents results of stock assessment update and adaptive management plan to MFC |
| May 2024 – August 2024 | Outreach and analysis |
| September 2024 | DMF updates Northern, Southern, and Shellfish/Crustacean advisory committees |
| September 2024 – December 2024 | Additional outreach and analysis. DMF drafts Revision to Amendment 3 |
| March 2025 | MFC AC (Northern, Southern, Shellfish/Crustacean) review draft |
| May 2025 | DMF updates MFC on advisory committee recommendations and next steps |
| **You Are Here** August 2025 | DMF provides update to MFC – **NO ACTION** |
| November 2025 | MFC scheduled to vote on adoption of Amendment 3 Revision |

*Gray indicates a step is complete.

NC Marine Fisheries Commission

# Southern Flounder Fishery Management Plan

**August 2025 Quarterly Business Meeting**

## Documents

Southern Flounder FMP Amendment 4 Memo

Draft Southern Flounder FMP Amendment 4

JOSH STEIN
Governor

D. REID WILSON
Secretary

KATHY B. RAWLS
Director

August 2, 2025

**MEMORANDUM**

**TO:** North Carolina Marine Fisheries Commission

**FROM:** Jeffrey Dobbs, Fishery Management Plan Coordinator
Anne Markwith, Southern Flounder Co-Lead
Holly White, Southern Flounder Co-Lead

**SUBJECT:** Amendment 4 to the Southern Flounder Fishery Management Plan

**Issue**
Vote on final adoption of Amendment 4 to the Southern Flounder Fishery Management Plan (FMP).

**Supporting Documents**
- Draft Amendment 4 to the Southern Flounder FMP

**Action**
Vote on final adoption of Amendment 4 to the Southern Flounder FMP.

**Background**
At their August 2024 business meeting the North Carolina Marine Fisheries Commission (MFC) passed a motion "*to ask the DMF Director to ask the DEQ Secretary to modify the Annual FMP Review Schedule to amend the Southern Flounder FMP for the review of the plan to begin in 2024. The intent is to allow for more recreational access while maintaining the rebuilding requirements of Amendment 3*". The Secretary approved this schedule change along with a request from the DMF to begin concurrent development of Amendment 5 to explore long-term solutions to the issue of recreational access while maintaining Amendment 3 rebuilding requirements. The primary purpose of Amendment 4 is to immediately address the August 2024 MFC motion by implementing the 50/50 sector allocation in 2025, instead of in 2026 as prescribed in Amendment 3 (Table 1). All other management measures from Amendment 3 are carried forward in Amendment 4. Expediting the shift to 50/50 reduces the possibility of recreational catch overages that may mitigate the need for future season closures, as the allocation shift will provide an additional buffer for catch. The shift in allocation will not increase the length of the recreational season.

**Table 1.** Amendment 3 annual allocations, in pounds, for the Southern Flounder commercial and recreational fisheries and associated sub-allocations for each sector that maintains a 72% overall reduction and the current pound net sub-allocation. An asterisk (*) indicates catch from Recreational Commercial Gear License holders is not included in the Total Allowable Landings.

| | | | | | Commercial Fisheries | | | Recreational Fisheries* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Allocation | Total Allowable Catch | Dead Discards | Total Allowable Landings | Total Allowable Commercial Landings | Mobile Gears | Pound Nets | Total Allowable Recreational Landings | Hook and Line | Gigs |
| 2021 | 70/30 | 548,034 | 15,682 | 532,352 | 372,646 | 186,188 | 186,458 | 159,706 | 142,206 | 17,500 |
| 2022 | 70/30 | 548,034 | 15,682 | 532,352 | 372,646 | 186,188 | 186,458 | 159,706 | 142,206 | 17,500 |
| 2023 | 70/30 | 548,034 | 15,682 | 532,352 | 372,646 | 186,188 | 186,458 | 159,706 | 142,206 | 17,500 |
| 2024 | 70/30 | 548,034 | 15,682 | 532,352 | 372,646 | 186,188 | 186,458 | 159,706 | 142,206 | 17,500 |
| 2025 | 60/40 | 548,034 | 15,682 | 532,352 | 319,411 | 132,953 | 186,458 | 212,941 | 189,608 | 23,333 |
| 2026 | 50/50 | 548,034 | 15,682 | 532,352 | 266,176 | 79,718 | 186,458 | 266,176 | 237,010 | 29,166 |

Following an accelerated timeline allows for adoption of Amendment 4 to the Southern Flounder FMP by the MFC in August 2025 (Table 2). If any step in this timeline is not completed as shown, it will result in an implementation date after the allowed window for a recreational season (August 16–September 30).

**Table 2.** Timeline for development and adoption of Amendment 4 to the Southern Flounder FMP.

| Milestones | Completion Date |
|---|---|
| DMF drafts Amendment 4 | October 31–December 20, 2024 |
| Advisory committee review draft Amendment 4 (Finfish AC) | January 27, 2025 |
| MFC approves Amendment 4 for AC review and public comment | March 21–23, 2025 |
| Public and MFC AC review (Northern, Southern, Finfish) | April 1–30, 2025 |
| MFC selects preferred management options | May 21–23, 2025 |
| Legislative review of draft FMP Amendment 4 | June–August, 2025 |
| MFC votes on final adoption of FMP Amendment 4 | August 20–21, 2025 |
| Implement management | August 2025 |

Development and adoption of Amendment 4, as proposed, is a short-term solution to address recreational access. Amendment 5 will explore options beyond an allocation shift to address the long-term management of Southern Flounder.

## Management Options

**Status Quo:** Maintain Amendment 3 allocation transition schedule.

**Expedite Allocation Shift:** Expedite the sector (commercial/recreational) allocation transition to 50/50 in 2025 rather than in 2026 as prescribed in Amendment 3.

## MFC Selected Management

At its May 2025 business meeting, the MFC selected expediting the sector allocation transition to 50/50 in 2025 rather than in 2026 as prescribed in Amendment 3 as their preferred management option for Amendment 4 to the Southern Flounder FMP. The draft FMP was revised to include this selected option and then provided to the Secretary of the North Carolina Department of Environmental Quality. The Secretary submitted the draft FMP to AgNER for their 30-day review period (N.C. General Statute § 113-182.1(e)). No comments were received from AgNER.

**Next Steps**

At the August 2025 business meeting, the MFC will vote on the final adoption of measures for Amendment 4 to the Southern Flounder FMP. After adoption, the DMF will immediately begin implementation of the adopted management measures. Concurrently, the DMF will continue developing the draft of Amendment 5.

June 2025

# North Carolina Southern Flounder Fishery Management Plan Amendment 4

North Carolina Division of Marine Fisheries

North Carolina Department of Environmental Quality
North Carolina Division of Marine Fisheries
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**Disclaimer**: Data in this Fishery Management Plan may have changed since publication based on updates to source documents.

**ACKNOWLEDGMENTS**

Amendment 4 to the North Carolina (NC) Southern Flounder Fishery Management Plan (FMP) was developed by the NC Department of Environmental Quality (NCDEQ), Division of Marine Fisheries (NCDMF) under the auspices of the NC Marine Fisheries Commission (NCMFC) with the advice of the Finfish Advisory Committee acting as the Southern Flounder Advisory Committee (AC). Deserving special recognition are the members of the Finfish AC and the NCDMF Plan Development Team (PDT) who contributed their time and knowledge to this effort.

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The following division staff were also invaluable in assisting with the development of this document and providing administrative support: Barbie Byrd, Daniel Zapf, Jason Rock, Kathy Rawls, Jesse Bissette, Catherine Blum, Deborah Manley, Hope Wade, and Patricia Smith.

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**EXECUTIVE SUMMARY**

The Southern Flounder supports important commercial and recreational fisheries along the U.S. South Atlantic and Gulf coasts and is particularly important to fisheries in North Carolina. Based on tagging, genetic, and age structure morphology data, Southern Flounder that occur in North Carolina are part of the biological unit stock that ranges from North Carolina to the east coast of Florida.

This South Atlantic Southern Flounder stock is overfished, and overfishing is occurring as of 2017, the terminal year of the 2019 coastwide stock assessment update (Flowers et al. 2019). Results indicate that spawning stock biomass (SSB) has decreased since 2006 and recruitment, while variable, has generally declined. Fishing mortality is less variable and decreased slightly in 2017. North Carolina law (G.S. § 113-182.1) requires management action to end overfishing within two years. Recovery of the stock from an overfished condition must occur within 10 years and provide at least a 50% probability of success from the date the plan is adopted.

Amendment 3 to the Southern Flounder Fishery Management Plan was adopted in May 2022 according to G.S. § 113-182.1. Amendment 3 implemented a quota-based approach to reduce North Carolina's portion of the coastwide catch by 72% to rebuild the stock to the SSB target by 2028 (NCDMF 2022). The quota was split between commercial and recreational fishing sectors with an initial split of 70% allocated to the commercial sector and 30% allocated to the recreational sector (70/30). The FMP outlines an allocation transition to 60/40 commercial/recreational in 2025 and 50/50 commercial/recreational in 2026.

At the August 2024 North Carolina Marine Fisheries Commission (NCMFC) business meeting, the NCMFC passed a motion "to ask the DMF Director to ask the DEQ Secretary to modify the Annual FMP Review Schedule to amend the Southern Flounder FMP for the review of the plan to begin in 2024. The intent is to allow for more recreational access while maintaining the rebuilding requirements of Amendment 3".

The goal and objectives of Amendment 4 are unchanged from Amendment 3. To address the August 2024 NCMFC motion Amendment 4, one issue was developed: increasing recreational access to Southern Flounder through sector allocation parity.

Expediting the sector (commercial/recreational) allocation transition to 50/50 (i.e., parity) in 2025 rather than 2026 as prescribed in Amendment 3 immediately addresses recreational access in time for a 2025 recreational season while maintaining Amendment 3 rebuilding requirements. Under the Amendment 3 allocation shift schedule to 60/40 in 2025, there would likely be a short recreational season in 2025. Expediting the shift to 50/50 in 2025 reduces the possibility of recreational catch overages that may mitigate the need for future season closures, though may not increase the length of the recreational season. Maintaining Amendment 3 rebuilding requirements does not provide substantial harvest opportunities for any fishing sector regardless of allocation. This allocation shift is a short-term approach to address recreational access. Long-term, more comprehensive approaches for recreational and commercial fisheries management will be addressed

during subsequent development of Amendment 5. For Amendment 4, the NCMFC selected the following management option at its March 2025 business meeting:

- Expedite the sector (commercial/recreational) allocation transition to 50/50 in 2025 rather than in 2026 as prescribed in Amendment 3.

Additionally, the following management measures from Amendment 3 are carried forward into Amendment 4:

- A commercial and recreational minimum size limit of 15 inches TL;
- A minimum mesh size of 6.0-inch stretched mesh (ISM) for anchored large-mesh gill nets used in the taking of flounder;
- A minimum mesh size of 5.75-ISM for pound net escape panels;
- Reduced commercial anchored large-mesh gill-net soak times to single overnight soaks where nets may be set no sooner than one hour before sunset and must be retrieved no later than one hour after sunrise the next morning;
- For anchored large-mesh gill nets with a 4.0 through 6.5 ISM, maintain a maximum of 1,500-yards in Management Units A, B, and C and a maximum of 750-yards in Management Units D1, D2, and E unless more restrictive yardage is specified through adaptive management or through the sea turtle or sturgeon Incidental Take Permit (ITP);
- Removal of all commercial gears targeting Southern Flounder from the water (e.g., commercial and RCGL anchored large-mesh gill nets and gigs) or make them inoperable (flounder pound nets) in areas and during times outside of an open season with exceptions for commercial large-mesh gill-net fisheries that target American shad (*Alosa sapidissima*), hickory shad (*A. mediocris*) and catfish species if these fisheries are only allowed to operate during times of the year and locations where bycatch of Southern Flounder is unlikely.
- Unlawful to use any method of retrieving live flounder from pound nets that causes injury to released fish (e.g., picks, gigs, spears, etc.);
- Unlawful for commercial fishery to possess any species of flounder harvested from the internal waters of the state during the closed Southern Flounder season;
- Combine mobile gears (gill nets, gigs, and “other” gears) into one gear category and maintain pound nets as their own separate commercial fishery;
- Divide mobile gears into two areas using the ITP boundary line for management sub-units Northern D1 and Southern D1, maintaining consistency with Amendment 2 and Amendment 3 boundary line;
- Divide the pound net fishery into three areas maintaining consistency with areas in Amendment 2 and 3;
- Maintain 72% reduction and current sub-allocation for the pound net fishery.
- Implement trip limits for pound nets, gigs, and hook and line only to maximize reopening after reaching division closure threshold;
- Implement a single season for the recreational gig and hook-and-line fisheries to constrain them to an annual quota;
- Maintain the recreational bag limit of flounder at one fish per person per day;
- Do not allow harvest of Southern Flounder using RCGL;

- Should landings be available, allow potential for spring ocellated flounder season to occur from March 1-April 1 in ocean waters only using hook-and-line gear with one-fish ocellated only bag limit;
- Maintain the adaptive management framework based on the peer-reviewed and approved stock assessment

## INTRODUCTION

This is Amendment 4 to the Southern Flounder Fishery Management Plan (FMP). By law, each FMP must be reviewed at least once every five years (G.S. 113-182.1). The NC Division of Marine Fisheries (NCDMF) reviews each FMP annually and a comprehensive review is undertaken about every five years. The last comprehensive review of the plan was approved by the NC Marine Fisheries Commission (NCMFC) in 2022. FMPs are the ultimate product that brings all information and management considerations into one document. The NCDMF prepares FMPs for all commercially and recreationally significant species or fisheries that comprise state marine or estuarine resources adopted by the NC Marine Fisheries Commission (NCMFC). The goal of these plans is to ensure long-term viability of these fisheries. All management authority for the North Carolina Southern Flounder fishery is vested in the State of North Carolina. The NCMFC adopts rules and policies and implements management measures for the Southern Flounder fishery in Coastal Fishing Waters in accordance with 113-182.1. Until Amendment 4 is approved for management, Southern Flounder are managed under Amendment 3 (NCDMF 2022).

### Fishery Management Plan History

| | | |
|---|---|---|
| Original FMP Adoption: | February 2005 | |
| Amendments: | Amendment 1 | February 2013 |
| | Amendment 2 | August 2019 |
| | Amendment 3 | May 2022 |
| Revisions: | None | |
| Supplements: | Supplement A to the FMP | February 2011 |
| | Supplement A to Amendment 1 | August 2017 |
| Information Updates: | None | |
| Schedule Changes: | Scheduled review was moved up from 2027 to begin concurrent development of Amendments 4 and 5 in 2024 | |

*Past versions of the Southern Flounder FMP (NCDMF 2005, 2011, 2013, 2017, 2019, 2022) are available on the NCDMF website.*

### Management Unit

The management unit of this FMP includes all Southern Flounder inhabiting North Carolina coastal and joint fishing waters including the Atlantic Ocean.

### Goal and Objectives

The goal of Amendment 4 is to manage the Southern Flounder fishery to achieve a self-sustaining population that provides sustainable harvest using science-based decision-making processes. The following objectives will be used to achieve this goal:

- Implement management strategies within North Carolina and encourage interjurisdictional management strategies that maintain/restore the Southern

Flounder spawning stock with expansion of age structure of the stock and adequate abundance to prevent overfishing.

- Restore, enhance, and protect habitat and environmental quality necessary to maintain or increase growth, survival, and reproduction of the Southern Flounder population.
- Use biological, environmental, habitat, fishery, social, and economic data needed to effectively monitor and manage the Southern Flounder fishery and its ecosystem impacts.
- Promote stewardship of the resource through increased public outreach and interjurisdictional cooperation throughout the species range regarding the status and management of the Southern Flounder fishery, including practices that minimize bycatch and discard mortality.
- Promote the restoration, enhancement, and protection of habitat and environmental quality in a manner consistent with the Coastal Habitat Protection Plan.

## DESCRIPTION OF THE STOCK

### Biological Profile

The Southern Flounder (*Paralichthys lethostigma)* is a bottom dwelling species of left eyed flounder found in the Atlantic Ocean, Gulf of Mexico, and estuaries from Virginia to northern Mexico (Blandon et al. 2001). This species is one of three commonly caught left eyed flounder in North Carolina; Southern Flounder, Gulf Flounder (*P. albigutta*), and Summer Flounder (*P. dentatus*). Southern Flounder supports important commercial and recreational fisheries along the U.S. South Atlantic and Gulf coasts and is particularly important to fisheries in North Carolina. Based on tagging, genetic, and age structure morphology data, Southern Flounder that occur in North Carolina are part of the biological unit stock that ranges from North Carolina to the east coast of Florida. Evidence also suggests some adult Southern Flounder return to the estuaries after spawning in the ocean, while others remain in the ocean (Watterson and Alexander 2004; Taylor et al. 2008; NCDMF 2024a). Tagged fish are typically recaptured south of original tagging locations and often in other states once in the ocean (Craig et al. 2015; Loeffler et al. 2019). Limited data from South Carolina and Georgia tagging programs suggest a low probability of adult movement from South Carolina or Georgia to North Carolina waters (Wenner et al. 1990; SCDNR Inshore Fisheries Section, unpublished data; Flowers et al. 2019).

NCDMF data indicates with the onset of maturity in the fall, females migrate to ocean waters to spawn. Spawning locations in the Atlantic Ocean are unknown; however, Benson (1982) observed the pelagic larval stage over the continental shelf where spawning is reported to occur. Data from satellite tagged Southern Flounder indicate a potential suite of migratory behaviors and habitat uses ranging from inshore estuarine environments to offshore outer continental shelf habitats (NCDMF 2024a). Southern Flounder can produce approximately 3 million eggs per female during multiple spawning events in a season, and spawning is thought to take place between November and April (Gunther 1945; Hettler and Barker 1993; Watanabe et al. 2001; Midway and Scharf 2012;

Hollensead 2018). Larval Southern Flounder pass through inlets within 30 to 45 days of hatching and settle throughout the sounds and rivers in the winter and early spring (Burke et al. 1991; Miller et al. 1991; Daniels 2000; Glass et al. 2008; Taylor et al. 2010; Lowe et al. 2011). Juveniles likely spend at least one year in inshore waters before migrating to the ocean (McKenna and Camp 1992; Hannah and Hannah 2000; Watterson and Alexander 2004; Taylor et al. 2008).

Nearly half of female Southern Flounder are mature by ages 1 and 2 (at approximately 16 inches TL; Monaghan, Jr. and Armstrong 2000; Midway and Scharf 2012). Females grow larger than males and Southern Flounder collected in the ocean tend to be larger and older than fish caught in estuarine waters. The largest female Southern Flounder observed in North Carolina was 33-inches TL and the largest male was 20-inches TL (Lee et al. 2018; Flowers et al. 2019; Schlick et al. 2024). The maximum observed age was 9 years for females and 6 years for males. Southern Flounder captured in North Carolina represent the oldest ages observed throughout the range (Lee et al. 2018; Flowers et al. 2019; Schlick et al. 2024).

For additional information about Southern Flounder life history and biology see NCDMF (2019) and NCDMF (2022).

**Assessment Methodology**

For additional assessment history see Lee et al. (2018) and Flowers et al. (2019).

Commercial and recreational landings and dead discards and data from eight fishery-independent surveys, were incorporated from all states across the biological unit stock (North Carolina south to the east coast of Florida). When considering population size and long-term viability, stock assessments most often use a measure of female spawning stock biomass (SSB) to determine the population's health. Female SSB includes mature female fish capable of producing offspring. Fishing mortality ($F$) is a measure of how fast fish are removed from the population by fishing activities. Removals include fish that are kept, discarded dead, or die after release.

The stock assessment estimates of female SSB and $F$ were compared to levels, or reference points, that are considered sustainable. Reference points include a target and threshold. The threshold is the minimum level required for sustainability and when that level is achieved, the stock is considered healthy. The target is a level that minimizes risk and increases the probability of rebuilding or maintaining the stock. If female SSB is less than the biomass threshold ($SSB_{25\%}$), the stock is overfished. If the harvest rate is greater than the $F$ threshold ($F_{25\%}$), the rate of removals is too high, and overfishing is occurring. Overfishing is the removal of fish at an unsustainable rate that will ultimately reduce female SSB and result in an overfished stock.

**Stock Status**

The South Atlantic Southern Flounder stock is overfished, and overfishing is occurring as of 2017, the terminal year of the 2019 coastwide stock assessment update (Flowers et al.

2019). Results indicate SSB has decreased since 2006 and recruitment, while variable, has generally declined. Fishing mortality is less variable and decreased slightly in 2017.

The model estimated a value of 0.35 for $F_{35\%}$ (*F* target) and a value of 0.53 for $F_{25\%}$ (*F* threshold). The estimate of $SSB_{35\%}$ (target) was 5,452 metric tons and the estimate of $SSB_{25\%}$ (threshold) was 3,900 metric tons.

The female SSB that represents the minimum level of sustainability for Southern Flounder was estimated at 8.6 million pounds. The stock assessment estimate of female SSB in 2017 was 2.3 million pounds (Figure 1). Because the 2017 estimate of female SSB is below the threshold reference point, the stock is considered overfished. The probability the 2017 estimate of SSB is below the threshold is 100%.

The assessment model estimated the *F* threshold at 0.53 (Figure 2). The 2017 *F* estimate was 0.91, which is above the *F* threshold. Because the 2017 *F* estimate is above the threshold, overfishing is occurring. The probability the 2017 *F* estimate is above the threshold is 96%. For additional information about the 2019 coastwide stock assessment see NCDMF (2019).

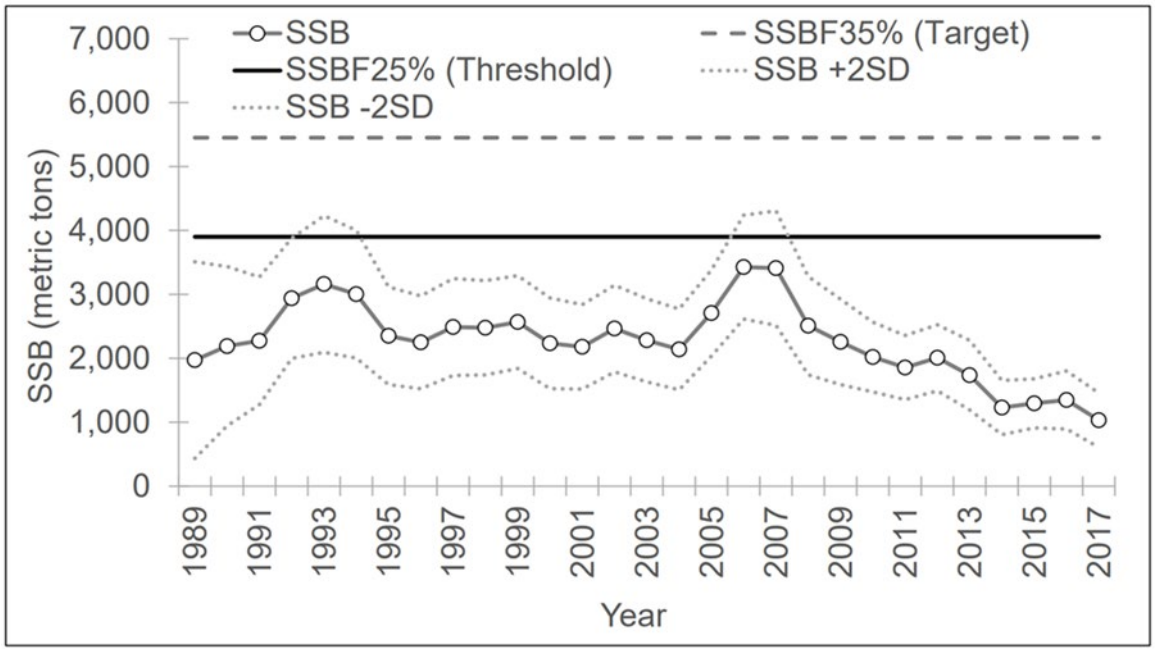



Figure 1. Estimated spawning stock biomass (SSB) compared to established reference points, 1989–2017 (Flowers et al. 2019).

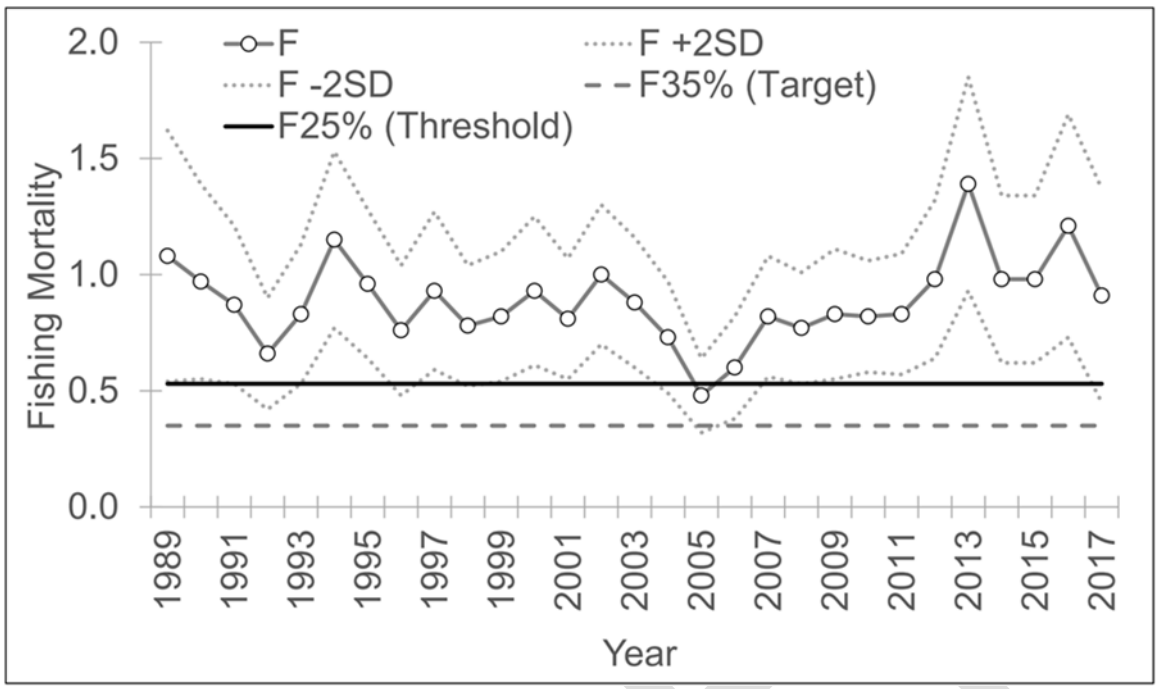



Figure 2. Estimated fishing mortality rates (numbers-weighted, ages 2-4) compared to established reference points, 1989–2017 (Flowers et al. 2019).

A second update to the ASAP model, with data through 2022, was completed in 2024. The update continued to show declining trends in SSB and recruitment since 2006; however, *F* decreased significantly in the last two years of the assessment (Schlick et al. 2024). Several trends and diagnostics from the model raised concerns, and division staff and partners from the other states decided to not use the new update for management. A new benchmark assessment is recommended no sooner than 2026.

**DESCRIPTION OF THE FISHERY**

Additional in-depth analyses and discussion of North Carolina's historical commercial and recreational Southern Flounder fisheries can be found in previous versions of the Southern Flounder FMP (NCDMF 2005, NCDMF 2019, NCDMF 2022). Commercial and recreational landings can be found in the License and Statistics Annual Report (NCDMF 2024b).

Discussion of socio-economic information in the License and Statistics Annual Report describes the fishery as of 2023 and is not intended to be used to predict potential impacts from management changes. This and other information are legislatively mandated and included to help inform decision-making regarding the long-term viability of the state's commercial and recreationally significant species and fisheries. For a detailed explanation of methodology used to estimate economic impacts, refer to the License and Statistics Section Annual Report (NCDMF 2023).

For additional discussion of commercial and recreational Southern Flounder fishery landings trends see Appendix 1: Increasing Recreational Access to Southern Flounder Through Sector Allocation Parity.

**Commercial Fishery**

All flounder landings reported as caught in inshore waters are considered Southern Flounder by the NCDMF Trip Ticket Program. Data from fishery-dependent sampling indicate Summer Flounder and Gulf Flounder account for approximately two percent or less of the flounder harvested from internal waters, while Southern Flounder make up less than one percent of the catch from ocean waters (NCDMF, unpublished data).

Most Southern Flounder commercial landings are from gill nets and pound nets, although gigs and other inshore gears (e.g., trawls) land flounder in smaller numbers. Between 1972 and 2022, peak commercial landings occurred in 1994 (Figure 3). Over this timeframe, there have been fluctuations in whether pound nets or gill nets were the dominant gear in terms of pounds landed (Figure 3). Historically, pound nets were the dominant gear, but gill nets became the dominant gear from 1994 to 2013 (Figure 3). The dominant gear switched back to pound nets from 2014 through 2020. Declining landings trends since 2010 were due, in part, to gill net regulations implemented to reduce the number of sea turtle and Atlantic Sturgeon interactions in this gear (78 FR 57132[1], 79 FR 43716[2]). Though less harvest overall comes from the gig fishery, harvest from this gear has generally increased over time, especially since 2010. Harvest by other commercial inshore gears decreased to its lowest point in 2023.



[1] https://www.federalregister.gov/documents/2013/09/17/2013-22592/endangered-species-file-no-16230
[2] https://www.federalregister.gov/documents/2014/07/28/2014-17645/endangered-species-file-no-18102

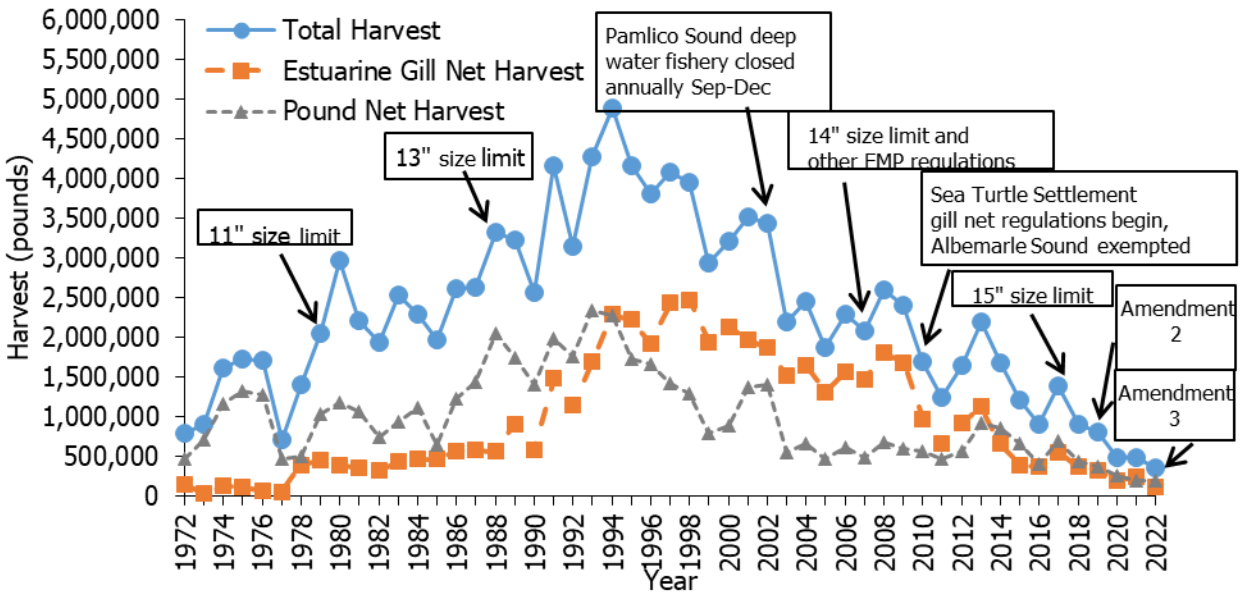



Figure 3. Southern Flounder commercial fishery landings (pounds) and landings from the top two gears (gill nets and pound nets) from the NC Trip Ticket Program, 1972–2023, with major fishery regulation changes noted. Noted regulation changes do not represent a comprehensive list. For additional regulation changes see Lee et al. (2018).

Commercial harvest from 2019 to 2023 was impacted by regulations implemented through Amendments 2 and 3 to the NC Southern Flounder FMP. Amendment 2 implemented seasons in the commercial Southern Flounder fishery for the first time, and Amendment 3 introduced quota management of the fishery. Under Amendment 2, the commercial fishing season was open for a maximum of 33 days in 2020 (Proclamation FF-25-2020) and 21 days in 2021 (Proclamation FF-40-2021) depending on management area. Under Amendment 3 the commercial fishery was separated into two mobile gear management areas (northern and southern) and three-pound net management areas. During 2022–2024, the commercial fishery was open between six and 28 days, depending on management area and gear type. For mobile gears, however, gill nets were not necessarily open all of those days.

Table 1. Number of days the Southern Flounder commercial fishery was open in 2022–2024 by gear type and management area: mobile gear, northern and southern management areas; pound nets, northern, central, and southern management areas.

| | Mobile Gear | | Pound Nets | | |
|---|---|---|---|---|---|
| | Northern | Southern | Northern | Central | Southern |
| Year | Days open | Days open | Days open | Days open | Days open |
| 2022 | 28 | 11 | 23 | 21 | 6 |
| 2023 | 21 | 21 | 21 | 24 | 8 |
| 2024 | 11 | 10 | 28 | 19 | 12 |

Trends in commercial trips reported between 1994 and 2023 have generally followed landings trends (Figure 4). Trips include the number of trip ticket records with landings reported; some trips may represent more than one day of fishing. The number of trips for all gears targeting Southern Flounder has decreased since regulatory changes due to Amendment 2 (seasonal management) and Amendment 3 (quota management) were implemented limiting the number of days flounder could be harvested.

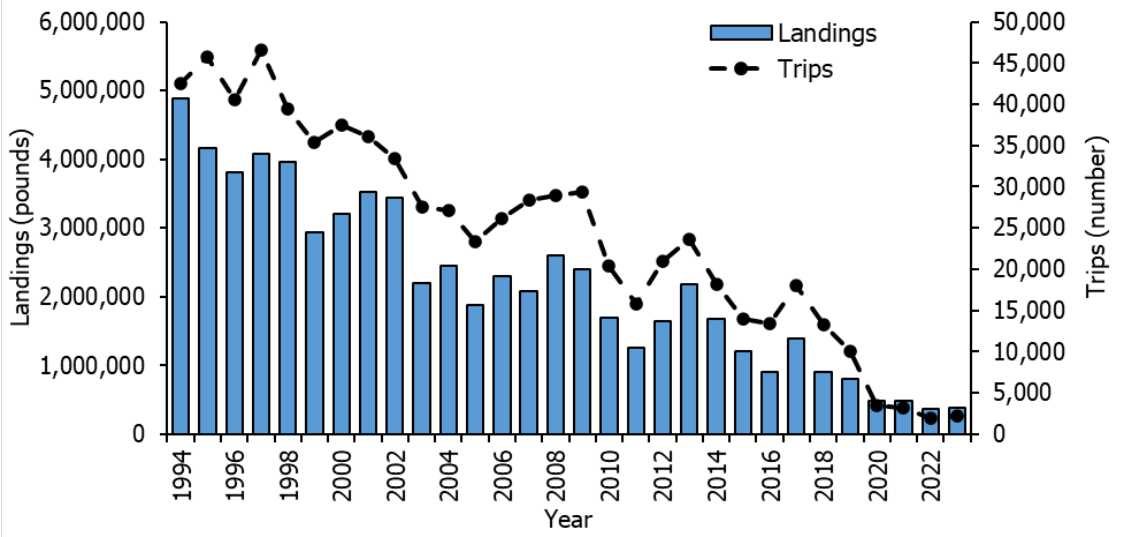



Figure 4. Southern Flounder commercial trips (numbers) and landings (pounds) from NC Trip Ticket Program, 1994–2023.

## Recreational Fishery

Recreational harvest of Southern Flounder is mainly by hook-and-line and gigs, with a small amount of harvest by spearfishing or Recreational Commercial Gear License (RCGL) gears (prior to 2022).

Hook-and-line harvest can be split into ocean and inshore harvest, with most Southern Flounder harvested inshore. Between 1989 and 2023, hook-and-line harvest peaked in 2010 (Figure 5). Seasonal closures implemented through Amendment 2 to the NC Southern Flounder FMP impacted recreational harvest in 2020 and 2021. The season was shortened from 45 days in 2020 to 14 consecutive days in 2021 due to excessive overages that occurred during the 2020 season. Amendment 3 implemented fishing seasons to maintain recreational harvest within a quota and added paybacks to the following year for overages. The season in 2022 was 30 days and the 2023 season was shortened to 14 days. Due to overages in 2022, the 2023 TAC (landings plus dead discards) was adjusted from 170,655 pounds to 114,315 pounds. In 2023, 192,168 pounds of Southern Flounder were caught recreationally by hook-and-line, exceeding the expected catch by 127,294 pounds. Because of these overages, there was no recreational flounder season in 2024.

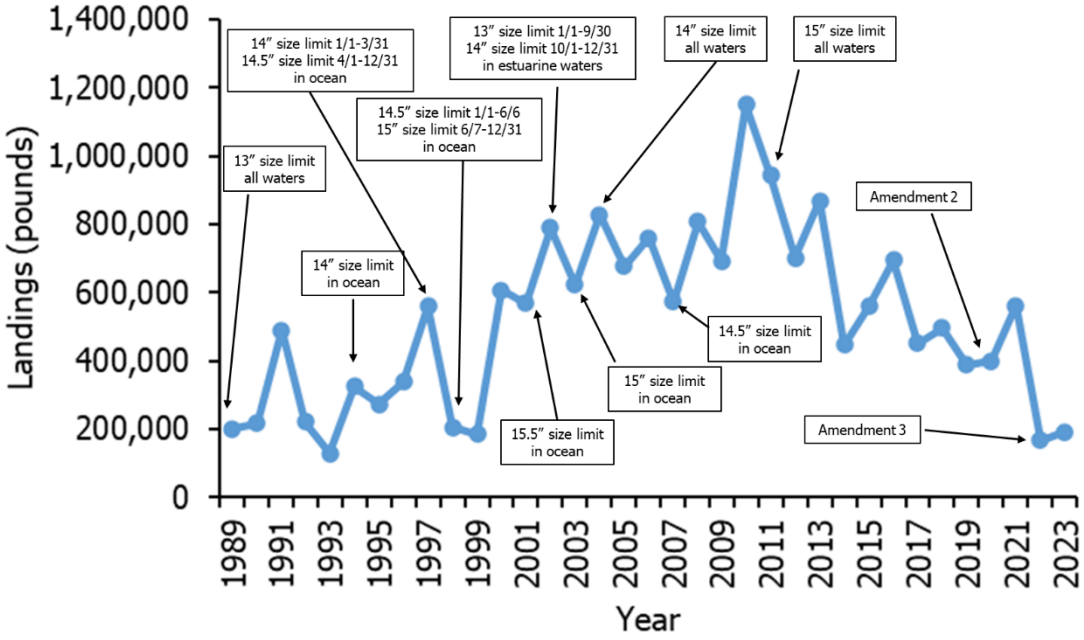



Figure 5. MRIP estimates of recreational hook-and-line Southern Flounder harvest (pounds) and major fishery regulation changes, 1989–2023. Noted regulation changes do not represent a comprehensive list. For additional regulation changes see Lee et al. (2018).

Trends in recreational trips are difficult to interpret because they represent all recreationally important Paralichthyid flounder species commonly caught in North Carolina (Southern, Summer, and Gulf flounder). This is because anglers only report targeting 'flounder' rather than a particular flounder species. Trips can be defined in several ways, but in this document all trips that harvested or released any Paralichthyid

flounder species were included. Trends in trips and harvest are similar throughout the time-series, but trips have declined since 2014 while harvest has varied (Figure 6). Recreational estimates across all years have been updated and are now based on the 2018 MRIP Fishing Effort Survey-based calibrated estimates. For more information on MRIP see https://www.fisheries.noaa.gov/topic/recreational-fishing-data.

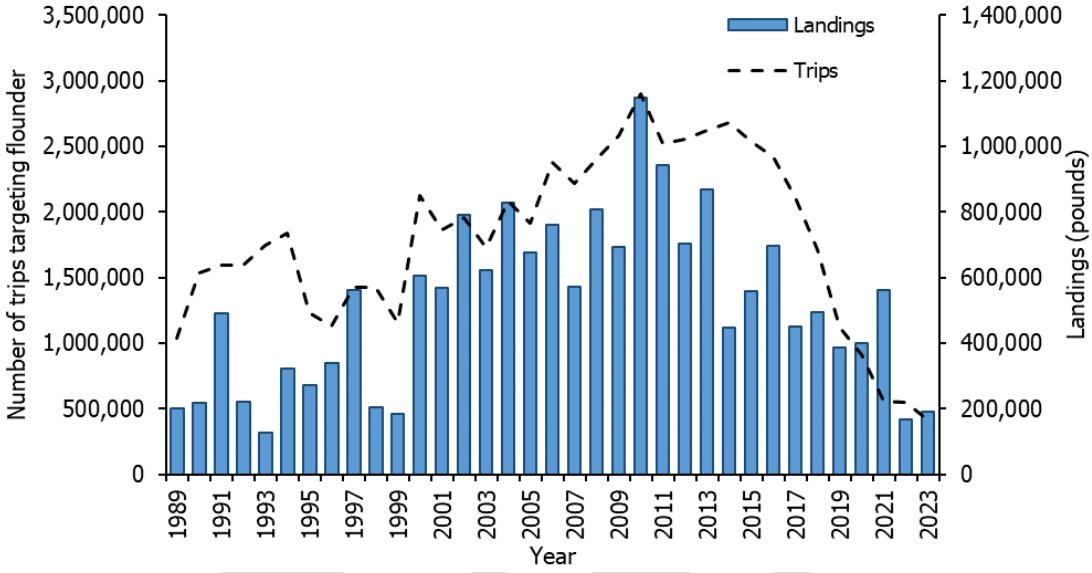



Figure 6. MRIP estimates of recreational hook-and-line harvest (pounds) and all trips that harvested or released Paralichthyid flounder species, 1989–2023. Data prior to 2004 were calibrated to align with MRIP estimates post-2004.

## SUMMARY OF ECONOMIC IMPACT

For detailed discussion of economic impacts of the commercial and recreational Southern Flounder fisheries see Appendix 1. For additional information see NCDMF (2022).

### Commercial Fishery

Historically, the Southern Flounder commercial fishery has been a strong economic driver for the state and one of its largest fisheries. Within the direct impacts effort and production have on the value of the commercial flounder industry, there are several factors that can dictate total economic impact of this fishery on a broader market level and individual product level. As a popular seafood across the country, the value of flounder in North Carolina is influenced by broader trends of supply and demand. There is a wide range of competitive substitutes for North Carolina caught flounder, including flounder caught in other states, as well as seafood products with comparatively similar properties, such as halibut (*Hippoglossus* spp.) or sole (*Solea* spp.). Because of this, the value of flounder in North Carolina is not only influenced by in-state product availability but also regulations,

seasons, and effort for the harvest of flounder and substitute products worldwide. However, as flounder is a popular fish with several available substitutes, it is difficult to accurately track how supply of other products directly influences in state prices.

In addition to broader dynamics of supply and demand that influence North Carolina's flounder market, there are specific factors that can adjust product value on different time scales. Method of catch often influences price, as consumers seek product caught with gears perceived to be more environmentally friendly, or gears that produce higher-quality flounder (Asche and Guillen 2011). This can lead to increased prices on flounder caught with certain gears.

Additionally, enterprise level marketing can impact product value. Fishermen and dealers market their business and product as they wish. When marketing strategies are successful, prices and value can increase, though this is on an individual level and demonstrates the volatility within the market. Such changes in value are demonstrated by the positive effects local product branding and direct-to-consumer strategies have produced in North Carolina (NCREDC 2013; Stoll et al. 2015). While these are just two examples of the variety of factors influencing value of North Carolina's flounder industry, they demonstrate the complicated dynamics at play, as many factors driving the price of flounder are not dictated by fishery managers, but by consumers and producers within the market.

### Recreational Fishery

The top industries impacted by recreational Southern Flounder fishing in terms of output sales and employment are retail gasoline stores, retail sporting goods stores, retail food and beverage stores, real estate, and wholesale trade businesses. Due to the magnitude and popularity of the recreational flounder fishery in North Carolina, changes in access may lead to tangible, yet unquantifiable impacts to the value of other sport fisheries (Scheld et al. 2020). Broadly, participants target or catch flounder more than other recreational species due to higher personal satisfaction gained from fishing for this species over others. However, it is unknown whether this benefit from flounder fishing would transfer to other fisheries if effort restrictions were put in place. There is a possibility that when faced with reduced access to flounder fishing, some anglers may choose not to fish, rather than seek out new target species, while others may target other species more frequently or switch to catch-and-release flounder fishing.

Through this complicated dynamic, the value and economic impact of other recreationally important species may increase or decrease. However, while it is important to acknowledge how flounder management may economically impact other fisheries, this interaction is not fully understood, and therefore, it cannot be determined how the value of other recreational species would shift with changes in access to flounder.

## ECOSYSTEM PROTECTION AND IMPACT

Habitat use patterns of Southern Flounder vary by life stage over time and space. Growth and survival of Southern Flounder within the habitats they use is maximized when water quality parameters, such as temperature, salinity, and dissolved oxygen, are within

optimal ranges. Good water quality is essential for supporting the various life stages of Southern Flounder (Figure 7) and maintaining their habitats. Natural processes and human activities can alter salinity or temperature conditions, elevate toxins, nutrients, turbidity, as well as lower dissolved oxygen levels which can degrade water quality.

For additional information about habitat use by life stage and optimal water quality parameters, see the Description of the Stock section of this FMP, NCDMF (2019), or NCDMF (2022). For a comprehensive review of ecosystem impacts from the Southern Flounder fishery, including habitat degradation and loss, water quality degradation, gear impacts on habitat, bycatch and discards of non-target species, protected species, climate change and resiliency, and habitat protection, see NCDMF (2022).

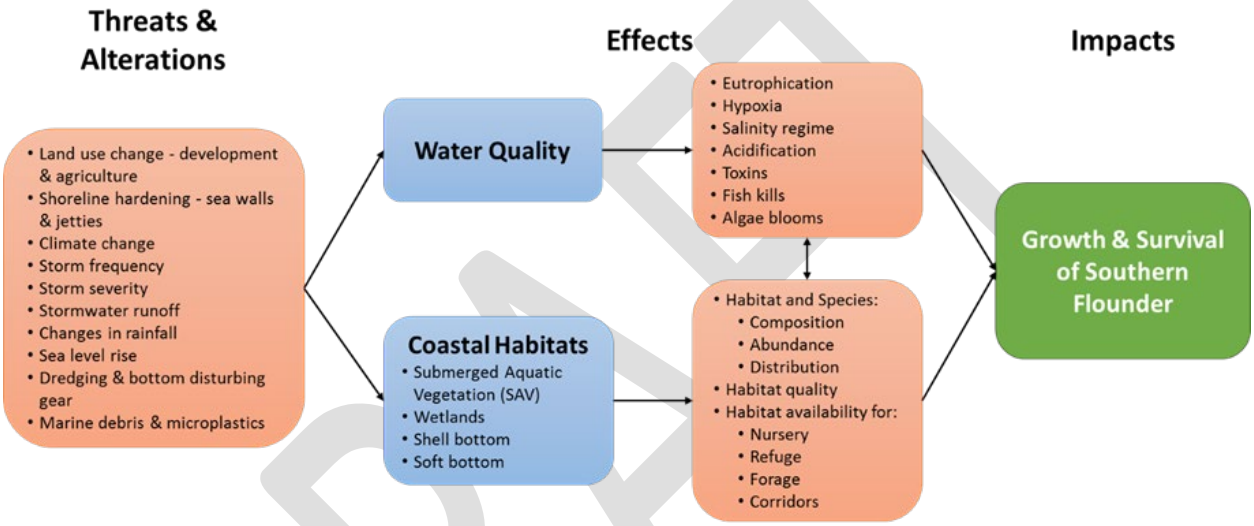



Figure 7. Effects of threats and alterations on water quality and coastal habitats and their ultimate impact on the growth and survival of Southern Flounder.

## Coastal Habitat Protection Plan

The Fisheries Reform Act of 1997 requires development of a Coastal Habitat Protection Plan (CHPP) be drafted by the NCDEQ and reviewed every five years (G.S. 143B-279.8). The CHPP is a resource and guide compiled by NCDEQ staff to assist the NCMFC, Environmental Management Commission (EMC), and Coastal Resources Commission (CRC) in developing goals and recommendations for the continued protection and enhancement of fishery habitats in North Carolina. These commissions are required by state law (G.S. 143B-279.8) to adopt and implement management strategies specified in the CHPP as part of a coordinated management approach. Habitat recommendations related to fishery management can be addressed directly by the NCMFC. The NCMFC has passed rules providing protection for Southern Flounder habitat including the prohibition of bottom-disturbing gear in specific areas, and designation of sensitive fish habitat such as nursery areas and submerged aquatic vegetation (SAV) beds with applicable gear restrictions. Habitat recommendations not under NCMFC authority (e.g., water quality management and shoreline development) can be addressed by the other

commissions through the CHPP process. The CHPP helps to ensure consistent actions among these commissions as well as their supporting NCDEQ divisions. The CHPP also summarizes the economic and ecological value of coastal habitats to North Carolina, their status, and potential threats to their sustainability. The 2021 CHPP Amendment (NCDEQ 2021) is the most recent update to the CHPP, building upon the 2016 CHPP source document (NCDEQ 2016)

## FINAL AMENDMENT 4 MANAGEMENT STRATEGY

The NCMFC selected management measure

### APPENDIX 1: INCREASING RECREATIONAL ACCESS TO SOUTHERN FLOUNDER THROUGH SECTOR ALLOCATION PARITY

Expedite the sector allocation transition to 50% commercial and 50% recreational in 2025 rather than in 2026 as prescribed in Amendment 3

## MANAGEMENT FROM PREVIOUS PLANS

There are several management measures from Amendment 3 to carry forward in Amendment 4 that address fishing behavior and potential changes in effort to minimize the possibility of catching Southern Flounder in greater volume than predicted.

Unless otherwise stated, all Southern Flounder Amendment 3 management measures will be carried forward in Amendment 4 and remain in effect including, but not limited to, the following:

- A commercial and recreational minimum size limit of 15 inches TL;
- A minimum mesh size of 6.0-inch stretched mesh (ISM) for anchored large-mesh gill nets used in the taking of flounder;
- A minimum mesh size of 5.75-ISM for pound net escape panels;
- Reduced commercial anchored large-mesh gill-net soak times to single overnight soaks where nets may be set no sooner than one hour before sunset and must be retrieved no later than one hour after sunrise the next morning;
- For anchored large-mesh gill nets with a 4.0 through 6.5 ISM, maintain a maximum of 1,500-yards in Management Units A, B, and C and a maximum of 750-yards in Management Units D1, D2, and E unless more restrictive yardage is specified through adaptive management or through the sea turtle or sturgeon Incidental Take Permit (ITP);
- Removal of all commercial gears targeting Southern Flounder from the water (e.g., commercial and RCGL anchored large-mesh gill nets and gigs) or make them inoperable (flounder pound nets) in areas and during times outside of an open season with exceptions for commercial large-mesh gill-net fisheries that target American shad (*Alosa sapidissima*), hickory shad (*A. mediocris*) and catfish species if these fisheries are only allowed to operate during times of the year and locations where bycatch of Southern Flounder is unlikely.
- Unlawful to use any method of retrieving live flounder from pound nets that causes injury to released fish (e.g., picks, gigs, spears, etc.);

- Unlawful for commercial fishery to possess any species of flounder harvested from the internal waters of the state during the closed Southern Flounder season;
- Combine mobile gears (gill nets, gigs, and “other” gears) into one gear category and maintain pound nets as their own separate commercial fishery;
- Divide mobile gears into two areas using the ITP boundary line for management sub-units Northern D1 and Southern D1, maintaining consistency with Amendment 2 and Amendment 3 boundary line;
- Divide the pound net fishery into three areas maintaining consistency with areas in Amendment 2 and 3;
- Maintain 72% reduction and current sub-allocation for the pound net fishery.
- Implement trip limits for pound nets, gigs, and hook and line only to maximize reopening after reaching division closure threshold;
- Implement a single season for the recreational gig and hook-and-line fisheries to constrain them to an annual quota;
- Maintain the recreational bag limit of flounder at one fish per person per day;
- Do not allow harvest of Southern Flounder using RCGL;
- Should landings be available, allow potential for spring ocellated flounder season to occur from March 1-April 1 in ocean waters only using hook-and-line gear with one-fish ocellated only bag limit;
- Maintain the adaptive management framework based on the peer-reviewed and approved stock assessment

**RESEARCH NEEDS**

The research recommendations listed below are offered by the NCDMF to improve future management strategies. They are considered high priority as they will help to better understand the Southern Flounder fishery and meet the goal and objectives of the FMP. A more comprehensive list of research recommendations is provided in the Annual FMP Review and NCDMF Research Priorities documents.

- Conduct studies to quantify fecundity and fecundity-size/age relationships in Atlantic Southern Flounder.
- Improve estimates of the discard (B2) component (catches, lengths, and ages) for Southern Flounder from MRIP.
- Expand, improve, or add fisheries-independent surveys of the ocean component of the stock.
- Determine locations of spawning aggregations of Southern Flounder.
- Complete and age validation study using known age fish.

## APPENDICES

### Appendix 1: Increasing Recreational Access to Southern Flounder Through Sector Allocation Parity

#### ISSUE

Provide the North Carolina Marine Fisheries Commission (NCMFC) with an option to increase recreational access to the Southern Flounder fishery by accelerating the shift to sector allocation parity in 2025 rather than in 2026 as originally scheduled in the Southern Flounder Fishery Management Plan (FMP) Amendment 3.

#### ORIGINATION

At the August 2024 NCMFC business meeting, the NCMFC passed a motion "to ask the DMF Director to ask the DEQ Secretary to modify the Annual FMP Review Schedule to amend the Southern Flounder FMP for the review of the plan to begin in 2024. The intent is to allow for more recreational access while maintaining the rebuilding requirements of the North Carolina Southern Flounder FMP Amendment 3 (Amendment 3)".

#### BACKGROUND

A coast-wide stock assessment update of Southern Flounder completed in 2019 concluded the stock was overfished and overfishing was occurring (Flowers et al. 2019). North Carolina law (G.S. § 113-182.1) requires management action to end overfishing within two years. Recovery of the stock from an overfished condition must occur within 10 years and provide at least a 50% probability of success from the date the plan is adopted. To rebuild the spawning stock biomass (SSB) to the target by 2028, a 72% coast-wide reduction in Total Allowable Catch (landings and dead discards; TAC), measured in pounds, was needed.

Amendment 3 was adopted in May 2022 and implemented a quota-based approach to reduce North Carolina's portion of the catch from the terminal year (2017) of the assessment by 72% to help rebuild the stock to the target SSB as required by G.S. § 113-182.1) (NCDMF 2022). The quota was set so the Total Allowable Landings (TAL) that establishes annual maximum fishing limits (in pounds) for all participants does not exceed a pre-determined amount. Quota management includes paybacks for more precise management and to account for quota overages. The quota that met the required reductions and the NCMFC allocation motion was 548,034 pounds of TAC, which results in 532,352 pounds of TAL. This TAL was further divided into commercial and recreational sector allocations. The allocation was set to 70% commercial and 30% recreational for 2021 through 2024, moving to 60% commercial and 40% recreational in 2025, and 50% commercial and 50% recreational beginning in 2026 (Table 1.1).

*Commercial Fisheries*

The TAL allocated to the commercial sector from the overall quota are 372,646 pounds of Southern Flounder for 2021 through 2024, 319,411 pounds in 2025, and 266,176 pounds beginning in 2026 (Table 1.1).

Table 1.1. Allocation in pounds for commercial and recreational fisheries for the North Carolina Southern Flounder Fishery that maintains overall reductions of 72%. An asterisk (*) indicates that Recreational Commercial Gear License (RCGL) gear removals are not included in the Total Allowable Landings.

| | | | | | Commercial Fisheries | Recreational Fisheries* |
|---|---|---|---|---|---|---|
| Year | Allocation | Total Allowable Catch | Dead Discards | Total Allowable Landings | Total Allowable Commercial Landings | Total Allowable Recreational Landings |
| 2021 | 70/30 | 548,034 | 15,682 | 532,352 | 372,646 | 159,706 |
| 2022 | 70/30 | 548,034 | 15,682 | 532,352 | 372,646 | 159,706 |
| 2023 | 70/30 | 548,034 | 15,682 | 532,352 | 372,646 | 159,706 |
| 2024 | 70/30 | 548,034 | 15,682 | 532,352 | 372,646 | 159,706 |
| 2025 | 60/40 | 548,034 | 15,682 | 532,352 | 319,411 | 212,941 |
| 2026 | 50/50 | 548,034 | 15,682 | 532,352 | 266,176 | 266,176 |

Commercial Gear Sub-Allocations

Given the large reduction needed to achieve sustainable harvest and the importance of maintaining each sector within its allowed landings, it was most practical to separate the commercial gears into two categories: pound nets and mobile gears. Mobile gears include those that target Southern Flounder, primarily gigs and gill nets, and “other” gears that do not target Southern Flounder such as shrimp trawls, crab pots, and fyke nets.

Allowed landings in the commercial sector were sub-allocated into the two commercial gear categories. Due to the scheduled shift in allocation between commercial and recreational sectors, it was prudent to evaluate the sub-allocations for the commercial fishery. Amendment 3 adopted sub-allocations so the pound net fishery could maintain its 2017 harvest of 186,458 pounds because of the increased monetary investment of operating and maintaining pound net gear (Table 1.2).

Table 1.2. Allocation in pounds for the North Carolina Southern Flounder commercial and recreational fisheries and associated sub-allocations for each sector that maintains overall reductions of 72% but maintains the current level of sub-allocation for the pound net fishery. An asterisk (*) indicates that RCGL gear removals are not included in the Total Allowable Landings.

| | | | | | Commercial Gear | | | | Recreational Gear* | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Allocation | Total Allowable Catch | Dead Discards | Total Allowable Landings | Total Allowable Commercial Landings | Mobile Gears | Pound Nets | Total Allowable Recreational Landings | Hook-and-line | Gigs |
| 2021 | 70/30 | 548,034 | 15,682 | 532,352 | 372,646 | 186,188 | 186,458 | 159,706 | 142,206 | 17,500 |
| 2022 | 70/30 | 548,034 | 15,682 | 532,352 | 372,646 | 186,188 | 186,458 | 159,706 | 142,206 | 17,500 |
| 2023 | 70/30 | 548,034 | 15,682 | 532,352 | 372,646 | 186,188 | 186,458 | 159,706 | 142,206 | 17,500 |
| 2024 | 70/30 | 548,034 | 15,682 | 532,352 | 372,646 | 186,188 | 186,458 | 159,706 | 142,206 | 17,500 |
| 2025 | 60/40 | 548,034 | 15,682 | 532,352 | 319,411 | 132,953 | 186,458 | 212,941 | 189,608 | 23,333 |
| 2026 | 50/50 | 548,034 | 15,682 | 532,352 | 266,176 | 79,718 | 186,458 | 266,176 | 237,010 | 29,166 |

Table 1.3. Total allowable landings (in pounds) for the North Carolina Southern Flounder commercial fishery and associated sub-allocations for each gear management area adopted in Amendment 3.

| Commercial Gear Sector | Allocation % | Management Area/Total Allowable Landings | | | |
|---|---|---|---|---|---|
| | | Northern | Central | Southern | Total Allowable Landings |
| Mobile Gears | 70 | 123,879 | - | 62,309 | 186,188 |
| | 60 | 88,460 | - | 44,493 | 132,953 |
| | 50 | 53,040 | - | 26,678 | 79,718 |
| Pound Nets | 70 | 39,700 | 121,756 | 25,002 | 186,458 |
| | 60 | 39,700 | 121,756 | 25,002 | 186,458 |
| | 50 | 39,700 | 121,756 | 25,002 | 186,458 |

Commercial Areas Allocation

Because of the migratory nature of Southern Flounder, management areas were established in Amendment 3 to allow more equitable access by fishermen across the state with seasonal openings varying by area (Figure 1.1). After investigating North Carolina Trip Ticket data by waterbody, the fishery was split into two areas for mobile gears and three areas for pound nets. Management area sub-allocations were determined by 2017 landings (Table 1.3)

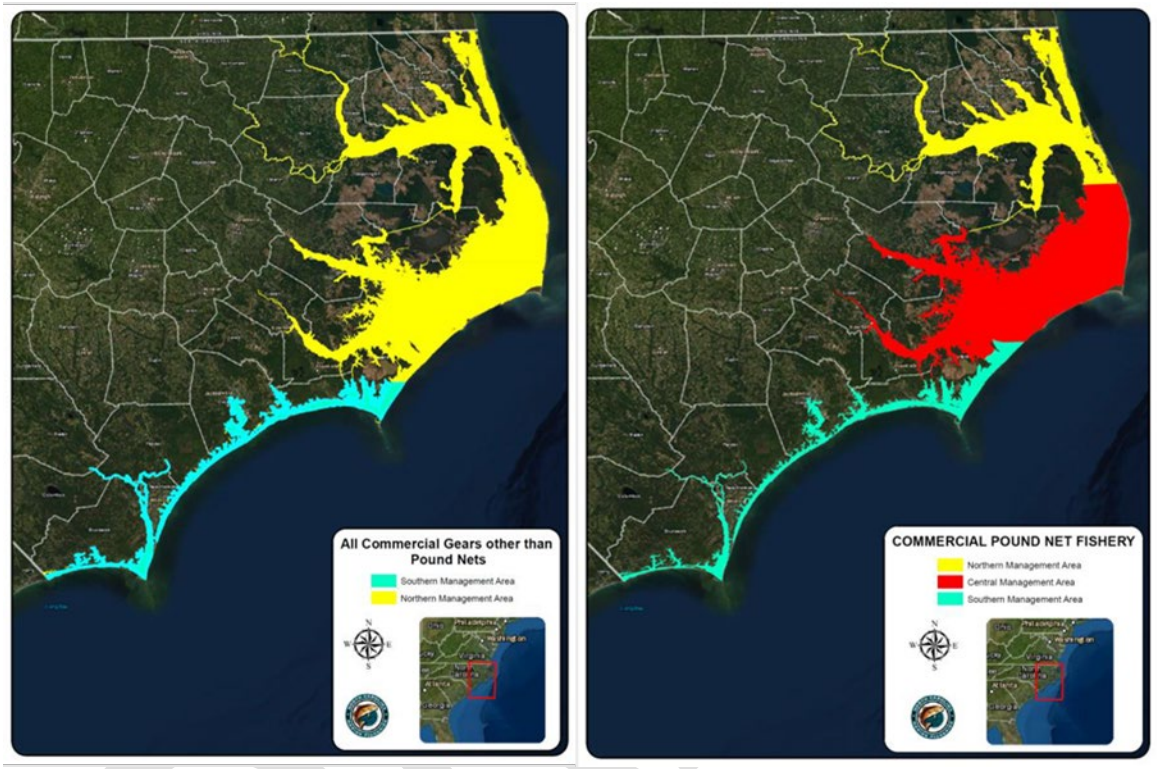



Figure 1.1. Boundary descriptions for the two mobile gear (left) and three pound net (right) management areas adopted in Amendment 3.

*Recreational Fisheries*

The TAL allocated to the recreational sector, including hook-and-line and gigs, from the overall quota will change from 159,706 pounds in 2021 through 2024, to 212,941 pounds in 2025, and from 2026 onward the TAL will be 266,176 pounds (Table 1.1).

The recreational allocation was further refined to allow an annual harvest of 89% of the recreational TAL for the hook-and-line fishery and 11% of the recreational TAL for the recreational gig fishery. However, it was determined that concurrent seasons for the recreational hook-and-line and gig fisheries be maintained to keep from undermining the success of achieving necessary harvest reductions.

*Landings and Reductions*

Under Amendment 3, commercial landings have been closely monitored by the Trip Ticket Program to maintain total landings near the quota in near real-time for each gear and management area sub-allocation. This approach is not realistic for the recreational sector; thus, a one-fish bag limit and restricted harvest seasons have been used to constrain recreational landings. Total recreational landings are estimated through the Marine Recreational Information Program (MRIP) and the NCDMF Gig Mail surveys and those data are not available until after the fishing season. A restructuring of the license database in 2023 disrupted the division's ability to establish a sampling of eligible anglers for mail surveys. As a result, the mail surveys could not be administered, and survey estimates are not available for 2023. Since the mail survey estimates are used in determining if the recreational fishery exceeded their TAC, recreational gig data from 2022 was used as a proxy for 2023. Dead discards for both sectors are not available until after the fisheries close but are added to make sure that the sector's total allowable catch is not exceeded each year. Management under Amendment 3 achieved a 59% harvest reduction in 2022, and 68% in 2023 (Table 1.4). However, the 72% target reduction has not been met through 2023 due to overages in the recreational fishery (Table 1.5).

In 2022, total removals from the recreational fishery (226,995 pounds) exceeded its TAC by an estimated 56,340 pounds (Table 1.5). This overage was deducted from the 2023 recreational TAC and the season was reduced to two weeks (Proclamation FF-31-2023). Despite this adjustment, recreational removals increased to 241,609 pounds in 2023, resulting in an overage of 127,294 pounds. The overage was deducted from the 2024 recreational TAC (170,655 pounds), leaving 43,361 pounds in adjusted TAC which was less than the predicted recreational dead discards (47,291 pounds), causing the NCDMF to not open the recreational season in 2024. A major contributor to recreational overages has been dead discards in the hook-and-line fishery, which have remained at or above the level observed in 2017 (39,080 pounds) despite shortened seasons. Regardless of the closed season in 2024, estimated dead discards and landings that were allowed by the NC Wildlife Resources Commission in internal waters will be used to adjust the TAC for the 2025 season.

Table 1.4. Catch estimates with target and actual reductions from the North Carolina Southern Flounder fishery, 2017–2023. (North Carolina Trip Ticket Program and MRIP). *Target reductions under Amendment 2.

| Year | Total Landings | Dead Discards | Total Removals | 2017 Total Removals | Target reduction | Actual reduction |
|---|---|---|---|---|---|---|
| 2017 | 1,901,256 | 56,008 | 1,957,264 | 1,957,264 | . | . |
| 2018 | 1,452,590 | 36,670 | 1,489,259 | 1,957,264 | . | . |
| 2019 | 1,233,695 | 41,309 | 1,275,003 | 1,957,264 | 62%* | 34.9% |
| 2020 | 905,149 | 45,266 | 950,415 | 1,957,264 | 72%* | 51.4% |
| 2021 | 1,071,541 | 52,132 | 1,123,673 | 1,957,264 | 72%* | 42.6% |
| 2022 | 540,494 | 62,668 | 603,162 | 1,957,264 | 72% | 69.2% |
| 2023 | 576,013 | 48,457 | 624,470 | 1,957,264 | 72% | 68.1% |

Table 1.5. Recreational Total Allowable Catch (TAC) and catch estimates in pounds with adjusted TAC based on overage reductions, 2022–2024. Estimates are based on data from the Marine Recreational Information Program (MRIP) and recreational gig survey. An asterisk (*) indicates that the value is estimated from the previous year.

| Year | TAC | Adjusted TAC | MRIP Landings | Gig Landings | Total Landings | MRIP Dead Discard | Gig Dead Discard | Total Dead Discard | Total Removals | Overage deducted from next year's TAC |
|---|---|---|---|---|---|---|---|---|---|---|
| 2022 | 170,655 | 170,655 | 166,091 | 7,882 | 173,973 | 52,771 | 251 | 53,022 | 226,995 | 56,340 |
| 2023 | 170,655 | 114,315 | 192,168 | *7,882** | 200,050 | 41,308 | *251** | 41,559 | 241,609 | 127,294 |
| 2024 | 170,655 | 43,361 | not yet available | | | | | | | |

In response to the closed recreational season in 2024, at the August 2024 NCMFC business meeting, the NCMFC passed a motion to request modification of the Annual FMP Review Schedule to amend the Southern Flounder FMP for the review of the plan to begin in 2024 to allow more recreational access to the fishery while maintaining Amendment 3 rebuilding requirements.

*Socioeconomic Analysis*

Commercial

Southern Flounder has historically been one of the top harvested species by the commercial fleet in North Carolina. From 2014 until 2021 Southern Flounder was in the top five species ranked by ex-vessel value (point of sale value). In 2022 and 2023 the ex-vessel value dropped below one million dollars from a high of over seven million dollars in 2017 (Table 1.6). Participation in the fishery decreased from 1,759 participants in 2014 to 492 in 2023.

Using IMPLAN modelling software and expenditure estimates from NOAA's Fisheries Economics of the U.S. (FEUS) report, the indirect impacts of the Southern Flounder fishery to the state economy at-large can also be estimated. By assuming the flounder industry contributes to these expenditure categories at a proportion equal to their contribution to total commercial ex-vessel values, estimates of the total economic impact of flounder harvest can be generated. For a detailed explanation of the methodology used to estimate the economic impacts please refer to the NCDMF's License and Statistics Section Annual Report.

Overall, the large economic impact of Southern Flounder to the state's commercial fishing industry is reflected in its effect on the state economy. Total impacts vary slightly year-over-year, though these values remain relatively consistent from a state-impact perspective until 2020. The ex-vessel value has declined significantly since 2014, with a precipitous decline in 2020 due to restrictive management and high supply of Summer Flounder. This reduced value has persisted through 2022 and 2023. These years had the lowest landings and ex-vessel value of Southern Flounder in the last ten years.

Flounder landings as a proportion of total commercial catch has decreased from a peak of 7% in 2017 to the current low of 2% (Figure 1.2).

Table 1.6. Commercial Southern Flounder economic contribution estimates from 2023–2014 reported in 2023 dollars.

| Year | Pounds Landed | Ex-Vessel Value | Job Impacts | Income Impacts | Value Added Impacts | Sales Impacts |
|---|---|---|---|---|---|---|
| 2023 | 375,963 | $837,570 | 492 | $1,633,087 | $2,854,513 | $3,665,223 |
| 2022 | 366,510 | $979,684 | 568 | $2,190,945 | $3,699,221 | $4,939,489 |
| 2021 | 485,024 | $1,626,653 | 674 | $3,820,854 | $6,005,097 | $8,767,231 |
| 2020 | 479,905 | $1,244,878 | 630 | $3,128,717 | $5,072,299 | $7,024,328 |
| 2019 | 800,080 | $3,669,245 | 1,086 | $9,300,809 | $13,624,054 | $21,729,471 |
| 2018 | 903,842 | $4,640,012 | 1,263 | $10,491,007 | $17,252,260 | $23,825,993 |
| 2017 | 1,396,384 | $7,039,608 | 1,662 | $18,245,416 | $27,209,451 | $42,008,243 |
| 2016 | 899,932 | $4,593,509 | 1,357 | $12,121,629 | $18,679,737 | $27,651,565 |
| 2015 | 1,202,952 | $4,916,044 | 1,463 | $12,849,015 | $19,860,767 | $29,247,840 |
| 2014 | 1,673,511 | $6,229,650 | 1,759 | $15,135,194 | $22,775,298 | $34,894,849 |

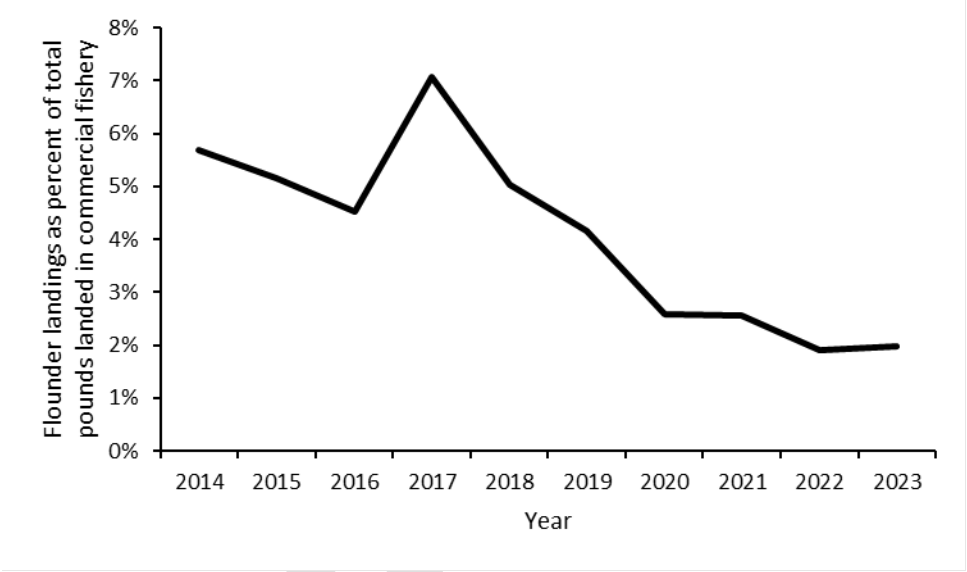



Figure 1.2. Pounds of Southern Flounder landed as a percent of total commercial finfish landed in North Carolina from 2014–2023.

Recreational

The economic impact estimates of Southern Flounder recreational fishing represent the economic activity generated from trip expenditures. These estimates are a product of annual trip estimations originating from the NOAA Fisheries Marine Recreational Information Program (MRIP) effort data by area and mode (i.e., shore, for-hire, private/rental vessel, and man-made), and trip expenditure estimates from the NCDMF

economics program biennial socioeconomic survey of Coastal Recreational Fishing License holders (Dumas et al. 2009; Crosson 2010; Hadley 2012; Stemle 2018). The product of these estimates provides an annual estimate of trip expenditures made by all licensed anglers for a given year. For this analysis, a recreational flounder trip is defined as any trip in which flounder was the primary or secondary target species by the angler, or if Southern Flounder was caught during that trip.

Additionally, these data are used to generate state-level economic impact estimates of recreational flounder fishing in North Carolina. Using IMPLAN statistical software, these direct expenditure estimates for recreational flounder fishing produce indirect output impacts to the state economy across four categories: sales, labor income, value-added impacts, and employment. Additionally, all imputed expenditure estimates are adjusted for inflation based on 2023 prices, as this was the most recent year of expenditure survey data. For a detailed explanation of the methodology used to estimate the economic impacts please refer to the NCDMF's License and Statistics Section Annual Report.

Since 2020 trips have declined with 2023 having the lowest number of trips in the time series (Table 1.7). The number of flounder trips as a percentage of total recreational trips ranged from a high of 5% in 2015 to a low of 1% in 2022 (Figure 1.3). The relative number of flounder trips increased to 3% in 2023.

Table 1.7. Recreational flounder economic contribution estimates from 2023–2014 reported in 2023 dollars.

| Year | Trips | Expenditure | Job Impacts | Income Impacts | Value Added Impacts | Sales Impacts |
|---|---|---|---|---|---|---|
| 2023 | 414,322 | $107,560,90 | 736 | $33,825,714 | $52,588,610 | $91,413,988 |
| 2022 | 515,638 | $111,446,34 | 711 | $33,956,950 | $52,603,145 | $92,802,221 |
| 2021 | 518,636 | $124,895,81 | 736 | $37,060,764 | $57,416,999 | $103,850,738 |
| 2020 | 891,057 | $236,224,06 | 1,521 | $76,653,218 | $109,987,034 | $195,316,448 |
| 2019 | 1,118,50 | $291,045,60 | 1,880 | $88,935,317 | $135,155,036 | $244,036,124 |
| 2018 | 1,179,89 | $308,646,57 | 2,003 | $96,804,743 | $146,722,413 | $261,904,279 |
| 2017 | 1,234,21 | $313,229,18 | 2,066 | $97,779,917 | $147,510,316 | $270,355,489 |
| 2016 | 1,676,50 | $435,414,42 | 2,935 | $139,973,659 | $208,013,684 | $377,002,717 |
| 2015 | 1,723,01 | $446,698,25 | 2,901 | $138,075,359 | $224,369,794 | $373,979,472 |
| 2014 | 1,619,85 | $435,654,16 | 2,887 | $135,636,199 | $201,597,395 | $360,751,939 |

It should be noted that not included in these estimates, but presented in NCDMF overall recreational impacts models, are the durable good impacts from economic activity associated with the consumption of durable goods (e.g., rods and reels, other fishing related equipment, boats, vehicles, and second homes). Durable goods represent goods that have multi-year life spans and are not immediately consumable. Some equipment related to fishing are considered durable goods. However, we cannot estimate the durable good expense of anglers for a given species. Durable good expenses and impacts are

estimated on an annual basis and serve to supplement angler expenditures outside of trip-based estimates.

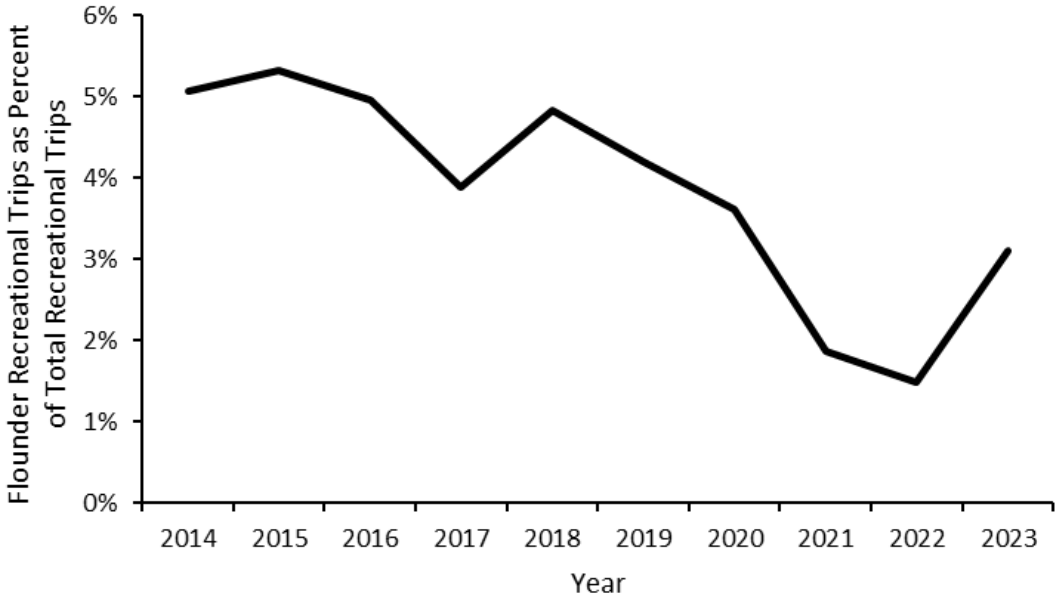



Figure 1.3. Number of flounder trips as a percent of total recreational fishing trips in North Carolina from 2014–2023.

**AUTHORITY**

North Carolina General Statutes

G.S. 113-134 RULES
G.S. 113-182 REGULATIONS OF FISHING AND FISHERIES
G.S. 113-182.1 FISHERY MANAGEMENT PLANS
G.S. 143B-289.52 MARINE FISHERIES COMMISSION – POWERS AND DUTIES

North Carolina Marine Fisheries Commission Rules

15A NCAC 03H .0103 PROCLAMATIONS, GENERAL
15A NCAC 03M .0503 FLOUNDER
15A NCAC 03M .0512 COMPLIANCE WITH FISHERY MANAGEMENT PLANS

**DISCUSSION**

Expediting the sector (commercial/recreational) allocation transition to 50/50 in 2025 rather than 2026 as prescribed in Amendment 3 immediately addresses recreational access in time for a 2025 recreational season while maintaining Amendment 3 rebuilding

requirements. This would result in a 66.7% increase in recreational TAL by adding 106,470 pounds from the commercial sector to the recreational sector allocation in 2025 (Table 1.2). Under the Amendment 3 allocation shift schedule to 60/40 in 2025, there would likely be a short recreational season in 2025. Expediting the shift to 50/50 in 2025 reduces the possibility of recreational catch overages that may mitigate the need for future season closures, though may not increase the length of the recreational season. However, maintaining Amendment 3 rebuilding requirements does not provide substantial harvest opportunities for any fishing sector regardless of allocation, and given recreational landings and discard levels in recent years, even with a shift to 50/50 allocation, season closures in 2026 and beyond remain a possibility due to overages. This allocation shift is a short-term approach to address recreational access. Long-term, more comprehensive approaches for recreational and commercial management will be addressed during subsequent development of Amendment 5.

*Recreational Season*

Estimated recreational landings from 2022 and 2023 indicate an increase in catch over shorter seasons (Tables 1.8). More successful trips are to be expected as the stock rebuilds. Angler reports of seeing more flounder than ever provide indication management is working. Even with a shift to 50/50 allocation, a recreational season that maintains the one fish bag limit from Amendment 3 would need to be brief (e.g., between two and four weeks) to maintain allowable landings (266,176 pounds; Table 1.2) while accounting for dead discards. The recreational catch estimates from 2024 will be available in 2025. These estimates will be used to determine if recreational catch estimates exceeded the adjusted TAC (43,361 pounds) in 2024. Any overages will be subtracted from the 2025 TAL.

Table 1.8. Recreational harvest estimates during 2022 and 2023 from the Marine Recreational Information Program (MRIP) and recreational gig survey. An asterisk (*) indicates the 2022 estimate was used because data from 2023 were not available.

| Year | Hook-and-line Landings | Gig Landings | Total Landings | Hook-and-line Dead Discard | Gig Dead Discard | Total Dead Discard | Total Catch | Season length |
|---|---|---|---|---|---|---|---|---|
| 2022 | 166,091 | 7,882 | 173,973 | 52,771 | 251 | 53,022 | 226,995 | 4 weeks |
| 2023 | 192,168 | *7,882** | 200,050 | 41,308 | *251** | 41,559 | 241,609 | 2 weeks |

*Commercial Implications*

The Amendment 3 management strategy provides guidance on the shift in landings from the commercial to the recreational sector. Per Amendment 3, the pound net TAL allocation will be maintained at 186,458 pounds and the poundage shifted to recreational landings will come from the commercial mobile gear TAL allocation (Tables 1.2; 1.3). This will leave 79,718 pounds of TAL for mobile gears, minus any overages that may have occurred in 2024. While the number of participants in the Southern Flounder commercial fishery declined precipitously following adoption of Amendment 2 (2019) and declined

further following adoption of Amendment 3 (2022), participation remains relatively high considering the constrained season (Table 1.9). Based on recent mobile gear landings trends, the scheduled allocation shift will result in a mobile gear season that will likely last one or two days, which may be non-consecutive.

Table 1.9. Commercial Southern Flounder pounds landed, number of trips landing southern flounder, and number of commercial participants and dealers participating in the fishery, 2018–2023.

| Year | Pounds | Trips | Participants | Dealers |
|---|---|---|---|---|
| 2018 | 903,842 | 13,320 | 912 | 186 |
| 2019 | 800,080 | 10,036 | 781 | 175 |
| 2020 | 479,905 | 3,485 | 522 | 144 |
| 2021 | 485,024 | 3,142 | 541 | 139 |
| 2022 | 366,510 | 1,927 | 485 | 125 |
| 2023 | 375,963 | 2,157 | 430 | 118 |

The 70% commercial, 30% recreational allocation (Tables 1.1; 1.2) from Amendment 3 is based on historical harvest for each sector through 2017. Different allocation scenarios have the potential to significantly reduce available harvest in a sector which may have ramifications for the viability of those sectors. Under the Amendment 3 allocation schedule, and the shift proposed in this Amendment, allocations for some sectors may be too low to viably prosecute.

Shifting allocation between sectors is within the authority of the MFC (G.S. 113-134, 113-182, 113-182.1, and 143B-289.52). Allocation changes may have positive or negative impacts on different sectors of the southern flounder fishery. Amendment 5 will further examine long-term management for both sectors.

**MANAGEMENT OPTIONS**

*Status Quo*

Status quo would maintain the allocation transition schedule from Amendment 3, moving to 60% commercial and 40% recreational in 2025, and 50% commercial and 50% recreational beginning in 2026. This does not immediately address the NCMFC motion to increase recreational access to the Southern Flounder fishery. The motion would be addressed by a more comprehensive amendment process.

*Expedited Allocation Shift*

Expedite the sector (commercial/recreational) allocation transition to 50/50 in 2025 rather than in 2026 as prescribed in Amendment 3. This option immediately addresses the NCMFC motion to increase recreational access to Southern Flounder. Long-term, more comprehensive approaches for recreational and commercial management will be addressed during subsequent development of Amendment 5 to the NC Southern Flounder FMP.

**RECOMMENDATIONS**

The NCDMF does not have a recommendation for this issue.

*Advisory Committee Recommendations and Public Comment: see Appendix 2*

*NCFMC Selected Management Options*

Expedite the sector allocation transition to 50% commercial and 50% recreational in 2025 rather than in 2026 as prescribed in Amendment 3

## Appendix 2: Summary Of Management Recommendations and Comment

Table 2.1. Summary of management recommendations from NCDMF, the Northern, Southern, Shellfish & Crustacean, and Habitat & Water Quality Advisory Committees (AC).

| | NCDMF | Northern AC | Southern AC | Finfish AC |
|---|---|---|---|---|
| *Increasing Recreational Access to Southern Flounder Through Sector Allocation Parity* | No Recommendation | Recommend to the Marine Fisheries Commission to remain status quo regarding southern flounder allocation | No recommendation | Recommend to the Marine Fisheries Commission to remain status quo in regard to the allocation schedule in Southern Flounder Fishery Management Plan Amendment 3 |
| *Other Issues* | No Recommendation | Recommend that the Marine Fisheries Commission ask the DEQ Secretary to allow Amendment 5 to the Southern Flounder Fishery Management Plan to change the 72% reduction that was adopted in Amendment 3 to a 52% reduction and split the total allocation equally between the commercial and recreational sectors | No Recommendation | |

*Online Southern Flounder Amendment 4 Public Comment*

The online public comment period was opened April 1, 2025, and closed April 30, 2025. The division received 21 responses during this period. Most commentors expressed broad support for the expedited shift to 50/50 allocation in 2025. Some commentors expressed concern over commercial gears' effect on the Southern Flounder population.

## REFERENCES


Asche, F., and J. Guillen. 2012. The importance of fishing method, gear and origin: The Spanish hake market. Marine Policy 36(2):365–369.

Benson, N.G. (editor). 1982. Life history requirements of selected finfish and shellfish in Mississippi Sound and adjacent waters. U.S. Fish and Wildlife Service FWS/OBS-81/51. 97 p.

Blandon, I. R., R. Ward, and T. L. King. 2001. Preliminary genetic population structure of southern flounder, *Paralichthys lethostigma*, along the Atlantic Coast and Gulf of Mexico. Fisheries Bulletin 99(4):671–678.

Craig, J. K., W. E. Smith, F. S. Scharf, and J. P. Monaghan. 2015. Estuarine residency and migration of southern flounder inferred from conventional tag returns at multiple spatial scales. Marine and Coastal Fisheries 7:450–463.

Crosson, S. 2010. A Social and Economic Survey of Recreational Saltwater Anglers in North Carolina. Department of Environment and Natural Resources, Division of Marine Fisheries.

Daniels, H. V. 2000. Species profile: southern flounder. Southern Regional Aquaculture Center Publication No. 726. 4 p.

Dumas, C., J. Whitehead, C. Landry, and J. Herstine. 2009. Economic Impacts and Recreational Value of the North Carolina For-Hire Fishing Fleet. North Carolina Sea Grant Fishery Resource Grant Report 07-FEG-05.

Flowers, A. M., S. D. Allen, A. L. Markwith, and L. M. Lee (editors). 2019. Stock assessment of southern flounder (*Paralichthys lethostigma*) in the South Atlantic, 1989–2017. Joint report of the North Carolina Division of Marine Fisheries, South Carolina Department of Natural Resources, Georgia Coastal Resources Division, Florida Fish and Wildlife Research Institute, University of North Carolina at Wilmington, and Louisiana State University. NCDMF SAP-SAR-2019-01. 213 p.

Glass, L. A., J. R. Rooker, R. T. Kraus, and G. J. Holt. 2008. Distribution, condition, and growth of newly settled southern flounder (*Paralichthys lethostigma*) in the Galveston Bay Estuary, TX. Journal of Sea Research 59(4):259–268.

Gunther, G. 1945. Studies on marine fishes of Texas. Publications of the Institute for Marine Science, University of Texas 1:1–190.

Hadley, J. 2012. A Social and Economic Profile of Ocean Fishing Piers in North Carolina. Department of Environment and Natural Resources, Division of Marine Fisheries.

Hannah, T., and P. Hannah. 2000. Crab trawl tailbag testing. North Carolina Fisheries Resource Grant. FRG-98-10. North Carolina Sea Grant. Raleigh, NC 19 p.

Hettler Jr., W. F., and D. L. Barker. 1993. Distribution and abundance of larval fishes at two North Carolina inlets. Estuarine, Coastal and Shelf Science 37:161–179.

Hollensead, L. D. 2018. Multi-scale examination of habitat use and migration dynamics of southern flounder in a North Carolina estuary using acoustic telemetry techniques. Doctoral dissertation, University of North Carolina Wilmington, Wilmington, North Carolina.

IMPLAN® model, [2024] Data, using inputs provided by the user and IMPLAN Group LLC, IMPLAN System (data and software), 16905 Northcross Dr., Suite 120, Huntersville, NC 28078 www.IMPLAN.com

Lee, L. M., S. D. Allen, A. M. Flowers, and Y. Li (editors). 2018. Stock assessment of southern flounder (*Paralichthys lethostigma*) in the South Atlantic, 1989–2015. Joint report of the North Carolina Division of Marine Fisheries, South Carolina Department of Natural Resources, Georgia Coastal Resources Division, Florida Fish and Wildlife Research Institute, University of North Carolina at Wilmington, and Louisiana State University. NCDMF SAP-SAR-2018-01. 425 p.

Loeffler, M. S., L. M. Paramore, S. P. Darsee, T. M. Mathes, A. M. Comer-Flowers, C. B. Stewart, S. J. Poland, T. C. Bauer, A. L. Markwith, and T. K. Scheffel. 2019. North Carolina multi-species tagging program. North Carolina Division of Marine Fisheries, CRFL Grant 2F40 F017, Morehead City, NC. 29 p.

McClellan, C. M. 2001. Mesoscale habitat use of juvenile southern flounder, *Paralichthys lethostigma*: responses to environmental variability. Master's thesis. Duke University Nicholas School of the Environment, Durham, North Carolina. 116 p.

McKenna, S. A., and J. T. Camp. 1992. An examination of the blue crab fishery in the Pamlico River Estuary. Albemarle-Pamlico Estuarine Study, No. 92-08. 101 p.

Midway, S. R., and F. S. Scharf. 2012. Histological analysis reveals larger size at maturity for southern flounder with implications for biological reference points. Marine and Coastal Fisheries 4:628–638.

Miller, J. M., J. S. Burke, and G. R. Fitzhugh. 1991. Early life history patterns of Atlantic North American flatfish: Likely (and unlikely) factors controlling recruitment. Netherlands Journal of Sea Research 27:261–275.

Monaghan, J. P., and J. L. Armstrong. 2000. Reproductive ecology of selected marine recreational fishes in North Carolina: southern flounder, *Paralichthys lethostigma*. Completion Report Grant F-60. Segments 1-2. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, North Carolina. 1.1-1.17.

National Marine Fisheries Service. 2024. Fisheries Economics of the United States, 2022. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-F/SPO-248B, 28 p.

NCDEQ (North Carolina Department of Environmental Quality). 2016. North Carolina Habitat Protection Plan: Source document. Division of Marine Fisheries, Morehead City, NC. 475 p.

NCDEQ. 2020. North Carolina Climate Risk Assessment and Resiliency Plan. 1601 Mail Service Center, Raleigh, NC.

NCDEQ. 2021. North Carolina Habitat Protection Plan 2021 Amendment: Department of Environmental Quality, Raleigh, NC. 267 p.

NCDMF (North Carolina Division of Marine Fisheries). 2005. North Carolina southern flounder (*Paralichthys lethostigma*) fishery management plan. North Carolina Division of Marine Fisheries, Morehead City, NC. 260 p.

NCDMF. 2011. Supplement A to the 2005 NC Southern Flounder Fishery Management Plan. North Carolina Division of Marine Fisheries, Morehead City, NC. 12 p.

NCDMF. 2013. North Carolina southern flounder (*Paralichthys lethostigma*) fishery management plan: Amendment 1. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, NC. 380 p.

NCDMF. 2017. North Carolina southern flounder (*Paralichthys lethostigma*) fishery management plan: Supplement A to Amendment 1. North Carolina Division of Marine Fisheries, Morehead City, NC. 83 p.

NCDMF. 2019. North Carolina southern flounder (Paralichthys lethostigma) fishery management plan: Amendment 2. North Carolina Department of Environmental Quality, Division of Marine Fisheries, Morehead City, NC. 62 p.

NCDMF. 2022. Amendment 3 to the North Carolina Southern Flounder (*Paralicthys lethostigma*) Fishery management Plan. North Carolina Department of Environmental Quality, North Carolina Division of Marine Fisheries, Morehead City, North Carolina. 176 p.

NCDMF. 2024a. North Carolina Division of Marine Fisheries Southern Flounder satellite tagging study. North Carolina Commercial Fishing Resource Fund Grant #2358-0006. North Carolina Department of Environmental Quality, Division of Marine Fisheries, Morehead City, NC. 48 p.

NCDMF. 2024b. North Carolina Division of Marine Fisheries License and Statistics Section Annual Report. North Carolina Department of Environmental Quality, Division of Marine Fisheries, Morehead City, NC.

NCREDC (North Carolina Rural Economic Development Center). 2013. A Supply Chain Analysis of North Carolina's Commercial Fishing Industry.

Scheld, A. M., W. M. Goldsmith, S. White, H. J. Small, and S. Musick. 2020. Quantifying the behavioral and economic effects of regulatory change in a recreational cobia fishery. Fisheries Research 224. [online serial].

Schlick, C. J. C., L. M. Lee, S. D. Allen, A. L. Markwith, and H. White (editors). 2024. Stock Assessment of Southern Flounder (*Paralichthys lethostigma*) in the South Atlantic, 1989–2022. North Carolina Division of Marine Fisheries, NCDMF SAP-SAR-2024-01. Morehead City, North Carolina.

Stemle, A., and M. Condon. 2018. Socioeconomic Survey of Recreational Saltwater Anglers in North Carolina 2016. Division of Marine Fisheries, Morehead City, NC

Stoll, J. S., B. A. Dubik, and L. M. Campbell. 2015. Local seafood: rethinking the direct marketing paradigm. Ecology and Society 20(2):40. [online serial].

Taylor, J. C., J. M. Miller, L. J. Pietrafesa, D. A. Dickey, and S. W. Ross. 2010. Winter winds and river discharge determine juvenile southern flounder (*Paralichthys lethostigma*) recruitment and distribution in North Carolina estuaries. Journal of Sea Research 64:15–25.

Taylor, J. C., J. M. Miller, and D. Hilton. 2008. Inferring southern flounder migration from otolith microchemistry. Final Report Fishery resource Grant 05-FEG-06, Morehead City, NC.

Watanabe, W. O., P. M. Carroll, and H. V. Daniels. 2001. Sustained, natural spawning of southern flounder *Paralichthys lethostigma* under an extended photothermal regime. Journal of the World Aquaculture Society 32(2):153–166.

Watterson, J. C., and J. L. Alexander. 2004. Southern flounder escapement in North Carolina, July 2001–June 2004. Final Performance Report Grant F-73 Segments 1–3. North Carolina Department of Natural Resources, Division of Marine Fisheries. Morehead City, North Carolina. 41 p.

Wenner, C. A., W. A. Roumillat, J. E. Moran Jr., M. B. Maddox, L. B. Daniel III, and J. W. Smith. 1990. Investigations on the life history and population dynamics of marine recreational fishes in South Carolina: Part 1. Marine Resources Research Institute, South Carolina Wildlife and Marine Resources Department, Charleston, SC. 180 p.

NC Marine Fisheries Commission

# Striped Bass Fishery Management Plan

**August 2025 Quarterly Business Meeting**

## Documents

Striped Bass FMP Amendment 2
Decision Document

Striped Bass Data Analysis
Information Paper

# DECISION DOCUMENT

## Estuarine Striped Bass
## Fishery Management Plan Amendment 2
### *Data Evaluation for Tar-Pamlico and Neuse Rivers Stocks*

This Decision Document provides background information for Amendment 2 to the N.C. Striped Bass Fishery Management Plan and the adaptive management steps prescribed for the Tar-Pamlico and Neuse Rivers stocks.

August 2025

# Summary

Estuarine striped bass (*Morone saxatilis*) in North Carolina are managed under Amendment 2 to the North Carolina Fishery Management Plan (FMP) adopted in November 2022 and its subsequent revision (2024). Striped bass stocks in North Carolina are managed jointly by the North Carolina Marine Fisheries Commission (MFC) and the North Carolina Wildlife Resources Commission (WRC). Amendment 2 management for the Tar-Pamlico and Neuse rivers stocks carried forward the Supplement A no-possession measure, maintained the gill net closure above the ferry lines, and maintained the use of 3-foot tie-downs for gill nets below the ferry lines. The Amendment 2 adaptive management framework for the Tar-Pamlico and Neuse rivers stocks prescribes that 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 MFC approved the following measure in Amendment 2 regarding the gill net closure: "maintain the gill net prohibition through 2024 to allow for assessment of its performance". This document provides Amendment 2 background information, data analysis results and conclusions, and next steps in the adaptive management process.

## Amendment 2 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, 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.

# Background

There are two estuarine striped bass management units and four stocks in North Carolina. The Northern Management Unit includes the Albemarle Sound Management Area (ASMA) and Roanoke River Management Area (RRMA). The striped bass stock in these management areas is the Albemarle-Roanoke (A-R) stock. The A-R stock is also included in the management unit of Amendment 7 to the Atlantic States Marine Fisheries Commission (ASMFC) Interstate FMP for Atlantic Striped Bass. The Southern Management Unit is the Central/Southern Management Area (CSMA) and includes the Tar-Pamlico, Neuse, and Cape Fear rivers stocks.

**CSMA Stock Status**

The stock status of the CSMA striped bass is unknown, no stock status determination has been performed, and no biological reference points have been generated. The CSMA Estuarine Striped Bass Stocks report, completed in 2020, is a collection of 1) all available data, 2) all management effort, and 3) all major analyses that have been completed for CSMA stocks; this report served as an aid in development of Amendment 2. While this report does not determine stock status, it does indicate that sustainability of Tar-Pamlico and Neuse rivers stocks is unlikely at any level of fishing mortality, citing the lack of natural recruitment as the primary limiting factor. The report concludes that without stocking, abundance will decline.

## Supplement A to Amendment 1

At the November 2018 MFC business meeting, the N.C. Division of Marine Fisheries (DMF) recommended development of temporary management measures to supplement the N.C. Estuarine Striped Bass FMP Amendment 1 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 FMP was developed. This supplement, Supplement A, was adopted by the MFC at their February 2019 business meeting and by the WRC in March 2019. Supplement actions were implemented March 29, 2019, consisting of the following:

- Commercial and recreational no possession measure for striped bass (including hybrids) in coastal and inland fishing waters of the CSMA (Proclamation 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 in the Cape Fear River by rule.
- Consistent with Amendment 1, commercial anchored gill-net restrictions requiring tie-downs and distance from shore measures will apply year-round.

**Ferry Line Gill Net Closures**

Prior to 2019, after the commercial striped bass season in the Tar-Pamlico and Neuse rivers closed, large mesh gill nets were required to use three-foot tie downs throughout the entirety

of the rivers and be set greater than 50 yards from shore in the upper portions of the rivers. These restrictions were based on data indicating their effectiveness with subsequent analysis estimating striped bass discards were reduced by approximately 82% after these restrictions were implemented.

*See Figure 1 for gill net restrictions in the Pamlico, Pungo, Bay, and Neuse rivers in place prior to implementation of the ferry line gill net closures.*

Independent of Supplement A but also at the February 2019 MFC business meeting, the following motion passed:

> "Ask the director of NCDMF to issue a proclamation, effective in conjunction with the Supplement, that restricts the use of gill-nets that interact with striped bass upstream of the ferry lines and requires attendance of gill-nets that interact with striped bass upstream of the tie-down lines."

After careful consideration, the director declined the motion request, concluding the scientific data did not support the requested management measure (see letter from the DMF director to the MFC chairman dated March 4, 2019).

On March 13, 2019, the MFC held an emergency meeting and passed a motion directing the director 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 Pamlico River and the Minnesott Beach Ferry to Cherry Branch Ferry on the Neuse River.
- Maintains tie-down (vertical 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.

North Carolina General Statute section 113-221.1(d), authorizes the Chair of the MFC to call an emergency meeting (pursuant to the request of five or more MFC members) 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.

## Amendment 2

Amendment 2 to the N.C. Estuarine Striped Bass FMP was adopted by the MFC at its November 2022 business meeting. The amendment included the no-possession measure for the Tar-Pamlico and Neuse rivers stocks that was included in Supplement A. Amendment 2 also maintained the gill net closure above the ferry lines and the use of 3-foot tie-downs for gill nets below the ferry lines. The draft of Amendment 2 presented to the MFC at their February 2022 business meeting included discussion of the ferry line gill net closures and options that would have provided limited access for the gill net fishery above the ferry

lines while continuing to minimize striped bass discards. However, at that meeting, the MFC approved a motion to send the draft Estuarine Striped Bass FMP Amendment 2 for review by the public and advisory committees with the change of deleting these options. Therefore, the only option considered by the public, MFC Advisory Committees, and MFC related to the ferry line gill net closure in Amendment 2 was to maintain it.

Amendment 2 included two measures for the Tar-Pamlico and Neuse rivers stocks that require reconsideration after 2024. First, the adaptive management framework prescribes that 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 MFC approved the following motion: "*maintain the gill net prohibition through 2024 to allow for assessment of its performance*".

**Adaptive Management**

Adaptive management allows managers to adjust management measures based on new information or data that was not available during adoption of the FMP. Data through 2024 were reviewed in early 2025 to determine the impact of the 2019 no-possession provision on the stocks.

If the data review suggests continuing the no-possession provision is needed for stock recovery, no changes in harvest management measures will be recommended until the next FMP Amendment is developed. Adaptive management may be used to adjust management measures, including area, time, and gear restrictions, if it is determined additional protections for the stocks are needed.

If analysis indicates the populations are self-sustaining and a level of sustainable harvest can be determined, recommendations for harvest strategies will be developed. Conversely, if analysis indicates biological and/or environmental factors prevent a self-sustaining population, then, consistent with the goal of Amendment 2, alternate management strategies will be developed that provide protection for, and access to, the resource.

## 2025 Data Review

**Methods**

Several data sets were updated with data from 2024 and analyzed to assess the impact of the 2019 no-possession provision on the Tar-Pamlico and Neuse rivers stocks. Analysis included evaluation of adult abundance, age structure, natural recruitment, and hatchery contribution. The analysis also considered environmental conditions (e.g., river flow), changes to stocking strategies, and new life history information. Details of complete data analysis and results can be found in "*Analysis of Striped Bass Fishery-Independent and Fishery-Dependent Data from the Tar-Pamlico and Neuse Rivers for Purposes of Amendment 2 Adaptive Management*".

**Summary of Results**

- No 'wild' juveniles have been caught in the Tar-Pamlico or Neuse rivers since two individuals were caught in 2021.
- From 2019–2024, the percentage of hatchery striped bass on the spawning grounds of the Tar-Pamlico and Neuse rivers has increased to nearly 100%.
- From 2019–2024, the percentage of hatchery origin striped bass in the lower Tar-Pamlico and Neuse rivers has been variable ranging from <50% to >90%.
- Abundance of all age classes in the lower rivers is significantly lower after the harvest closure.
- Abundance of all age classes on the spawning grounds did not increase significantly after the harvest closure.

**Conclusions**

- Harvest closure and gill net closure have been ineffective at increasing adult abundance, expanding the age structure, and promoting recruitment.
- The Tar-Pamlico and Neuse rivers striped bass stocks are currently not sustainable.
- Factors other than fishing mortality and inadequate spawning abundance are preventing sustainability of the Tar-Pamlico and Neuse rivers striped bass stocks.
- Acoustic and conventional tagging data indicate that most 'wild' fish in the Tar-Pamlico and Neuse rivers are likely part of the Albemarle-Roanoke stock.
- Environmental factors and declines in the Albemarle-Roanoke stock have contributed to reduced striped bass abundance in the Tar-Pamlico and Neuse rivers.

Based on data from the DMF and WRC fishery-independent and dependent sampling programs reviewed through 2024, the striped bass populations in the Tar-Pamlico and Neuse rivers are currently not self-sustaining. Evaluation of the harvest and gill net closures shows these measures have been ineffective at increasing adult abundance, expanding the age structure, and promoting natural recruitment through year six of implementation. Striped bass have been shown to quickly rebound even at low population levels given favorable environmental conditions (Robitaille et al. 2011; DFO 2023), suggesting factors other than fishing mortality and inadequate spawner abundance are preventing successful reproduction and self-sustaining striped bass populations in the Tar-Pamlico and Neuse rivers. Additional management aimed at trying to achieve sustainability of these stocks is unlikely to be effective unless significant environmental improvements occur.

Acoustic telemetry and genetic data suggest there are three groups of striped bass in the Tar-Pamlico and Neuse rivers. Most of the fish are hatchery reared stocked fish, followed by 'wild' fish originating from the Albemarle-Roanoke, with a small portion of 'wild' fish originating from the spawning ground on the Tar-Pamlico and Neuse rivers.

## Next Steps and Timeline

Consistent with the Amendment 2 goal and adaptive management framework, the DMF and WRC will begin developing harvest management measures that provide protection for, and access to, the resource. Harvest management measures will focus harvest on stocked fish in the Tar-Pamlico and Neuse rivers while limiting harvest of Albemarle-Roanoke stock striped bass to the greatest extent possible. Additionally, harvest will be limited to allow for mature stocked striped bass abundance in the rivers to be maintained so in the event of favorable environmental conditions, natural reproduction could occur.

Preliminarily, the DMF and WRC have explored harvest management measures that include the following:

- An open recreational harvest season in the Tar-Pamlico and Neuse rivers from April 1-30
- A one fish per person per day recreational creel limit
- And 18-22" recreational harvest slot with an allowance for one fish >27"

Next steps include reviewing available data to determine the downstream extent of where harvest could be allowed to minimize harvest of Albemarle-Roanoke stock striped bass and exploring possibilities for commercial harvest. An initial harvest plan will be presented to the MFC in November 2025.

## Timeline

*(gray indicates completed step)*

| | |
|---|---|
| Supplement A to Amendment 1 adopted | March 2019 |
| Ferry Line Gill Net Closure implemented | March 15, 2019 |
| Amendment 2 adopted | November 2022 |
| Division begins data review | January 1, 2025 |
| Division provides background to MFC | May 21 - 23, 2025 |
| **Division presents data analysis/conclusions/next steps to MFC – NO ACTION** | **August 2025** |
| Division presents initial harvest management plan to MFC | November 2025 |

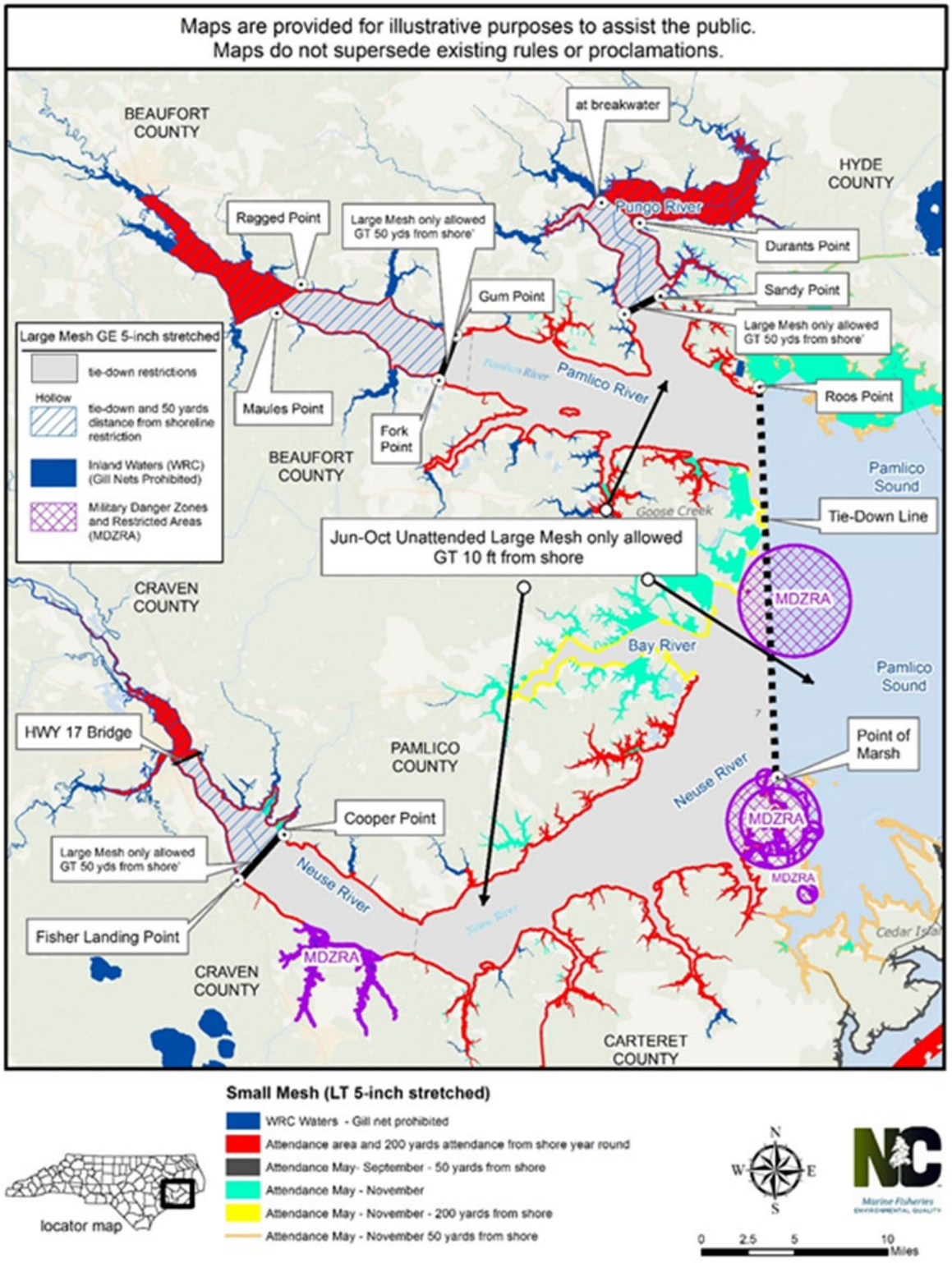



Figure 1. Gill-net regulations for small and large mesh gill nets in the Pamlico, Pungo, Bay, and Neuse rivers in place prior to implementation of the ferry line gill net closures. LT=less than.

## References

Fisheries and Ocean Canada (DFO). 2023. Update of spawner abundance and biological characteristics of Striped Bass (*Morone saxatilis*) in the southern Gulf of St. Lawrence to 2022. DFO Canadian Science Advisory Secretariat Science Response. 2023/004.

Robitaille, J., M. Bérubé, A. Gosselin, M. Baril, J. Beauchamp, J. Boucher, S. Dionne, M. Legault, Y. Mailhot, B. Ouellet, P. Sirois, S. Tremblay G. Trencia, G. Verreault and D. Villeneuve. 2011. Recovery Strategy for the Striped Bass (Morone saxatilis), St. Lawrence Estuary Population, Canada. Species at Risk Act Recovery Strategy Series. Ottawa : Fisheries and Oceans Canada. xi + 51 p.

**Analysis of Striped Bass Fishery-Independent and Fishery-Dependent Data from the Tar-Pamlico and Neuse Rivers for Purposes of Amendment 2 Adaptive Management**

**August 1, 2025**

## ISSUE

- Determine whether striped bass populations in the Tar-Pamlico and Neuse rivers are self-sustaining and if sustainable harvest can be determined
- Assess the impact of the 2019 no-possession provision and the gill net closure (closures) on the stocks
- Assess the impact of the 2019 gill net closure above the ferry line in each river system on the stocks

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.

## ORIGINATION

Amendment 2 to the North Carolina Estuarine Striped Bass Fishery Management Plan (FMP) adopted an adaptive management strategy where data through 2024 will be reviewed in 2025 to determine if populations are self-sustaining and if sustainable harvest can be determined. In addition, the approved North Carolina Marine Fisheries Commission (MFC) motion included language to: “maintain the gill net prohibition through 2024 to allow for assessment of its performance”.

The Amendment 2 adaptive management strategy further stated if the data review suggests continuing the no-possession provision is needed for additional stock recovery, no changes in harvest management measures will be recommended until the next scheduled FMP Amendment is developed starting in 2027. Adaptive management may be used to adjust management measures including area and time restrictions and gear restrictions if it is determined additional protections for the stock are needed.

If analysis indicates the populations are self-sustaining and a level of sustainable harvest can be determined, recommendations for harvest strategies will be developed. If analysis indicates biological and/or environmental factors prevent a self-sustaining population, then alternate management strategies will be developed that provide protection for and access to the resource.

## BACKGROUND

Natural reproduction is required for maintaining self-sustaining fish populations at levels that support harvest. In self-sustaining populations, the numbers of offspring produced by natural reproduction are greater than can be stocked by managers. Striped bass stocks that allow harvest and can self-replace through natural reproduction are considered sustainable. Until there are naturally reproducing populations in the Tar-Pamlico and Neuse rivers capable of self-replacement, the sustainable harvest objective of Amendment 2 cannot be met.

The Tar-Pamlico and Neuse rivers striped bass populations have been sustained by continuous stocking since at least the early 2000’s (O’Donnell and Farrae 2017; see NCDMF 2022, Appendix 1), providing harvest opportunities for recreational and commercial fisheries in the rivers which generally harvested between 5,000 and 10,000 striped bass annually (Table 1).

Table 1. Recreational harvest (number of fish landed and weight in pounds) and releases (number of fish) and commercial harvest (number and weight in pounds) of CSMA striped bass from North Carolina, 2004–2024.

| | Recreational | | | Commercial | | |
|---|---|---|---|---|---|---|
| Year | Number Landed | Number Released | Weight Landed | Number Landed | Weight Landed | Total Weight Landed |
| 2004 | 6,141 | 13,557 | 22,958 | 3,950 | 32,479 | 55,437 |
| 2005 | 3,832 | 16,854 | 14,965 | 3,723 | 27,132 | 42,097 |
| 2006 | 2,481 | 14,895 | 7,352 | 2,850 | 21,149 | 28,501 |
| 2007 | 3,597 | 23,527 | 10,794 | 3,608 | 25,008 | 35,802 |
| 2008 | 843 | 17,966 | 2,990 | 1,719 | 10,115 | 13,105 |
| 2009 | 895 | 6,965 | 3,061 | 4,140 | 24,847 | 27,908 |
| 2010 | 1,757 | 7,990 | 5,537 | 4,486 | 23,888 | 29,425 |
| 2011 | 2,728 | 24,188 | 9,474 | 4,083 | 28,054 | 37,528 |
| 2012 | 3,922 | 43,313 | 15,240 | 3,693 | 22,725 | 37,964 |
| 2013 | 5,467 | 32,816 | 19,537 | 4,439 | 28,597 | 48,134 |
| 2014 | 3,301 | 30,209 | 13,368 | 5,830 | 25,245 | 38,613 |
| 2015 | 3,934 | 31,353 | 14,269 | 6,029 | 27,336 | 41,605 |
| 2016 | 6,697 | 75,461 | 25,260 | 4,123 | 23,041 | 48,301 |
| 2017 | 7,334 | 131,129 | 26,973 | 4,382 | 23,018 | 49,991 |
| 2018 | 3,371 | 49,122 | 10,884 | 3,788 | 20,057 | 30,941 |
| 2019 | 959 | 36,080 | 3,562 | 0 | 0 | 3,562 |
| 2020 | 0 | 19,420 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 23,216 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 30,026 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 13,536 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 9,795 | 0 | 0 | 0 | 0 |
| Mean | 3,579 | 31,020 | 12,889 | 4,056 | 24,179 | 35,557 |

Roanoke River origin striped bass have either been stocked or used as broodstock in the Tar-Pamlico and Neuse rivers for decades (Bayless and Smith 1962; Woodroffe 2011). Although North Carolina rivers, including the Tar-Pamlico and Neuse rivers, may have once supported genetically distinct populations, evidence suggests there is little genetic differentiation between populations (Reading 2020). The need for continued conservation management efforts are supported by persistent recruitment failure, multiple mortality sources, absence of older, larger fish, low water flow levels on the spawning grounds in the spring, poor environmental conditions in the nursery areas, and the high percentage of stocked fish in the populations (Bradley et al. 2018; Rachels and Ricks 2018; Mathes et al. 2020). Reliable population estimates have never been determined for Tar-Pamlico River striped bass. In 2018, Bradley et al. (2018) provided a population estimate of 18,457 for Neuse River adult striped bass.

## Life History

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. Striped bass migrate long distances to spawning grounds located in freshwater portions of coastal rivers. The Albemarle-Roanoke (A-R) stock is considered migratory, meaning they spend most of their adult life in estuarine and nearshore ocean waters, migrating to fresh water to spawn in the spring. Striped bass stocks from the Tar-Pamlico and Neuse rivers stocks south through Florida, are considered riverine, meaning they do not make extensive seasonal ocean migrations like northern (Roanoke River and north) striped bass stocks and, instead, spend their entire life in the upper estuary and riverine system (Setzler et al. 1980; Rulifson et al. 1982; Callihan 2012).

Historically there were naturally reproducing stocks of striped bass in many of the large coastal rivers in South Carolina, Georgia, and Florida. Similar to North Carolina, the striped bass stocks in these states started showing declines in abundance and reduced natural spawning success in the 1970s or earlier. While there remain a few coastal rivers in these states that have naturally reproducing populations of striped bass, reproduction is limited and harvest management strategies are supported by extensive striped bass stocking programs in these states (GADNR; FLFWC SCDNR).

A maximum age of 15 years has been observed for striped bass in the Tar-Pamlico and Neuse rivers, and fish older than eight are rare. Striped bass in the Central Southern Management Area (CSMA; Tar-Pamlico, Neuse and Cape Fear rivers) grow at a faster rate and have a greater total length at age compared to the A-R stock (Knight 2015) and Neuse River striped bass exhibit the fastest growth rate in the CSMA (NCDMF 2020).

In the Tar-Pamlico and Neuse rivers, 50% of female striped bass are mature at 2.7 years and 98% are mature by age-3 (Knight 2015). Length at 50% maturity (L50) in the Tar-Pamlico and Neuse rivers was estimated at 467.8 mm TL (18.4 inches TL) and fish were estimated to be 100% mature at 537.3 mm TL (21.2 inches TL). Female striped bass produce large quantities of eggs which are broadcast into riverine spawning areas and fertilized by age-2 and older males. In the Tar-Pamlico and Neuse rivers, fecundity ranged from 223,110 eggs for an age-3 female to 3,273,206 eggs for an age-10 female.

In the Tar-Pamlico River, striped bass spawning is suspected to occur from the Rocky Mount Mills Dam,125 miles upstream of Washington, NC, to Tarboro, NC (Smith and Rulifson 2015). Neuse River spawning grounds are centered between Smithfield and Clayton, NC, but range from Kinston at river mile (rm) 130 to Raleigh (rm 236). Successful juvenile recruitment occurs infrequently and at low levels in the Tar-Pamlico and Neuse rivers. The Tar-Pamlico and Neuse rivers stocks are supported by continuous stocking efforts as evidenced by stocked fish comprising nearly 100% of the striped bass on the spawning grounds and up to 70% in downriver coastal fishing waters in some years ( O'Donnell and Farrae 2017; Cushman et al. 2018; Farrae 2019; Harris and Farrae 2020; Mathes et al. 2020; Harris and Farrae 2021; Harris and Farrae 2022; Doll and Farrae 2023; Doll and Farrae 2024).

## Management History

*Amendment 1*

Management measures in Amendment 1 consisted of daily possession limits, open and closed harvest seasons, seasonal gill net attendance and other gill-net requirements, minimum size limits, and slot limits to work towards the goal of achieving sustainable harvest. Tie down and distance from shore gill net management measures from the 2004 Estuarine Striped Bass FMP (NCDMF 2004) that were maintained in Amendment 1 were implemented using science-based decision-making processes. Rock et al. (2016) estimated these measures decreased striped bass

discards by 82% compared to estimates prior to implementation, indicating effectiveness of these measures. Amendment 1 also maintained the stocking measures in the major CSMA river systems (NCDMF 2013).

*Supplement A to Amendment 1*

In 2017 and 2018, available Parentage-Based Tagging (PBT) data, which is a genetic method used to identify parentage of hatchery origin fish, suggested there were potentially one or two successful striped bass spawning events in the Tar-Pamlico and Neuse rivers in 2014 and 2015 that produced 'wild' fish and was particularly evident in the Neuse River (Table 2). Additionally, 2016–2018 CSMA Creel Survey angler data showed a significant increase in recreational catch of under-sized striped bass in the Pungo, Tar-Pamlico and Neuse rivers (Figure 1). Supplement A to Amendment 1 (NCDMF 2019) implemented a recreational and commercial no-possession provision for striped bass in the internal coastal and joint waters of the CSMA (Tar-Pamlico and Neuse rivers) with the objective of providing additional protection for these potentially naturally produced year classes in support of the Amendment 1 goal to achieve sustainable harvest through science-based decision-making processes that conserve adequate spawning stock and provide and maintain a broad age structure. Supplement A maintained commercial gill net restrictions requiring 3-foot tie-downs and 50-yard distance from shore measures year-round (M-5-2019).

Table 2. PBT results from Tar-Pamlico and Neuse rivers striped bass showing the number and percentages of hatchery origin versus 'wild' origin fish, 2016–2024.

| River System | Year | Number of PBT Samples | Hatchery (n) | 'Wild' (n) | Hatchery (%) | 'Wild' (%) |
|---|---|---|---|---|---|---|
| Tar-Pamlico | 2016 | 190 | 164 | 26 | 86.0 | 14.0 |
| | 2017 | 147 | 102 | 45 | 70.0 | 31.0 |
| | 2018 | 206 | 74 | 132 | 36.0 | 64.0 |
| | 2019 | 108 | 48 | 60 | 44.4 | 55.6 |
| | 2020 | 56 | 39 | 17 | 69.6 | 30.4 |
| | 2021 | 103 | 53 | 50 | 51.5 | 48.5 |
| | 2022 | 81 | 75 | 6 | 92.6 | 7.4 |
| | 2023 | 47 | 44 | 3 | 93.6 | 6.4 |
| | 2024 | 21 | 20 | 1 | 95.2 | 4.8 |
| Neuse | 2016 | 150 | 142 | 8 | 95.0 | 5.0 |
| | 2017 | 118 | 66 | 52 | 56.0 | 44.0 |
| | 2018 | 86 | 46 | 40 | 54.0 | 47.0 |
| | 2019 | 102 | 68 | 34 | 66.7 | 33.3 |
| | 2020 | 24 | 17 | 7 | 70.8 | 29.2 |
| | 2021 | 114 | 56 | 58 | 49.1 | 50.9 |
| | 2022 | 34 | 29 | 5 | 85.3 | 14.7 |
| | 2023 | 35 | 33 | 2 | 94.3 | 5.7 |
| | 2024 | 23 | 22 | 1 | 95.7 | 4.3 |

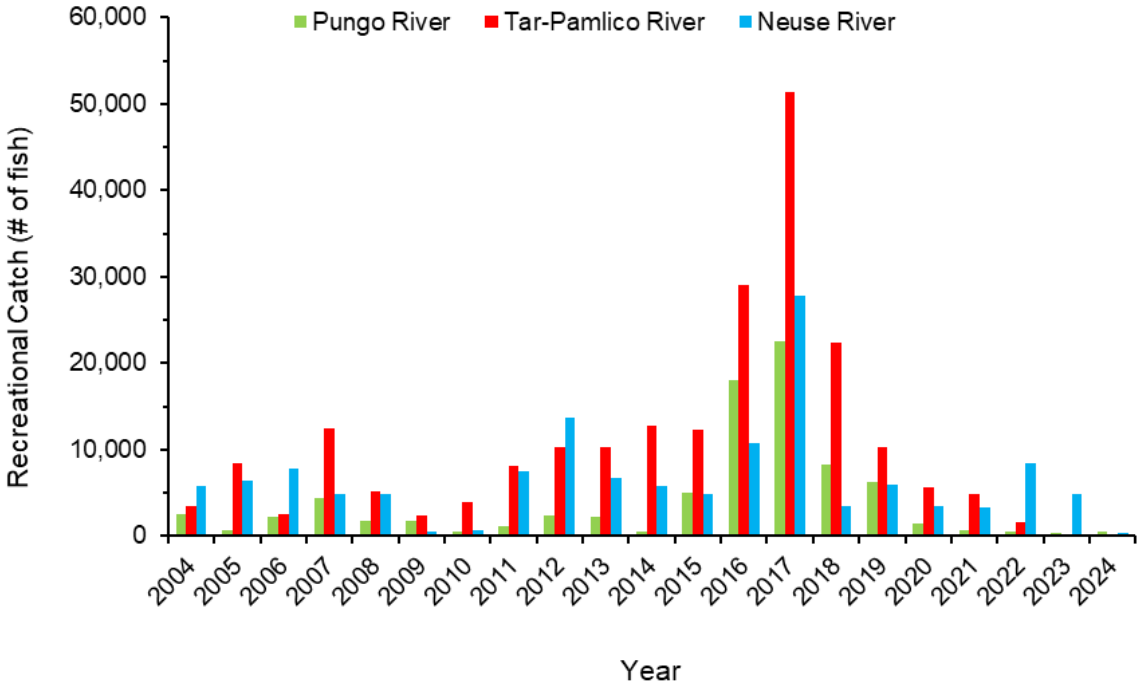



Figure 1. CSMA Creel Survey estimates of under-sized recreationally caught striped bass in the Pungo, Tar-Pamlico, and Neuse rivers, 2004–2024.

*Ferry Line Gill Net Closure*

Independent of Supplement A but also at the February 2019 NCMFC business meeting, the following motion passed:

> "Ask the director of the NCDMF to issue a proclamation, effective in conjunction with the Supplement, that restricts the use of gill nets that interact with striped bass upstream of the ferry lines and requires attendance of gill nets that interact with striped bass upstream of the tie-down lines."

After careful consideration, the DMF Director declined the request concluding that scientific data did not support the requested management measure (see Appendix 2 DMF Director Memo to MFC, March 4, 2019). On March 13, 2019, the MFC held an emergency meeting to request the North Carolina Wildlife Resources Commission (WRC) adopt concurrent regulations regarding recreational harvest of striped bass in joint waters. At the emergency meeting the MFC passed a motion directing the division to issue a proclamation regarding gill nets beyond what was contained in Supplement A.

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

*Amendment 2*
Amendment 2, adopted in November of 2022, contained management measures for the Tar-Pamlico and Neuse rivers stocks that maintained the no-possession measure, the gill net closure above the ferry lines, and the use of 3-foot tie-downs below the ferry lines. Additionally, the Amendment 2 adaptive management strategy prescribed that in 2025, data through 2024 will be reviewed to determine if populations are self-sustaining and if sustainable harvest can be determined. In addition, Amendment 2 maintained the gill net prohibition through 2024 to allow for assessment of its performance.

## DATA

### Methods
To assess if the 2019 no-possession provision and ferry line gill net closures have increased relative abundance of striped bass and expanded the age structure of the stock, and to assess whether striped bass populations in the Tar-Pamlico and Neuse rivers have achieved a level of sustainability through successful natural reproduction, several fishery-independent and dependent data sources were reviewed. The DMF Independent Gill Net Survey and the WRC Electrofishing Survey data sets are the primary data sources for the evaluation; however, the CSMA Striped Bass Creel survey and DMF gill net observer program data were also evaluated.

For further information about survey methodology, design and data collection see Mathes et al. (2020) and NCDMF (2024).

*Adult Relative Abundance*

*Fisheries-Independent Gill Net Survey (Program 915)*
Program 915 employs a random survey design stratified by area and depth that has sampled in the Tar-Pamlico, Pungo, and Neuse rivers since 2003. Striped bass abundance calculations exclude Pungo River data due to elevated presence of A-R stock fish in this river (Mathes et al. 2020). Only shallow sets during April, and October–November were used in relative abundance calculations because striped bass are most available to the survey in these areas and months.

*WRC Spawning Grounds Electrofishing Survey*
Electrofishing surveys have been conducted by the WRC on the Tar-Pamlico River spawning grounds since 1996 and on the Neuse River spawning grounds since 1994. 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 each year. The survey uses a stratified random sampling design in the Tar-Pamlico and Neuse rivers. In the Tar-Pamlico River, striped bass sampling typically begins in March and continues into May until water temperatures consistently exceed optimal temperatures for spawning (18–22 °C) and spawning appears complete. Sampling on the Neuse River is conducted a minimum of once at each stratum per week during the spawning season and generally occurs from April–May. Sampling upstream strata is highly dependent on streamflow, with low flow conditions causing sampling to only occur in lower river strata. In these instances, striped bass using upper river habitats would not be sampled; however,

striped bass access to upriver habitats is also limited during low water levels. Relative abundance is calculated as the number of fish captured per hour of electrofishing.

*Age Data*

Striped bass otoliths and fin clips were collected opportunistically from DMF fishery-independent and dependent sampling programs. Age samples were primarily collected from Program 915, but DMF also uses an electrofishing boat to collect striped bass to increase the sample size and collect a representative size range of striped bass including older, larger fish.

*Juvenile Relative Abundance (Program 100)*

Program 100 sampling has been conducted in the Tar-Pamlico and Neuse rivers since 2017. The survey employs beach seines (June–July) and trawls (July–October) to monitor striped bass recruitment and assess the effectiveness of management measures aimed at promoting natural reproduction. Seine and trawl survey stations are located in the upriver sections of the Tar-Pamlico and Neuse rivers, near Washington and New Bern, respectively. A sample consisted of one trawl tow or one pull of the seine per station (Mathes et. al 2020). A fin clip was collected from all YOY striped bass to determine if they are of hatchery or 'wild' origin using genetic methods.

*Parentage-Based Tagging (PBT)*

Analysis using microsatellite markers has been used by the WRC since 2010 and the DMF since 2016 to genetically identify stocked fish in the Tar-Pamlico and Neuse rivers. PBT techniques identify a fish as hatchery reared or non-hatchery by using genetic microsatellite markers to match stocked fish with broodfish used in hatchery production (Denson et al. 2012). PBT cannot distinguish the origin of non-hatchery striped bass. Fish determined to not be of hatchery origin could be the result of 'wild' reproduction in any system. Additionally, striped bass stocked prior to 2010 are not identifiable using PBT techniques. Striped bass fin clip samples were collected opportunistically from DMF fishery-independent and dependent sampling programs, as well as from the WRC spawning ground surveys to identify fish as either hatchery or non-hatchery origin.

*Mann-Kendall (M-K) Trend Test*

The M-K test is a non-parametric statistical test used to detect significance of increasing or decreasing trends over time, without requiring the data to be normally distributed. M-K tests were used to assess the impact of the 2019 no-possession provision on the stocks. The test provides a p-value, which indicates the probability of observing the results if there is no trend in the time series. If the p-value is below a certain significance level (e.g., 0.05), the null hypothesis is rejected, suggesting there is a statistically significant trend. In an M-K Trend Test, Kendall's Tau is a correlation coefficient used as a measure of the relationship between two variables. Kendall's Tau measures the strength and direction of the trend in a time series. It indicates whether the values tend to increase or decrease over time. A positive Tau suggests an increasing trend, a negative Tau indicates a decreasing trend, and a value close to zero suggests no trend.

*Randomization Test*

The Randomization test is a non-parametric statistical test used to detect significant differences between groups that relies on randomly shuffling observed data to determine if observed differences are statistically significant. Randomization tests shuffle data many times to evaluate mean catch per unit effort differences. Additionally, after each shuffle, the means computed from the shuffled data are compared with the observed mean difference. The p-value for the

randomization test is the percentage of times the absolute value of the shuffled mean difference is equal to or greater than the absolute value of the observed mean. Randomization tests were applied to fisheries-independent data (Program 915 and WRC Electrofishing Survey) to assess if striped bass catch was significantly different after the harvest closure compared to before the harvest closure and if striped bass catch was significantly different above the ferry lines after the gill net closure.

## Results

### *Adult Relative Abundance*

*Program 915*

Striped bass relative abundance from Program 915 in the Tar-Pamlico and Neuse rivers ranged from 0.8 to 9.0 fish per sample during 2004–2024. Striped bass relative abundance in the Tar-Pamlico River was the lowest in the time series during 2021–2024, and well below the time series average of 4.3 striped bass per set before the 2019 closure (Figure 2). After the management measures went into place in the Tar-Pamlico River there was a decrease in relative abundance (61% reduction, 4.3 to 1.7 fish per set; Figure 2).

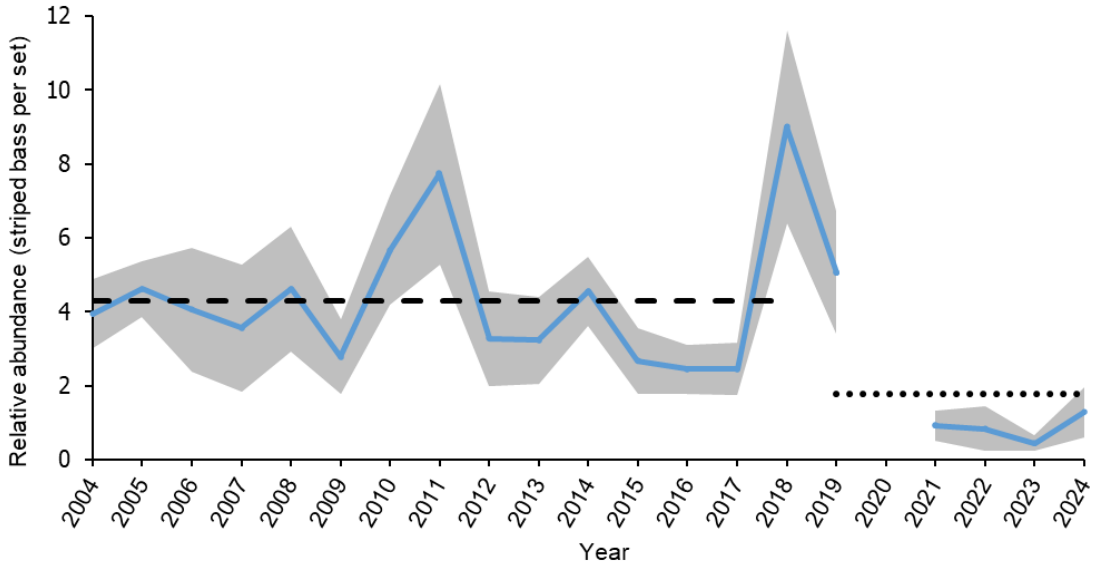



Figure 2. Annual index of adult striped bass relative abundance from Program 915 in the Tar-Pamlico River during April, and October–November, in shallow water sets, 2004–2024. No sampling occurred in 2020, and limited sampling occurred in 2021 (July–December). Error bars represent ± 1 standard error. Dashed line is mean abundance from 2004–2018 (pre-closure), dotted line is mean abundance from 2019–2024 (post-closure).

In the Neuse River, striped bass relative abundance has declined since 2021 and in 2022–2024 had the lowest values in the time series, well below the time series average of 3.6 striped bass per set before the 2019 closure (Figure 3). After the closure went into place in the Neuse River there was a decrease in relative abundance (42% reduction, 3.6 to 2.1 fish per set; Figure 3).

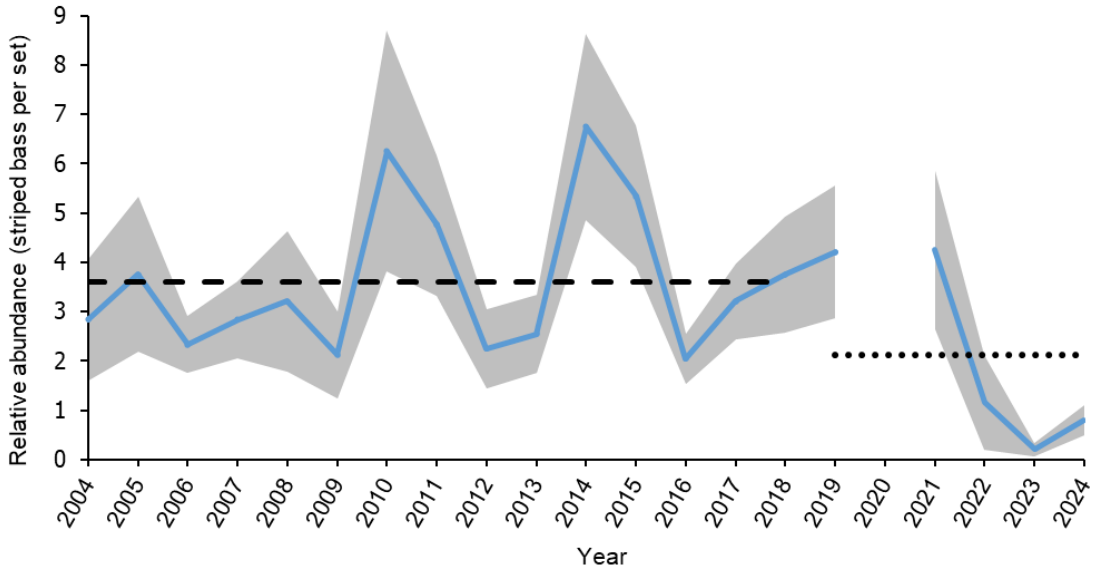



Figure 3. Annual index of adult striped bass relative abundance from Program 915 in the Neuse River during April, and October–November, in shallow water sets, 2004–2024. No sampling occurred in 2020, and limited sampling occurred in 2021 (July–December). Error bars represent ± 1 standard error. Dashed line is mean abundance from 2004–2018 (pre-closure), dotted line is mean abundance from 2019–2024 (post-closure).

Striped bass length frequencies from Program 915 in the Tar-Pamlico and Neuse rivers are shown in Figure 4. Length frequency distributions are variable between years but generally range from 10–25 inches total length (TL), however in the Tar-Pamlico River from 2016–2017 (Figure 4A) and in the Neuse River from 2015–2017 (Figure 4B) there was a higher percentage of small fish that could represent the two-year classes of striped bass thought to be the result of successful natural reproduction in 2014 and 2015. In 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. 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.

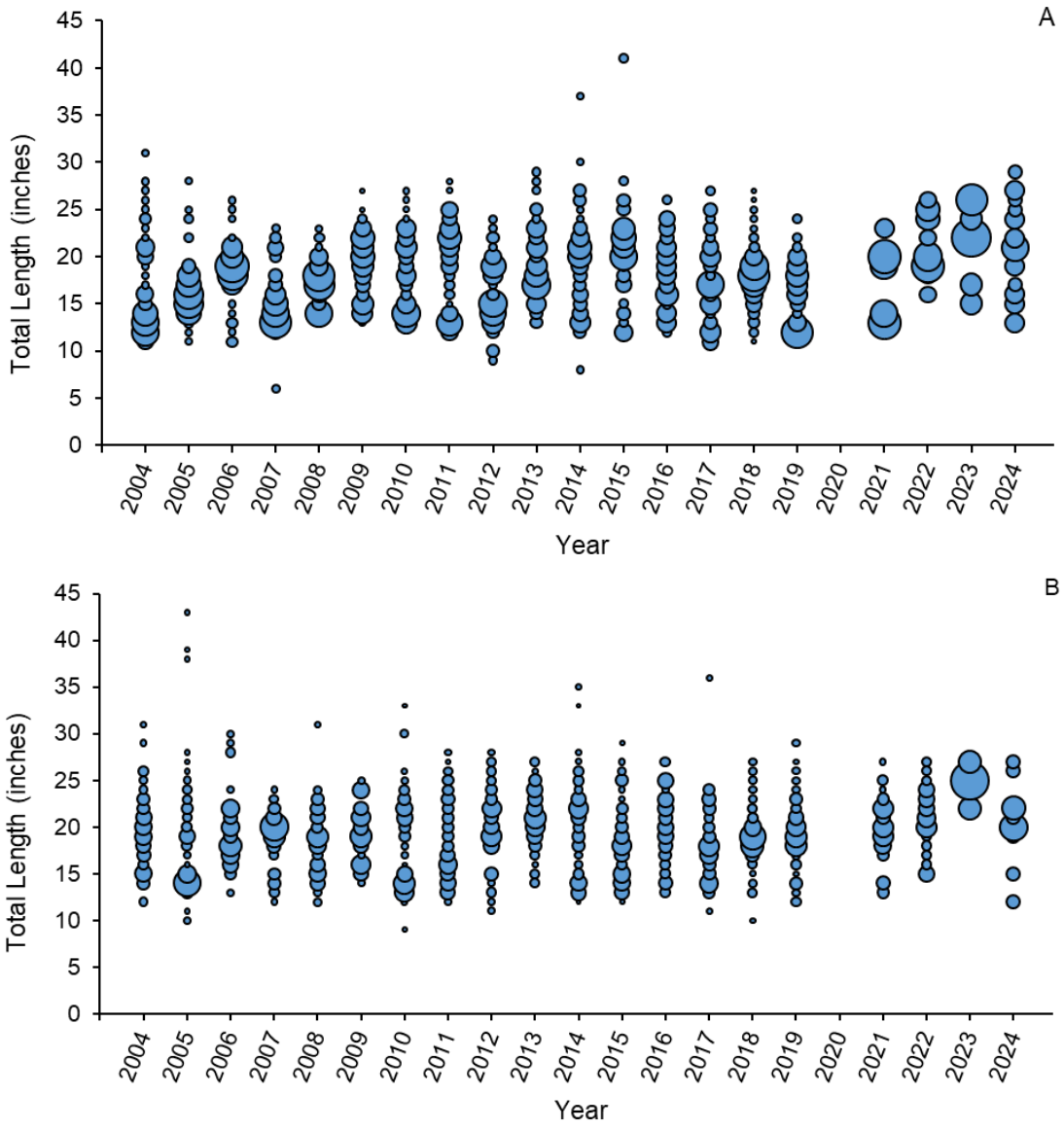



Figure 4. Length frequency of striped bass captured in Program 915 in the Tar-Pamlico River (A), and the Neuse River (B) during April, and October–November, in shallow water sets (2004–2024). No sampling occurred in 2020 and limited sampling occurred in 2021 (July–December). Bubbles represent fish at length and the bubble size is proportional to the number of fish at that length.

*WRC Spawning Grounds Electrofishing Survey*

Striped bass relative abundance from the WRC spawning grounds electrofishing survey in the Tar-Pamlico River has ranged from a low of 18.2 striped bass per hour in 2018 to a peak of 100.0 per hour in 2010 (Figure 5). Since the harvest closure in 2019, relative abundance has increased approaching levels near the 1996–2018 time series average of 40.8 fish per hour; however, there was a decrease in relative abundance after the 2019 closures went into place (20% reduction, 40.8 to 32.7 fish per sample; Figure 5). Additionally, the percentage of Age 6+ (~600 mm TL) striped bass on the Tar River spawning grounds has decreased from a 10-year average (2009–2018) of 18% by approximately 12% since the 2019 closures.

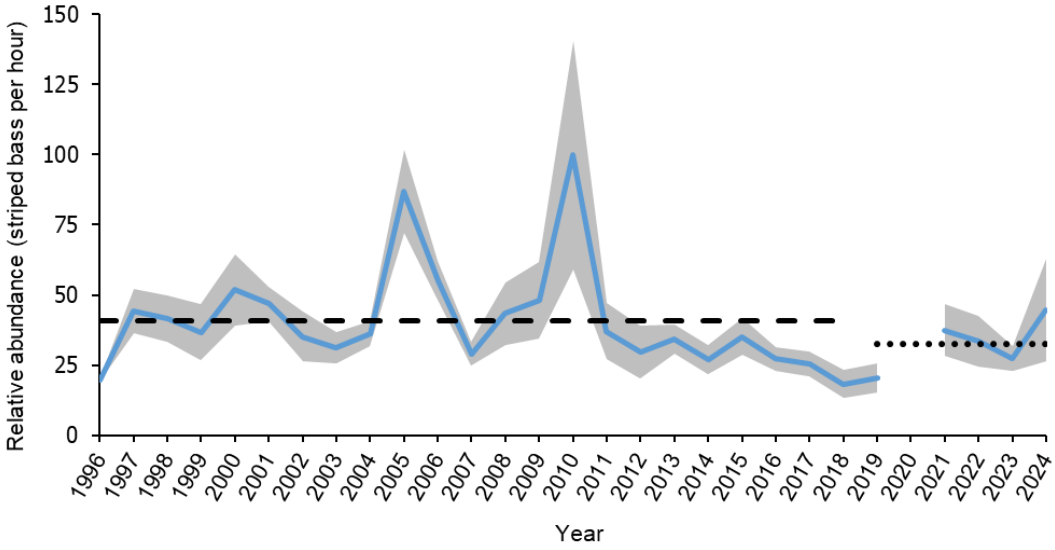



Figure 5. Relative abundance of Tar-Pamlico River striped bass from the WRC spawning grounds electrofishing survey, 1996–2024. No sampling occurred in 2020. Shaded error bars represent ± 1 standard error. Dashed line is mean abundance from 2004–2018 (pre-closures), dotted line is mean abundance from 2019–2024 (post-closures).

From 1994 through 2024, striped bass relative abundance in the Neuse River has been highly variable, ranging from 4.4 fish per hour in 2008 to 20.4 fish per hour in 1999 (Figure 6).

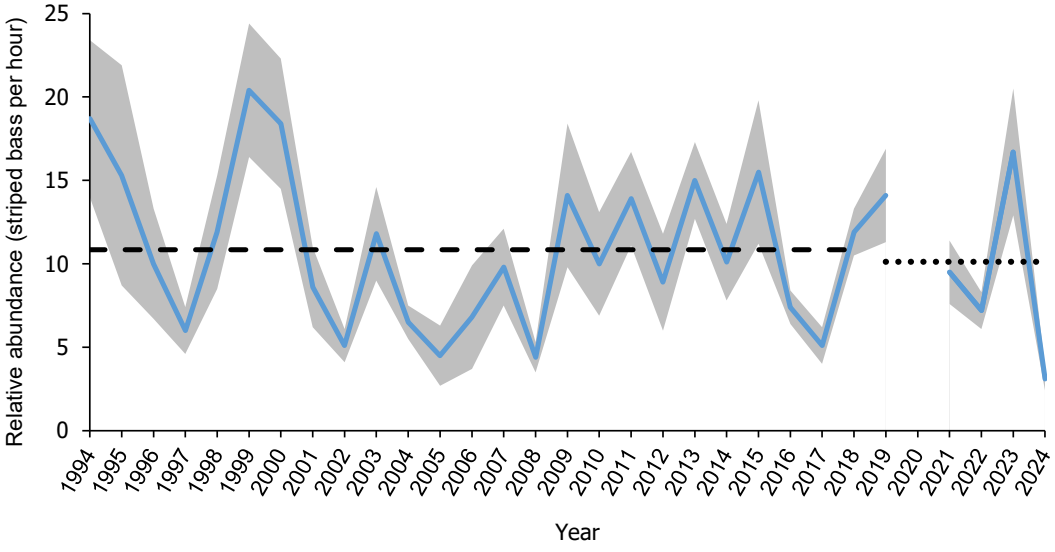



Figure 6. Relative abundance of Neuse River striped bass from the WRC spawning grounds electrofishing survey, 1994–2024. No sampling occurred in 2020. Shaded error bars represent ± 1 standard error. Dashed line is mean abundance from 2004–2018 (pre-closures), dotted line is mean abundance from 2019–2024 (post-closures).

Although relative abundance has continued to be highly variable since the 2019 closures, ranging from 16.7 fish per hour in 2023 to 3.1 fish per hour in 2024, the mean value during 2019–2024 (7% reduction, 10.1 fish per hour) is at the 1994–2018 time series average (10.8 fish per hour). Relative abundance from the WRC electrofishing surveys in the Tar-Pamlico and Neuse rivers shows little to no trend since the 2019 closures.

## *Age Data*

Fishery-independent and fishery-dependent age data (2004–2024) collected from otolith and genetic samples show no expansion of the age structure (increased numbers of age-10+ fish) in the Tar-Pamlico or Neuse rivers since implementation of the harvest and gill net closures in 2019. Modal and maximum age has not increased beyond what was observed prior to 2019 (Table 3, modal age=3; maximum age=12).

Table 3. Tar-Pamlico and Neuse rivers striped bass otolith and genetic age data from fishery dependent and independent surveys, 2004–2024. PBT age data for 2024 are not yet 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 | - | 10 | - | 65 | 45 |

Striped bass up to age-6 are commonly encountered and striped bass age-6 and under make up around 90% of the DMF otolith age samples in the Tar-Pamlico and Neuse rivers (Figure 7). However, fish older than age-10 are rare and make up less than 10% of the age samples in all years since 2013.

Two tagged striped bass, raised at Edenton National Fish Hatchery and released into the Tar-Pamlico River as phase-II sized fingerlings in 2008, were recaptured in November 2023 by an angler along the railroad bridge over the Tar-Pamlico River in Washington, NC. These tag returns indicate an increase in the maximum observed age of Tar-Pamlico River striped bass from 12 years to 15 years.

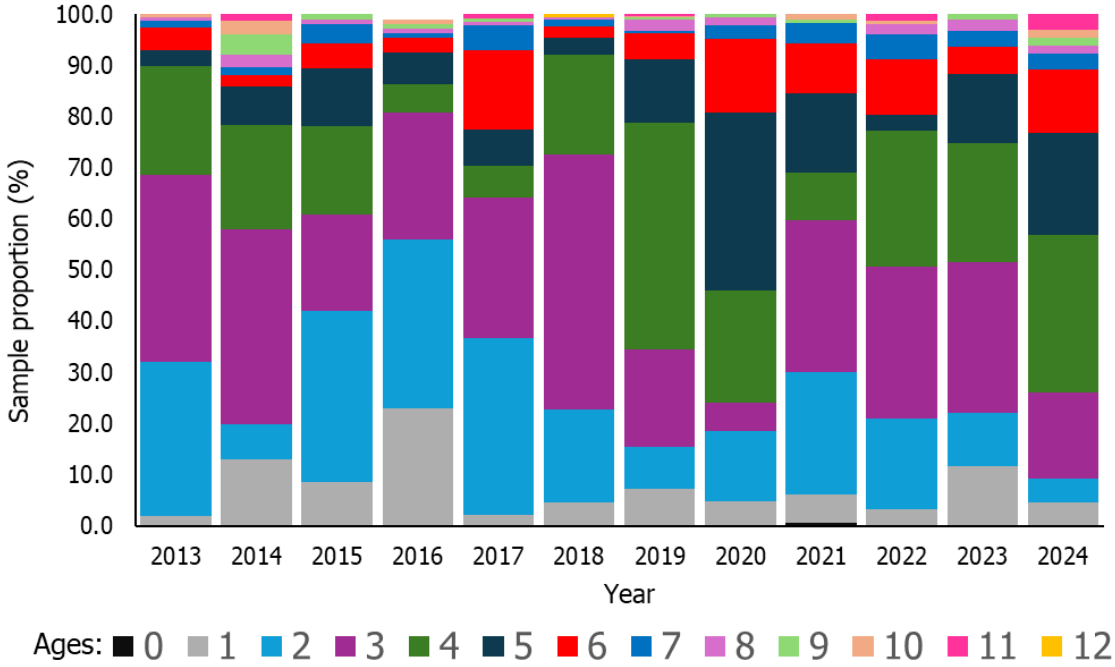



Figure 7. Proportion (%) at age (otolith ages) for striped bass collected from DMF sampling programs in the Tar-Pamlico and Neuse rivers, 2013–2024.

*Juvenile Relative Abundance*

As of 2024, only two 'wild' (non-hatchery) juvenile striped bass were collected from the Tar-Pamlico River (2021), with no 'wild' juvenile striped bass collected in the Neuse River. Stocked phase-I size (1–2 inch) juvenile striped bass were collected from the Tar-Pamlico (n=35) and Neuse rivers (n=8) in 2022 and 2023 (Table 4). Because no striped bass were captured in trawl sampling 2017–2022, trawl sampling was discontinued after the 2022 season and additional seine sampling was added.

Table 4. Relative abundance (Index) 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.

| | Tar-Pamlico River | | | | | | Neuse River | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Seine | | | Trawl | | | Seine | | | Trawl | | |
| Year | Striped bass (N) | Samples (N) | Index | Striped bass (N) | Samples (N) | Index | Striped bass (N) | Samples (N) | Index | Striped bass (N) | Samples (N) | Index |
| 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 | 0.00 | - | - | - |
| Total | 37 | 398 | 0.09 | 0 | 264 | 0.00 | 8 | 398 | 0.02 | 0 | 264 | 0.00 |

*non-hatchery or ‘‘wild’’ fish
† phase-I hatchery origin

*Parentage Based Tagging*

PBT analysis of samples collected on the spawning grounds and from internal coastal waters of the Tar-Pamlico and Neuse rivers indicates stocked striped bass can make up greater than 90% of the fish sampled in some years (2013–2016); however, results from 2017 and 2018 indicated a noticeable decrease in contribution of hatchery-stocked fish in the Tar-Pamlico and Neuse rivers (Farrae and Darden 2018; Figure 8). From 2019 to 2023, the percentage of stocked fish continued to increase. However, results from 2021 DMF samples (n=220) showed a noticeable drop in the percentage of hatchery fish to a 50/50 split with ‘wild’ striped bass. Upon further investigation of the 2021 PBT data, DMF striped bass collections in the Tar-Pamlico and Neuse rivers from January through March consisted of nearly 100% ‘wild’ origin striped bass. Interestingly, ages 6 and 7 represented 29% of the catch which could be ‘wild’ A-R stock striped bass from the 2014- and 2015-year classes produced in the Roanoke River. Additionally, age-3 striped bass represented 27% of the samples which could indicate successful natural recruitment in the Tar-Pamlico and Neuse rivers from the 2018-year class, or recruitment from the A-R system even though the 2018 A-R juvenile abundance index was low.

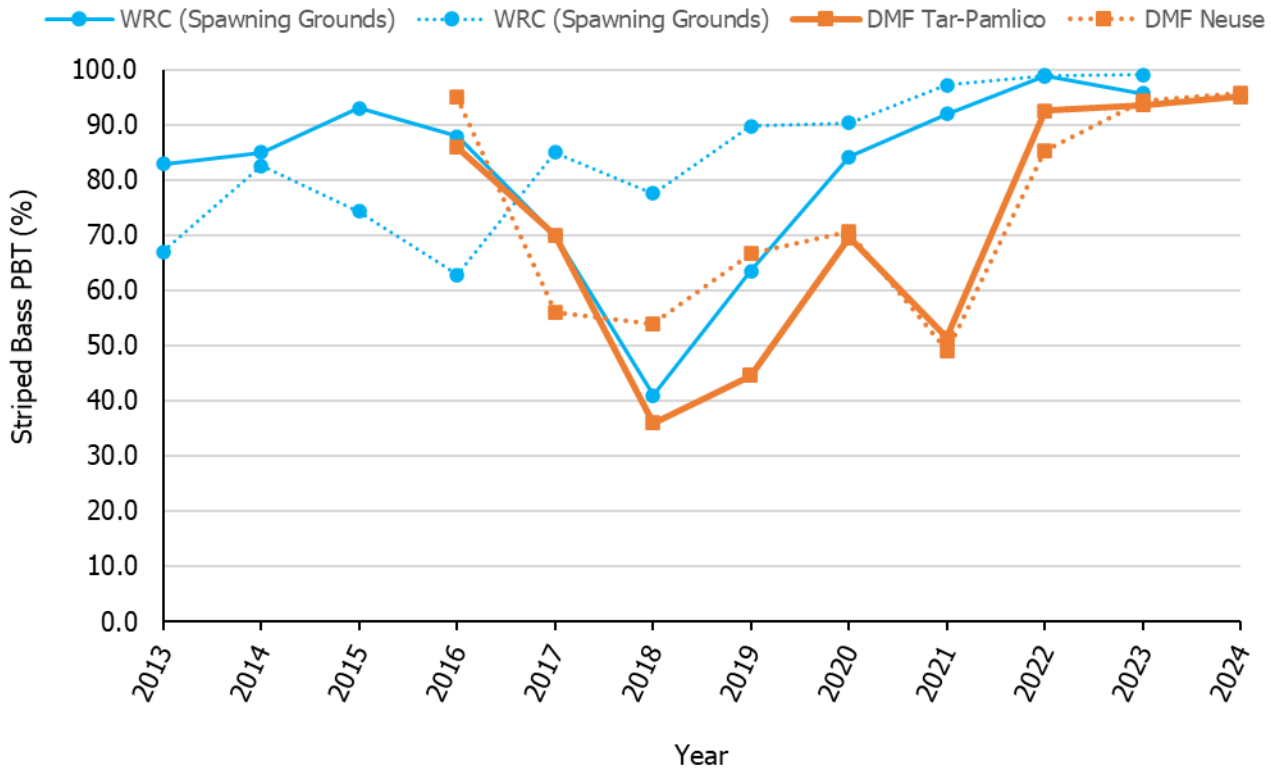



Figure 8. Hatchery contribution from the DMF Fisheries Independent and Dependent sampling programs (2016–2024) and the WRC Electrofishing Surveys (2013–2023) on the spawning grounds in the Tar-Pamlico and Neuse rivers. WRC PBT data for 2024 are not yet available.

*Creel Survey*

A comprehensive creel survey was initiated in January 2004 to identify and estimate recreational striped bass effort and catch in the CSMA, particularly the Tar-Pamlico and Neuse rivers. Although the recreational striped bass season in the CSMA has remained closed since March 2019, data collection characterizing fishing effort and release disposition has continued. Within the CSMA there is a significant catch-and-release fishery and releases during the past ten years (2015–2024) have averaged 43,168 fish annually (Table 5). In 2024, the number of striped bass caught and released as discards was 6,971 fish which was a decrease from 12,957 fish in 2023, and below the ten-year average. Under-sized discards peaked in 2017 mainly due to the large number of sub-legal striped bass available in the Tar-Pamlico River system; however, the number of under-sized discards has declined since, and in 2024 there were only an estimated 944 under-sized striped bass discards.

Table 5. Recreational striped bass effort (trips and hours), harvest, and discards from the Pungo, Tar-Pamlico, and Neuse rivers (2004–2024). There was a limited

recreational harvest season in 2019 (January 1–March 19, 2019) prior to the closures.

| Year | Number Striped Bass Trips | Number Striped Bass Hours | Harvest | | Discard | | | | Catch # Fish |
|---|---|---|---|---|---|---|---|---|---|
| | | | Number | Pounds | Over Creel | Under-Sized | Legal-Sized | Slot | |
| 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 | 20,136 | 86,049 | 5,467 | 19,537 | 447 | 19,302 | 10,356 | 2,357 | 37,928 |
| 2014 | 15,244 | 68,153 | 3,301 | 13,368 | 728 | 19,185 | 7,104 | 1,641 | 31,959 |
| 2015 | 17,950 | 78,696 | 3,934 | 14,269 | 40 | 22,272 | 8,029 | 813 | 35,088 |
| 2016 | 23,283 | 108,989 | 6,697 | 25,260 | 203 | 57,874 | 9,977 | 6,779 | 81,529 |
| 2017 | 26,100 | 119,522 | 7,334 | 26,973 | 549 | 101,787 | 26,487 | 2,293 | 138,450 |
| 2018 | 16,369 | 69,856 | 3,371 | 10,884 | 871 | 34,128 | 12,092 | 1,890 | 52,353 |
| 2019 | 8,796 | 40,485 | 959 | 3,562 | 924 | 22,375 | 7,817 | 2,481 | 34,557 |
| 2020 | 2,839 | 13,247 | 0 | 0 | 0 | 10,440 | 7,575 | 1,406 | 19,420 |
| 2021 | 4,641 | 17,596 | 0 | 0 | 0 | 8,815 | 12,311 | 1,769 | 22,895 |
| 2022 | 3,953 | 13,727 | 0 | 0 | 0 | 10,601 | 12,159 | 4,701 | 27,462 |
| 2023 | 3,020 | 10,923 | 0 | 0 | 0 | 5,268 | 5,860 | 1,829 | 12,957 |
| 2024 | 1,604 | 7,867 | 0 | 0 | 0 | 944 | 4,724 | 4,055 | 9,722 |
| Total | 244,480 | 1,060,873 | 57,258 | 206,224 | 7,502 | 438,943 | 157,776 | 38,293 | 699,758 |

*Observer Program*

*Program 466*

Onboard Observer Monitoring was designed to monitor fisheries for protected species interactions in the large and small mesh anchored commercial gill-net fishery by providing onboard observations. During onboard trips, this program also monitors finfish catch and discards and characterizes effort in the fishery. Program 466 does not conduct observations on commercial trips using gill nets that are exempt from the Division's Incidental Take Permit, including runaround, strike, drop, or drift gill nets. Number of striped bass observed in the Tar-Pamlico and Neuse rivers commercial large and small mesh gill net fisheries averaged 102 fish per year with a high of 302 fish in 2014 and a low of zero fish in 2020 and 2021 (Table 6). Since the harvest and gill net closures (2019), the number of observed striped bass has averaged 5.3 fish per trip. The decrease in number of observed striped bass is due in part to prohibiting the use of gill nets above the ferry lines and harvest restrictions in other fisheries, most notably southern flounder, that have significantly limited the use of anchored large mesh gill nets.

Table 6. Number of observed (Program 466) gill net trips and number of striped bass harvested and discarded, including disposition observed by mesh size in the Tar-Pamlico and Neuse rivers (all trips west of tie down line), 2012–2024. Note: observations in 2020 and 2021 were limited due to COVID restrictions.

| | Large Mesh | | | | Small Mesh | | | | Total Numbers | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Trips | Harvested | Dead Discard | Alive Discard | Trips | Harvested | Dead Discard | Alive Discard | Trips | Harvested | Dead Discard | Alive Discard | Striped Bass Captured |
| 2012 | 70 | 19 | 1 | 8 | 17 | 0 | 1 | 12 | 87 | 19 | 2 | 20 | 41 |
| 2013 | 104 | 58 | 14 | 12 | 11 | 0 | 0 | 0 | 115 | 58 | 14 | 12 | 84 |
| 2014 | 252 | 167 | 41 | 83 | 39 | 2 | 0 | 9 | 291 | 169 | 41 | 92 | 302 |
| 2015 | 149 | 202 | 16 | 42 | 39 | 4 | 4 | 9 | 188 | 206 | 20 | 51 | 277 |
| 2016 | 153 | 119 | 25 | 14 | 23 | 0 | 4 | 12 | 176 | 119 | 29 | 26 | 174 |
| 2017 | 163 | 110 | 12 | 134 | 35 | 0 | 0 | 36 | 198 | 110 | 12 | 170 | 292 |
| 2018 | 122 | 37 | 15 | 45 | 23 | 1 | 2 | 10 | 145 | 38 | 17 | 55 | 110 |
| 2019 | 60 | 0 | 8 | 12 | 45 | 0 | 2 | 5 | 105 | 0 | 10 | 17 | 27 |
| 2020 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 1 | 7 | 0 | 0 | 0 | 1 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| 2023 | 8 | 0 | 0 | 3 | 4 | 0 | 0 | 3 | 12 | 0 | 0 | 3 | 3 |
| 2024 | 4 | 0 | 0 | 1 | 4 | 0 | 0 | 1 | 8 | 0 | 0 | 1 | 1 |
| Totals | 1,088 | 712 | 132 | 355 | 247 | 7 | 13 | 98 | 1,335 | 719 | 145 | 447 | 1,312 |

*Analysis of Pre and Post Closures Abundance Trends*

The M-K Trend Test was used to compare Program 915 and the WRC Electrofishing Survey abundance trends before and after the striped bass harvest and gill net closures to determine if striped bass abundance trends were significant after the closures.

Randomization Tests were used to compare striped bass abundance from Program 915 and the WRC Electrofishing Survey before and after the harvest and gill net closures to determine if striped bass abundance increased significantly after the closures.

*Program 915 M-K Trend Test*

M-K Trend Test results showed for the period before the closures (2004–2018) there was no significant trend in Program 915 striped bass catch in the Tar-Pamlico River (P value greater than 0.05; Table 7). In the Neuse River, M-K Trend Test results indicated no significant trend in striped bass catch before or after the closures.

Table 7. M-K Trend Test for striped bass relative abundance from Program 915 indicating the direction of the trend in the Tar-Pamlico and Neuse rivers before (2004–2018) and after (2019–2024) the closures (P-value < α; α = 0.05). NS = not a significant trend.

| System | Closures | P-value < a; a = 0.05 | Trend |
|---|---|---|---|
| Tar-Pamlico River | Before (2004 - 2018) | 0.28 | NS |
| | After (2019 - 2024) | 0.46 | NS |
| Neuse River | Before (2004 - 2018) | 0.65 | NS |
| | After (2019 - 2024) | 0.22 | NS |

*Program 915 Randomization Test*

The Randomization Test for the Tar-Pamlico River indicated abundance of striped bass in Program 915 was significantly lower after the closures compared to before the closures (Figure 9, *p-value = 0.0002). Results of the Neuse River Randomization Test indicated abundance of striped bass was significantly lower after the closures compared to before the closures (Figure 10, *p-value = 0.0006).

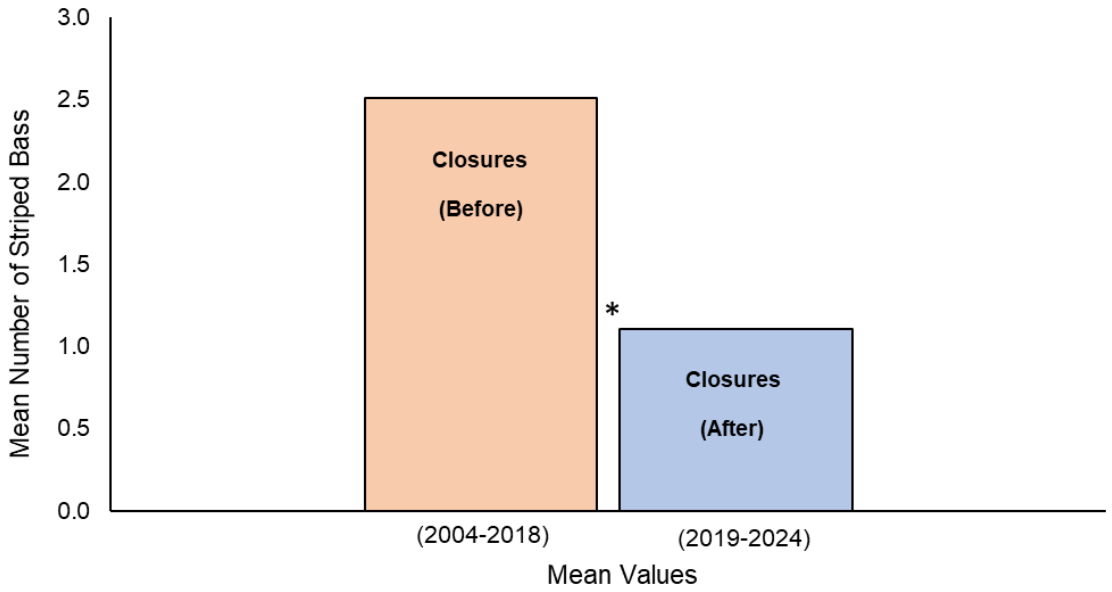



Figure 9. Abundance of Tar-Pamlico River striped bass from Program 915 before (2004–2018) and after (2019–2024) the closures. *Represents a statistically significant difference (p-value ≤ 0.05).

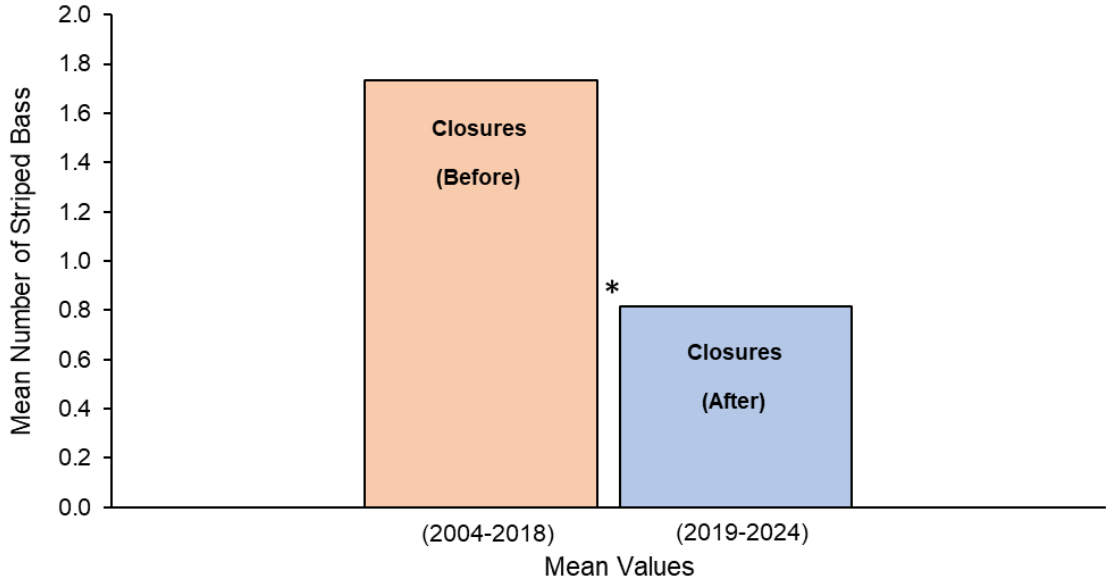



Figure 10. Abundance of Neuse River striped bass from Program 915 before (2004–2018) and after (2019–2024) the closures. *Represents a statistically significant difference (p-value ≤ 0.05).

*WRC Electrofishing Survey M-K Trend Test*

In the Tar-Pamlico River, M-K Trend Test results indicated a negative abundance trend on the spawning grounds before the closures (1996–2018); however, a p-value of exactly 0.05 is on the borderline but still considered significant at the 5% level (Table 8). Results of the Kendall's Tau correlation for the period before the closures indicated a decreasing trend (Tau=-0.3). There was no significant trend in abundance after (2019–2024) the closures in the Tar-Pamlico River. In the Neuse River, M-K Trend Test results indicated no significant trend before or after the closures.

Table 8. M-K Trend Test of annual striped bass relative abundance from the WRC Electrofishing Spawning Ground Survey indicating the direction of the trend (P-value < α; α = 0.05) in the Tar-Pamlico (1996–2024) and Neuse rivers (1994–2024). NS = not a significant trend.

| System | Closures | P-value < a; a = 0.05 | Trend |
|---|---|---|---|
| Tar-Pamlico River | Before (1996–2018) | 0.05 | ↓ |
| | After (2019–2024) | 0.46 | NS |
| Neuse River | Before (1994–2018) | 0.48 | NS |
| | Ater (2019–2024) | 0.46 | NS |

*WRC Electrofishing Survey Randomization Test*

The Randomization Test indicated striped bass abundance on the Tar-Pamlico River spawning grounds was significantly lower after the closures compared to before (Figure 11; *p-value=0.03).

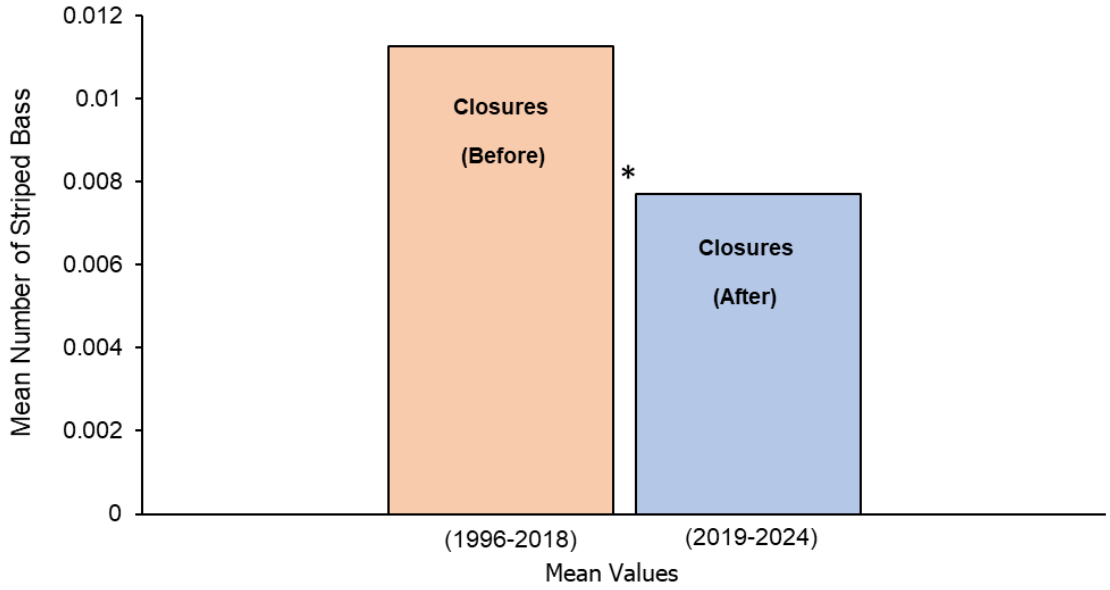



Figure 11. Abundance of Tar-Pamlico River striped bass from the WRC Electrofishing Survey before (1996–2018) and after (2019–2024) the closures. *Represents a statistically significant difference (p-value ≤ 0.05).

While striped bass abundance from the WRC electrofishing survey on the Neuse River spawning grounds was higher after the closures the Randomization Test indicated the difference before and after was not significant and therefore considered to be equal or not different (Figure 12; *p-value=0.08).

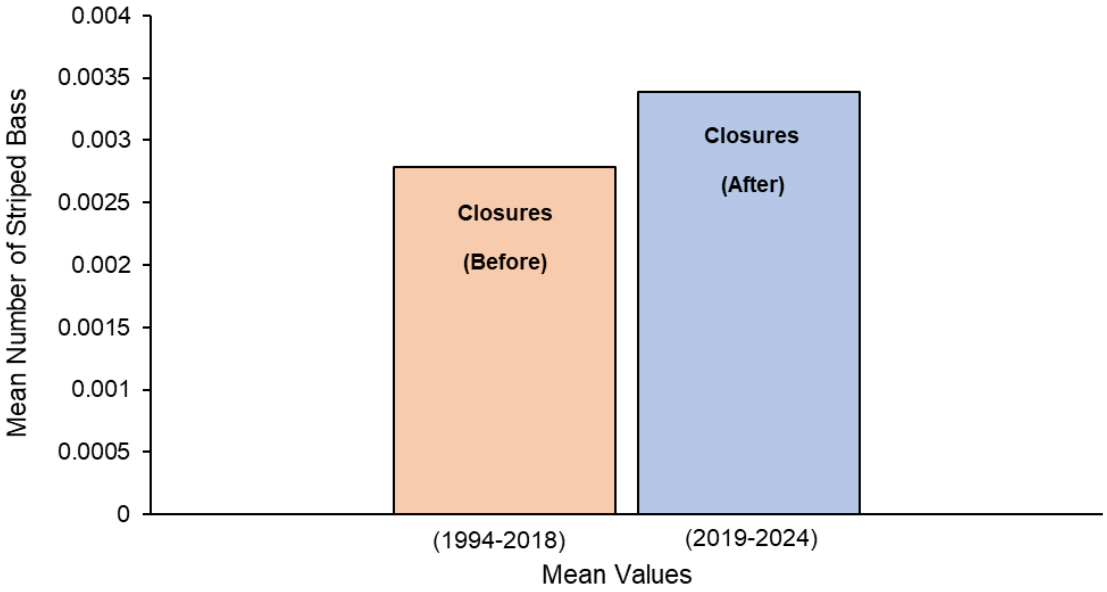



Figure 12. Abundance of Neuse River striped bass from the WRC Electrofishing Survey before (1994–2018) and after (2019–2024) the closures.

*Ferry Line Gill Net Closure Analysis*

Program 915 data was used to evaluate performance of the gill net closure above the ferry lines by comparing striped bass abundance upstream of the lines before and after the gill net closure and striped bass harvest closure were put in place.

*M-K Trend Test*

M-K Trend Test results for the Tar-Pamlico River indicated there was no significant trend in striped bass abundance above the ferry line for the period before or after the closures. In the Neuse River, M-K Trend Test results indicated no significant trends in abundance above the ferry line before or after the closures.

Table 9. M-K Trend Test of annual striped bass relative abundance from Program 915 for the areas above the ferry lines indicating the direction of the trend in the Tar-Pamlico and Neuse rivers, before (2004–2018) and after (2019–2024) the closures (P-value < α; α = 0.05). NS = not a significant trend.

| System | Closures | P-value < a; a = 0.05 | Trend |
|---|---|---|---|
| Tar-Pamlico River | Before (2004–2018) | 0.30 | NS |
| | After (2019–2024) | 0.46 | NS |
| Neuse River | Before (2004–2018) | 0.88 | NS |
| | After (2019–2024) | 0.09 | NS |

*Randomization Test*

Abundance of striped bass above the ferry lines in the Tar-Pamlico River was significantly lower after the closures compared to before the closures (Figure 13; p-value=0.0002).

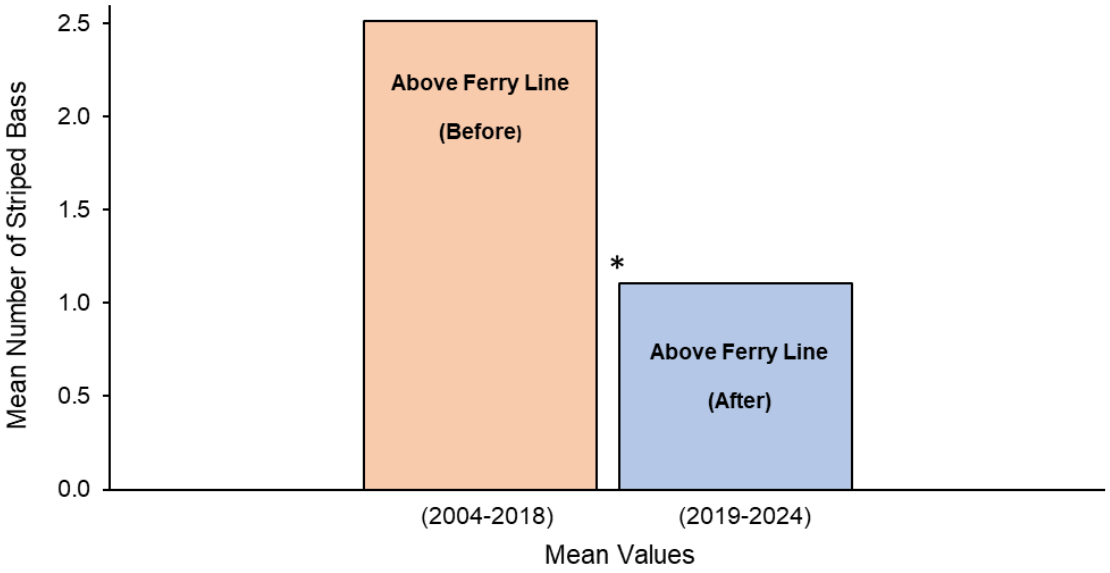



Figure 13. Abundance of Tar-Pamlico River striped bass from Program 915 above the ferry line closure area before (2004–2018) and after (2019–2024) the closures. *Represents a statistically significant difference (p-value ≤ 0.05).

Abundance of striped bass above the ferry lines in the Neuse River was significantly lower after the closures compared to before the closures (Figure 14; p-value=0.003).

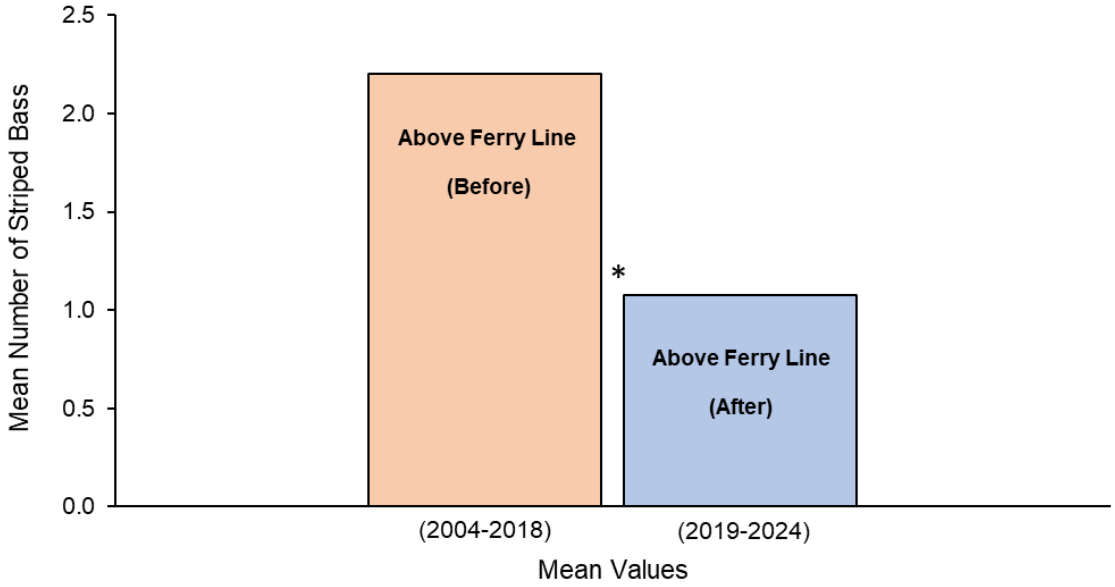



Figure 14. Abundance of Neuse River striped bass from Program 915 above the ferry line closure area before (2004–2018) and after (2019–2024) the closures. *Represents a statistically significant difference (p-value ≤ 0.05).

## DISCUSSION

Amendment 2 to the North Carolina Estuarine Striped Bass FMP adopted an adaptive management strategy to review data through 2024 to determine if striped bass populations in the Tar-Pamlico and Neuse rivers are self-sustaining and if sustainable harvest can be determined. In addition, Amendment 2 included language to: “maintain the gill net prohibition through 2024 to allow for assessment of its performance”. Adaptive management allows adjustments to management measures as new information or data becomes available. Trends in key population parameters including natural recruitment, adult abundance, age structure, and hatchery contribution were evaluated to determine the impact of the 2019 no-possession provision and the gill net closure above the ferry lines on the stocks.

As part of Amendment 2 development, a demographic matrix model was used to evaluate stocking and management strategies for striped bass in the Tar-Pamlico and Neuse rivers (Mathes et al. 2020). Matrix model results indicated natural recruitment is the primary factor limiting Tar-Pamlico and Neuse rivers stocks and if stocking was stopped the populations would decline. Based on matrix model results, the striped bass populations in the Tar-Pamlico and Neuse rivers were depressed to an extent that no level of fishing mortality is sustainable.

The matrix model results indicated a 10-year closure was most effective at increasing adult (age-3+) and old adult (age-6+) abundance (Figure 15; Mathes et al. 2020). The stocking strategy in the Tar-Pamlico and Neuse rivers during the closure has been to stock 100,000 phase-II fish per year in each river (stocking scenario 4; Figure 15). Under this stocking scenario and a 10-year closure old adult abundance is not projected to increase significantly for the first five years of the closure before starting to increase in year six. In this stocking and management scenario, abundance of age-3+ striped bass was projected to begin increasing in year two of the closure.

The striped bass harvest and ferry line gill net closures in the Tar-Pamlico and Neuse rivers were implemented in 2019 and as of 2024 have been in place for six years and have significantly decreased the number of striped bass removed from these rivers by fishing each year (Table 1). Fishery-independent monitoring since 2019 does not indicate abundance increases in downriver areas and abundance on the spawning grounds remains at levels similar to what was observed before the closure. Abundance of age-3+ and age-6+ striped bass has declined or remained consistent and there appears to be little expansion of the age structure past age-6.

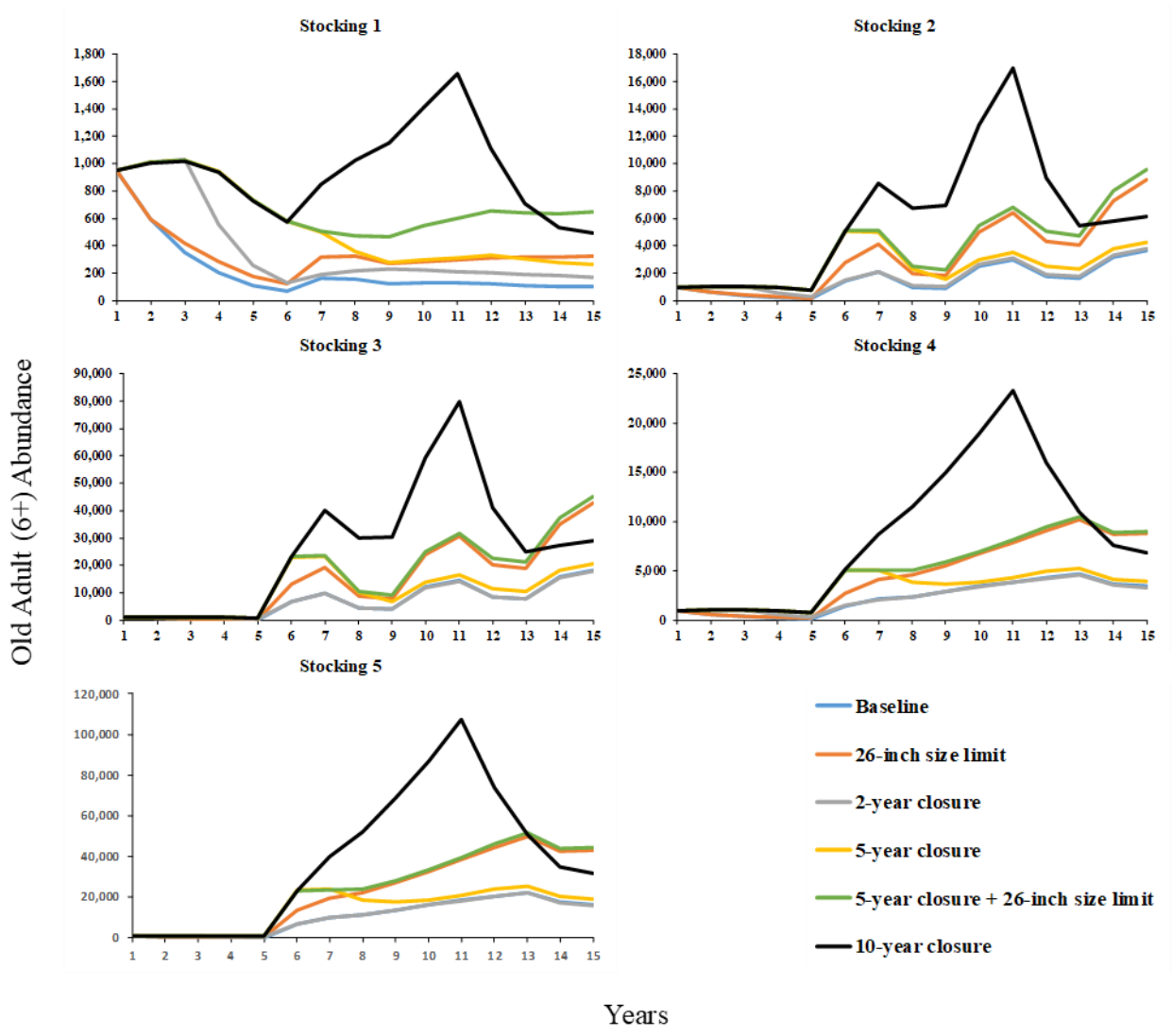



Figure 15. Abundance of old adults (age 6+) projected under five stocking strategies and six fishing strategies. Stocking 1 - no stocking; Stocking 2 - stocking 100,000 fish per year with 2-year stocking and 2-year no stocking alternating for 15 years (8 years of stocking in total); Stocking 3 - stocking 500,000 fish per year with 2-year stocking and 2-year no stocking alternating for 15 years (8 years of stocking in total); Stocking 4 - stocking 100,000 fish per year with 8-year continuous stocking; Stocking 5 - stocking 500,000 fish per year with 8-year continuous stocking. Lines show the median from 10,000 iterations (figure from Mathes et al. 2020).

Since 2019 the percentage of stocked fish on the spawning grounds has increased to nearly 100% suggesting the 'wild' fish present in 2018 and 2019 are not making spawning runs in these systems and are not contributing to natural reproduction. In the lower rivers, the percentage of 'wild' fish has been more variable, and examination of age data suggests some persistence of the 2014- and 2015-year classes, at least through 2020.

It is difficult to pinpoint specific reasons why abundance has not increased, and the age structure has not expanded despite significant reductions in fishing mortality. The Tar-Pamlico and Neuse rivers striped bass stocks are supported by a stocking program with an annual goal of stocking 100,00 phase-II striped bass per river system; however, actual stocking numbers are variable

from year to year and since implementation of the harvest and ferry line gill nets closures in 2019, an average of 55,541 phase-II fish were stocked in the Tar-Pamlico River each year and 66,036 phase-II striped bass were stocked in the Neuse River each year (Table 10). Additionally, environmental conditions, such as low dissolved oxygen and warm water temperatures play a role in successful striped bass recruitment and increasing stock size. There is evidence total mortality (especially natural mortality) is high in these systems. A telemetry tagging study conducted on the Neuse River from December 2013 through September 2015 estimated a discrete annual total mortality of 66.3% for phase II stocked juveniles (202–227 mm TL), a discrete annual total mortality of 54.0% for adults (349–923 mm TL), and a discrete natural mortality of 20.1% for adults (Bradley et al. 2018). Analysis of tagging data showed that striped bass stocked in the Neuse and Tar-Pamlico rivers experienced higher mortality (instantaneous total mortality of 0.48–0.51) than in the Roanoke River/Albemarle Sound habitat (instantaneous total mortality of 0.33; Callihan et al. 2014).

Mathes et al. (2020) and Rachels and Ricks (2018) documented commercial effort as an important predictor of striped bass mortality in the Neuse River. Model averaging analysis by Rachels and Ricks (2018) indicated commercial gill-net effort was far more influential than other parameters that were examined. Although Rachels and Ricks (2018) did not include recreational effort or harvest in the model due to the benefits of a longer available time series for commercial data, the study acknowledged the potential importance of recreational angling on total mortality of Neuse River striped bass. Results of analysis from Mathes et al. (2020) indicated recreational effort and recreational discards may indeed be as influential on annual striped bass mortality as commercial effort and commercial harvest. While recreational and commercial harvest and commercial discard mortality of striped bass have been minimized by the harvest closure and concurrent gill net restrictions, recreational discards remain a source of mortality and may confound capacity for the stock to grow. Since the harvest closure, recreational striped bass discards remain similar to those observed prior to the harvest closure in some years (Table 5; NCDMF 2024).

In response to increased abundance of non-hatchery origin (wild) striped bass present in the Tar-Pamlico and Neuse rivers in 2017 and 2018, DMF initiated an acoustic telemetry study to track movements of ‘wild’ fish. Because striped bass return to natal rivers to spawn, the objective of the acoustic tagging study was to infer origin of wild striped bass found in the lower-middle Tar-Pamlico and Neuse rivers by tracking spring spawning migrations. Fifty adult striped bass (ages 4–5) from the lower-middle Tar-Pamlico and Neuse rivers were implanted with acoustic tags. Fin clips were taken from each fish, and PBT analysis was conducted to determine if the fish were hatchery or wild origin. PBT results indicated 30 of the tagged striped bass were wild. Of the 30 wild striped bass, 70% (n=21) were later detected in the Albemarle Sound or on the Roanoke River spawning grounds in the spring (see Appendix 3). Most (53%) wild fish entering the Albemarle Sound were detected on the spawning grounds near Weldon, N.C. Several of these wild striped bass (n=5) made repeated annual migrations in the spring back to the Roanoke River spawning grounds. The remaining wild acoustic tagged striped bass did not move out of the Tar-Pamlico and Neuse rivers and were not detected in Albemarle Sound. A single wild striped bass tagged in the Tar-Pamlico River was later detected on the spawning grounds in the Tar River and one wild striped bass tagged in the Neuse River was later detected on the spawning grounds in the Neuse River suggesting limited natural recruitment in these rivers or straying of A-R stock fish to the Tar and Neuse rivers spawning grounds. Additionally, one wild striped bass tagged in the Neuse River was later detected on the spawning grounds in the Tar River (see Appendix 3).

Results of the acoustic study add additional support to the existing body of evidence indicating annual movement of striped bass between the Albemarle Sound and Tar-Pamlico and Neuse rivers. Conventional tag return data has documented increased movement of smaller A-R stock striped bass into the Tar-Pamlico and Neuse rivers during periods of increased A-R stock

abundance (Callihan et al. 2014). While abundance of A-R stock striped bass is currently very low, 2014 and 2015 represent the most recent strong year classes produced (Figure 16). Striped bass from the strong 2014 and 2015 A-R year classes likely migrated to the Tar-Pamlico and Neuse rivers: increasing abundance and providing the appearance of successful natural reproduction. Callihan et al. (2014) indicated up to 31% of the A-R stock could use areas outside the Albemarle Sound during times of higher abundance. Rulifson (2014) concluded 53% of striped bass sampled from the Neuse River in 2010 were not of hatchery origin. While the exact origin of these fish is unknown, they could be fish from the strong 2005 A-R year class. Potential spillover of the 2005 A-R year class into the Tar-Pamlico and Neuse rivers may also explain the 2010 and 2011 striped bass abundance peaks from Program 915 in the Tar-Pamlico and Neuse rivers (Figures 2 and 3) and the 2010 abundance peak from the WRC Electrofishing Survey on the Tar River spawning grounds (Figure 5).

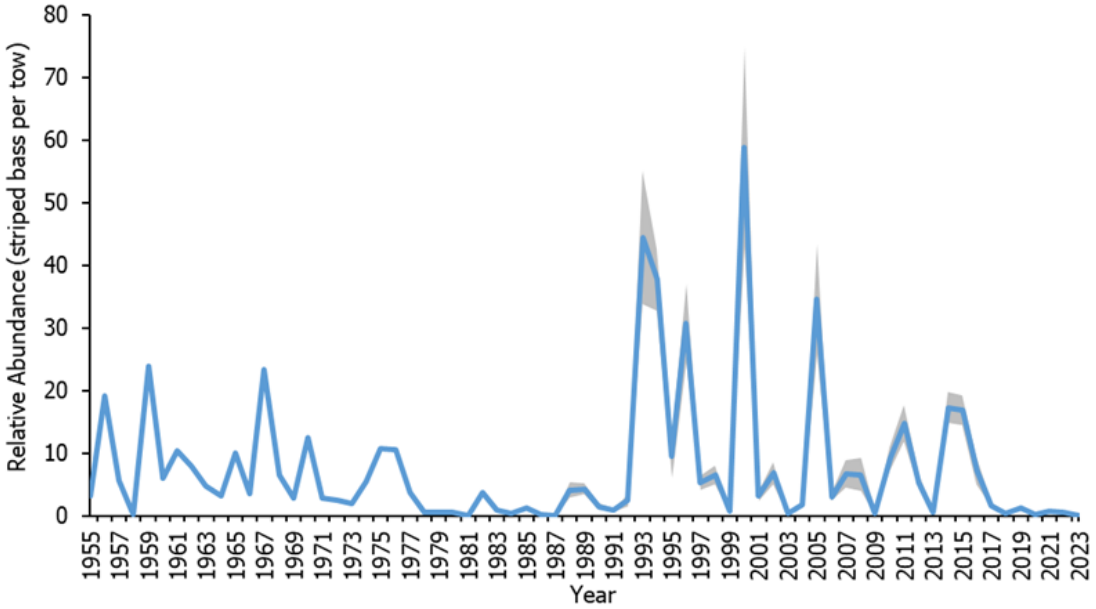



Figure 16. Juvenile abundance index (JAI) of Albemarle-Roanoke striped bass from the DMF juvenile trawl survey, western Albemarle Sound, NC, 1955–2023.

Striped bass are generally thought to exhibit low levels of straying to non-natal rivers and Roanoke River striped bass are suspected to have high spawning site fidelity (Callihan et al. 2015); though, potential straying to non-natal systems has been suggested for other stocks (Secor et al. 2020). In addition, striped bass have been documented to reside in non-natal estuaries in Maine and New Jersey, including moving upriver during expected spawning seasons suggesting an attempt to reproduce (Grothues et al. 2009), and Roanoke River striped bass have been documented in river systems in other states outside of the spawning season (Callihan et al. 2015). This suggests it would not be unlikely for A-R stock striped bass to reside in the adjacent Tar-Pamlico and Neuse rivers and for some small portion of the stock to make spawning runs in these systems.

There has been little change in abundance or the age structure of the Tar-Pamlico and Neuse rivers striped bass stocks since implementation of the harvest and gill net closures. It appears abundance of striped bass in the lower Tar-Pamlico and Neuse rivers is highly influenced by year-class strength of the A-R stock. Abundance on the spawning grounds, while highly variable, is generally more stable, likely due to stocking. Matrix model results suggested stocking more fish provides the most benefit to the stocks (Figure 15; stocking scenario 5). During the closure period

the goal has been to stock 100,000 phase-II fish per river system, though this goal has not always been met (Table 10). Recently (beginning in 2023) stocking resources have shifted toward maintaining and restoring the A-R stock. Given hatchery and resource constraints it is unlikely the number of fish stocked in the Tar-Pamlico and Neuse rivers can be increased by any significant amount, and without increased stocking, the populations may not be able to grow beyond current levels, though recovery and expansion of the A-R stock is likely to increase abundance of striped bass in the Tar-Pamlico and Neuse rivers.

Table 10. Number of Phase-I and Phase II size striped bass stocked in the Tar-Pamlico and Neuse rivers, 2010–2024.

| | Tar-Pamlico River | | | Neuse River | |
|---|---|---|---|---|---|
| Year-Class | Phase-I | Phase-II | Year-Class | Phase-I | Phase-II |
| 2010 | 0 | 114,012 | 2010 | 0 | 107,142 |
| 2011 | 0 | 107,767 | 2011 | 0 | 102,089 |
| 2012 | 0 | 45,667 | 2012 | 50,180 | 91,985 |
| 2013 | 257,404 | 123,416 | 2013 | 181,327 | 113,784 |
| 2014 | 138,889 | 92,727 | 2014 | 79,864 | 78,866 |
| 2015 | 0 | 52,922 | 2015 | 0 | 109,107 |
| 2016 | 234,718 | 121,190 | 2016 | 80,910 | 134,559 |
| 2017 | 0 | 101,987 | 2017 | 0 | 14,203 |
| 2018 | 0 | 120,668 | 2018 | 96,900 | 86,556 |
| 2019 | 0 | 97,920 | 2019 | 0 | 85,694 |
| 2020 | 0 | 90,614 | 2020 | 0 | 96,933 |
| 2021 | 0 | 23,082 | 2021 | 31,208 | 80,122 |
| 2022 | 175,633 | 55,465 | 2022 | 91,569 | 33,560 |
| 2023 | 116,989 | 66,165 | 2023 | 62,885 | 71,527 |
| 2024 | 0 | 0 | 2024 | 0 | 0 |

Based on historical stocking efforts for striped bass, population abundance can increase dramatically from just a few individuals, provided adequate environmental conditions exist. In 1879, 132 young striped bass from the Navesink River, New Jersey, were released into the Carquinez Strait, the tidal estuary where the Sacramento and San Joaquin rivers drain into San Francisco Bay. A second batch of 300 young fish from the Shrewsbury River, New Jersey, were introduced in 1882. Commercial harvest started in the early 1880s, and by 1900 exceeded 99,208 lb. (450,000 kg) annually. The greatest catch occurred in 1903 when over 1,984,160 lb. (900,000 kg) were harvested (Craig 1928).

The striped bass population in the southern Gulf of St. Lawrence, Canada, declined to less than 5,000 spawners in the late 1990s which led to the closure of the commercial fishery in 1996 and recreational and indigenous fisheries in 2000 (DFO 2023). Between 2002 and 2009 a stocking program stocked 6,475,000 striped bass fry and 6,321 striped bass ages 0–6 (Robitaille, et al. 2011) into the systems. The striped bass population subsequently increased to an estimated 900,000 spawners by 2017 (DFO 2023).

Over the past several decades, few larval and juvenile striped bass have been collected from CSMA systems (Marshall 1976; Hawkins 1980; Nelson and Little 1991; Burdick and Hightower 2006; Barwick et al. 2008; Smith and Rulifson 2015; and Buckley et al. 2019, NCDMF 2024).

Several factors have been suggested as potentially affecting natural recruitment in the Tar-Pamlico and Neuse rivers, including spawning stock abundance, truncated age structure (Bradley et al. 2018; Rachels and Ricks 2018; Buckley et al. 2019), and egg abundance. Even in the absence of most fishing mortality, abundance has not increased, and the age structure has not expanded suggesting biological and/or environmental factors are preventing self-sustaining populations and that additional management changes aimed at achieving sustainable striped bass populations in these rivers are unlikely to be successful unless significant environmental improvements occur.

One possible confounding factor is that eggs produced by Tar-Pamlico and Neuse rivers broodstock are very small, heavy (dense) eggs, which are more likely to sink than float (Kowalchyk 2020). Egg densities have been shown to be influenced by both genetic and environmental factors (Kowalchyk 2020). Spawning grounds in these river systems are predominantly shallow (between 0.2 and 1.0 meters), so the potential for heavy eggs to contact bottom sediment and die is increased. Additionally, because many of the streams and creeks in these systems have been altered by channelization, rapid flow increases can occur shortly after a rainfall event begins followed by a rapid return to base conditions after the end of the rainfall event potentially impacting striped bass spawning success (NCDWQ 2009; NCDWQ 2010).

Flows during the spring striped bass spawning season are an important factor affecting successful striped bass natural reproduction; however, unlike on the Roanoke River, there are no agreements with the U.S. Army Corps of Engineers (USACE) to maintain adequate flows for striped bass spawning in the Tar-Pamlico or Neuse rivers. The USACE is consulted weekly regarding water releases in the Neuse River from Falls Lake in Raleigh, but due to the watershed and storage capabilities, it is not possible to manipulate flows in the Neuse River like it is in the Roanoke River. The USACE, in cooperation with DMF and WRC staff, is currently studying flows in the Neuse River in an attempt to identify conditions that could be beneficial for striped bass spawning. Flows on the Tar-Pamlico River are based on pulse rainfall events. The ability to manipulate releases, while limited, may become important as we get more information on flows in these systems. If flows are too low during the spawning period, heavy eggs may be more likely to contact the bottom and die before hatching successfully.

**CONCLUSIONS**

Based on data from DMF and WRC fishery-independent and dependent sampling programs which were reviewed through 2024, the striped bass populations in the Tar-Pamlico and Neuse rivers are currently not self-sustaining. However, it is worth noting again that striped bass have been shown to quickly rebound even at low population levels given favorable environmental conditions. Evaluation of the harvest and gill net closures has shown these measures to be ineffective at promoting natural recruitment, increasing adult abundance, or expanding the age structure and increasing the number of older, larger (age-10+) striped bass through year six of implementation. Even if these closures had resulted in a measurable effect on striped bass populations, it would be impossible to attribute the effect to either the harvest or gill net closures individually because they occurred concurrently. Factors other than fishing mortality and inadequate spawner stock abundance are preventing successful reproduction and self-sustaining populations of the Tar-Pamlico and Neuse rivers striped bass stocks. Environmental factors and declines in the A-R stock have contributed to reduced striped bass abundance in the Tar-Pamlico and Neuse rivers. Additional management aimed at trying to achieve sustainability of these stocks is unlikely to be effective unless significant environmental improvements occur.

Acoustic telemetry and PBT data suggest there are three groups of striped bass in the Tar-Pamlico and Neuse rivers. Most of the fish are hatchery reared stocked fish, followed by wild fish originating from the A-R (see Appendix 3), with a very small portion of fish originating from the

spawning grounds on the Tar-Pamlico or Neuse rivers. Acoustic data revealed that striped bass stocked in the Tar-Pamlico and Neuse rivers do not leave the system where they were released and fish can be found throughout the entire system; however, a portion of adult wild fish were shown to reside within the lower portions of both the Tar-Pamlico and Neuse rivers and return annually to the Roanoke River spawning grounds in spring (April\May).

Based on Amendment 2 adaptive management, if analysis indicates biological and/or environmental factors prevent a self-sustaining population, then alternate management strategies will be developed that provide protection for and access to the resource.

**ADAPTIVE MANAGEMENT NEXT STEPS**

In accordance with the Amendment 2 adaptive management framework the DMF and WRC will develop harvest management measures that allowing access to and protection for the resource. Harvest will be allowed, but harvest will be restricted to levels low enough that mature striped bass abundance in the rivers is maintained so in the event of favorable environmental conditions, natural reproduction could occur. Confounding this management strategy, however, is the fact the A-R stock has had very poor spawning success since 2017 and is currently under a harvest moratorium. The harvest management strategy will focus harvest on stocked fish in the Tar-Pamlico and Neuse rivers but limit harvest of A-R striped bass to the greatest extent possible.

**REFERENCES**

Barwick, R. D., J. M. Homan, K. R. Rundle, W. J. Collart, and C. D. Thomas. 2008. An assessment of striped bass spawning stocks and contribution by stocked juveniles in two North Carolina coastal rivers. North Carolina Wildlife Resources Commission, Federal Aid in Fish Restoration, Project F-22. Final Report, Raleigh.

Bayless, J.D., and W.B. Smith. 1962. Survey and classification of the Neuse River and tributaries, North Carolina. Final Report, Federal Aid in Fish Restoration Job IA, Project F-14-R. North Carolina Wildlife Resources Commission, Raleigh.

Bradley, C. E., J. A. Rice, D. D. Aday, J. E. Hightower, J. Rock, and K. L. Lincoln. 2018. Juvenile and adult Striped Bass mortality and distribution in an unrecovered coastal population. North American Journal of Fisheries Management 38:104–119.

Buckley, C., K. Lincoln, K. Rachels, and B. Ricks. 2019. Striped bass ichthyoplankton surveys in the Neuse River, 2016–2017. Final Report, Project F-108, Federal Aid in Sport Fish Restoration. North Carolina Wildlife Resources Commission, Raleigh, North Carolina.

Burdick, M., and J.E. Hightower. 2006. Distribution of spawning activity by anadromous fishes in an Atlantic slope drainage after removal of a low-head dam. Transactions of the American Fisheries Society 135:1290–1300.

Callihan, J. 2012. Summary maps of North Carolina tagging programs. NCDMF Marine Fisheries Fellowship, 2011–2012. North Carolina Division of Marine Fisheries, Morehead City, North Carolina.

Callihan, J.L., C.H. Godwin, and J.A. Buckel. 2014. Effect of demography on spatial distribution: movement patterns of Albemarle Sound-Roanoke River striped bass (*Morone saxatilis*) in relation to their stock recovery. Fisheries Bulletin 112(2-3):131–143.

Callihan, J.L., J.E. Harris, and J.E. Hightower. 2015. Coastal migration and homing of Roanoke River striped bass. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science. 7:301-315.

Craig, J.A. 1928. The striped bass supply of California. California Fish and Game. 14: 265-272.

Cushman, B., T. O'Donnell, and D. Farrae. 2018. North Carolina Wildlife Resources Commission 2017 striped bass genotyping and parentage analyses. South Carolina Department of Natural Resources. 2017 Final Report.

Denson, M.R., K. Brenkert, W.E. Jenkins, and T.L. Darden. 2012. Assessing red drum juvenile stocking in a South Carolina estuary using genetic identification. North American Journal of Fisheries Management 32:32– 43.

Doll and D. Farrae. 2023. North Carolina Wildlife Resources Commission 2022 striped bass genotyping and parentage analyses. South Carolina Department of Natural Resources. 2022 Final Report.

Doll and D. Farrae. 2024. North Carolina Wildlife Resources Commission 2023 striped bass genotyping and parentage analyses. South Carolina Department of Natural Resources. 2023 Final Report.

Farrae, D. 2019. North Carolina Wildlife Resources Commission 2018 striped bass genotyping and parentage analyses. South Carolina Department of Natural Resources. 2018 Final Report.

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

Fisheries and Ocean Canada (DFO). 2023. Update of spawner abundance and biological characteristics of Striped Bass (Morone saxatilis) in the southern Gulf of St. Lawrence to 2022. DFO Canadian Science Advisory Secretariat Science Response. 2023/004.

Grothues, T.M., K.W. Able, J. Carter, and T.W. Arienti. 2009. Migration patterns of striped bass through nonnatal estuaries of the U.S. Atlantic coast. American Fisheries Society Symposium. 69:135-150.

Harris, S., and D. Farrae. 2020. North Carolina Wildlife Resources Commission 2019 striped bass genotyping and parentage analyses. South Carolina Department of Natural Resources. 2019 Final Report.

Harris, S., and D. Farrae. 2021. North Carolina Wildlife Resources Commission 2020 striped bass genotyping and parentage analyses. South Carolina Department of Natural Resources. 2020 Final Report.

Harris, S., and D. Farrae. 2022. North Carolina Wildlife Resources Commission 2019 striped bass genotyping and parentage analyses. South Carolina Department of Natural Resources. 2021 Final Report.

Hawkins, J. H. 1980. Investigations of Anadromous Fishes of the Neuse River, North Carolina. Final Report for Project AFCS-13. N.C. Department of Natural Resources and Community Development, Division of Marine Fisheries, 111 p.

Kowalchyk, C. 2020. Influence of Genetic and Environmental Adaptation on Striped bass (*Morone saxatilis*) Egg Characteristics. Master's Thesis, North Carolina University, Raleigh, NC. 59 pp.

Marshall, M.D. 1976. Anadromous Fisheries Research Program: Tar River, Pamlico River, and northern Pamlico Sound, North Carolina. Completion Report for Project AFCS-10. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, N.C.

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 p. + appendices

NCDMF (North Carolina Division of Marine Fisheries). 2004. North Carolina Fishery Management Plan. Estuarine Striped Bass. By the North Carolina Division of Marine Fisheries and the North Carolina Wildlife Resources Commission. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries. Morehead City, NC. 375 p.

NCDMF. 2013. Amendment 1 to the North Carolina estuarine striped bass fishery management plan. By the North Carolina Division of Marine Fisheries and the North Carolina Wildlife Resources Commission. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries. Morehead City, NC. 826 p.

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. 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. Fishery Management Plan Update Estuarine Striped Bass. North Carolina Division of Marine Fisheries, Morehead City, North Carolina. 50 p.

NCDWQ (North Carolina Division of Water Quality). 2009. Neuse River Basinwide Water Quality Plan. North Carolina Department of Environmental Quality, Division of Water Quality, Raleigh, North Carolina.

NCDWQ 2010. Tar-Pamlico River Basinwide Water Quality Management Plan. North Carolina Department of Environmental Quality, Division of Water Quality, Raleigh, North Carolina.

Nelson, K.L., and A.E. Little. 1991. Early life history characteristics of Striped Bass in the Tar and Neuse rivers, North Carolina. Final Report, Project F-22-11, Federal Aid in Sport Fish Restoration. North Carolina Wildlife Resources Commission, Raleigh, North Carolina.

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. 2018. Exploring causal factors of spawning stock mortality in a riverine striped bass population. Marine and Coastal Fisheries 10:424–434.

Reading, B.J., J. Fischer, and C. Kowalchyk 2020. Egg yolk, egg buoyancy, and striped bass recruitment: A common link? Semi-Annual Performance Report, CRFL Grant 2017-F-046. North Carolina Department of Environmental Quality, Division of Marine Fisheries. Morehead City, North Carolina. 60 p.

Robitaille, J., M. Bérubé, A. Gosselin, M. Baril, J. Beauchamp, J. Boucher, S. Dionne, M. Legault, Y. Mailhot, B. Ouellet, P. Sirois, S. Tremblay G. Trencia, G. Verreault and D. Villeneuve. 2011. Recovery Strategy for the Striped Bass (Morone saxatilis), St. Lawrence Estuary Population, Canada. Species at Risk Act Recovery Strategy Series. Ottawa : Fisheries and Oceans Canada. xi + 51 p.

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. Final Report, CRFL Grant 2011-F-001. North Carolina Department of Environmental Quality, Division of Marine Fisheries. Morehead City, North Carolina. 76 p.

Rulifson, R.A., M.T. Huish, and R.W.W Thoesen. 1982. Status of anadromous fisheries in southeast U.S. estuaries. Pages 413–425 In: V. Kennedy (editor), Estuarine comparisons. Academic Press Inc., New York, NY.

Rulifson, R.A. 2014. Origin of Central Southern Management Area striped bass using otolith chemistry, and recommendations for fishery management. Final Report, Coastal Recreational Fishing License Grant 2011-F-005. 67 p.

Secor, D.H., M.H.P. O'Brien, B.I. Gahagan, D.A. Fox, A.L. Higgs, and J.E. Best. 2020. Multiple spawning run contingents and population consequences in migratory striped bass *Morone saxatilis*. PLoS ONE 15(11): e0242797. https://doi.org/10.1371/journal.pone.0242797

Setzler, E.M., W.R. Boynton, K.V. Wood, H.H. Zion, L. Lubbers, N.K. Mountford, P. Frere, L. Tucker, and J.A. Mihursky. 1980. Synopsis of biological data on striped bass. NOAA Technical Report, NMFS Circular 443: FAO Synopsis No. 121. 69 p.

Smith, C.M., and R.A. Rulifson. 2015. Overlapping habitat use of multiple anadromous fish species in a restricted coastal watershed. Transactions of the American Fisheries Society, 144(6):1173-1183.

Woodroffe, J. R. 2011. Historical Ecology of Striped Bass Stocking in the Southeastern United States. Master's Thesis. East Carolina University. Greenville, North Carolina.

Appendix 1

## Motions
## N.C. Marine Fisheries Commission Emergency Meeting
## March 13, 2019

Motion by Cameron Boltes to approve the agenda. Second by Chuck Laughridge.
Motion carries unanimously.

Motion by Cameron Boltes to direct the director of the Division of Marine Fisheries to issue a proclamation, effective in conjunction with the Supplement, that prohibits the use of gill nets upstream of the ferry lines, dock to dock from the Bayview to Aurora Ferry on the Pamlico River and dock to dock from the Minnesott Beach to Cherry Branch Ferry on the Neuse River, within the Central Southern Management Area. Second by Pete Kornegay.
Motion carries 5-4.

Motion by Chuck Laughridge to ask the N.C. Wildlife Resources Commission to adopt concurrent regulations for recreational harvest in Supplement A in joint coastal waters. Second by Pete Kornegay.
Motion carries with no opposition.

Appendix 2

ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

STEPHEN W. MURPHEY
Director

March 4, 2019

Dear Chairman Bizzell,

At the February 2019 Marine Fisheries Commission (MFC) meeting the MFC passed Supplement A to Amendment 1 of the Estuarine Striped Bass Fishery Management Plan. As approved, Supplement A specifies a no-possession limit, essentially a closed season for striped bass, in the Central Southern Management Area (CSMA). There are, however, complicating jurisdictional issues between MFC and the Wildlife Resources Commission (WRC).

Last week, Department of Environmental Quality (DEQ) and Division of Marines Fisheries (DMF) staff met with the Director and staff of the WRC. The WRC Director indicated that because of the joint jurisdictional language in N.C.G.S. §113-132 that the Supplement A measure would be inconsistent with existing WRC recreational limits in joint waters of the CSMA. After consulting with WRC and with legal counsel for both Commissions and DEQ it was decided that the best approach forward would be to convene a special meeting of the MFC to formally request that the WRC implement management measures consistent with Supplement A for the joint coastal waters of the CSMA to harmoniously resolve the jurisdictional conflict. I think this could be done over the phone with at least one listening station and it would be up to you to decide if any additional public comment would be warranted.

If a special meeting is not called, then it is important to have this on the May agenda for the MFC meeting. The recreational season closes April 30 by rule (15A NCAC 03M .0202) so if we do hold a special meeting it would only buy a brief period with the no-possession limit was in place for the recreational spring season. However, it is important to address it to implement the no-possession limit in the fall recreational fishery. The next regularly scheduled meeting of the WRC is in April.

Considering this, I plan to issue proclamations this week to implement the following:

1. Close the remainder of the recreational season on striped bass in the coastal waters of the CSMA. This closes the season year-round.
2. Allowing the joint coastal water recreational season to remain open with current catch limits until the MFC can request from concurrence from the WRC and they concur.
3. Implementing in the coastal and joint coastal waters 36-inch tie-down and 50-yard distance from shore regulations in the western Pamlico Sound including the Tar-Pamlico and Neuse rivers and their tributaries. This is required under the management measures of the FMP whenever the striped bass season is closed. The MFC, in the adoption of the Supplement confirmed that action.
4. The CSMA commercial season which opens by proclamation will not be opened due to the adoption of Supplement A.

This will present a situation where our coastal waters include stronger recreational conservation measures for striped bass than the joint coastal waters until this consistency issue is resolved. It is likely the recreational season for spring 2019 will close before this can happen (April 30). Because WRC does not regulate any commercial gear, there is not an inconsistency with existing rule to prevent our implementing the commercial no-possession and gill net measures in the joint coastal waters as well.

Finally, after the passage of Supplement A, the MFC approved a motion to “ask” the DMF Director to issue a proclamation, effective in conjunction with the supplement, that restricts the use of gill nets that interact with striped bass upstream of the ferry lines and requires attendance of gill nets that interact with striped bass upstream of the tie-down lines. I have received dozens of emails

supporting this measure both in form letters and in original letters.

While I respect the concerns of both the public and the MFC, after careful consideration I have concluded that such a measure is not supported by the scientific data that support gill nets as the primary or even the most significant source of discard mortality. As you are aware, recreational effort will not be controlled under the Supplement and catch and release will be a source of discard mortality as well. The motion to remove nets was also not a part of the supplement measure approved by the DEQ Secretary. The DMF Director's proclamation authority acts within the bounds of the FMP.
Therefore, I respectfully decline to act on this request to issue a proclamation further restricting gill nets beyond those measures outlined in Supplement A. I would, however, like to provide some supporting information underlying the basis for this decision.

**SUPPORTING INFORMATION FOR DECISION**
The journal article by Rachels and Ricks (2018), explores causal factors of spawning stock mortality sources in the N.C. riverine striped bass fishery, and notes that their inability to include recreational angling as an exploitation factor reduces the amount of variability in spawning stock mortality that can be accounted for in their study. The authors go on to include that it is likely that the inclusion of recreational harvest and discard would perform comparably to the results of the commercial harvest in their modeling.

In Supplement A, the DMF used the CSMA creel survey data, (not a part of MRIP), to determine recreational harvest, discards and discard mortality. From 2012-2017 all but the last two years' total removals of striped bass (harvest + dead discards) were nearly equal between the recreational and commercial sector. The increase in recreational discard mortality in the last two years is due to what appears to be a successful natural spawning event in the rivers during 2014 and possibly 2015.

Moreover, the following is a list of gill net regulations that are either already in place or will be implemented by proclamation in the areas upstream of the tie down lines. The purpose of these regulations is to reduce regulatory discards of striped bass and important estuarine finfish and protected species. On-board observer data and empirical *in-situ* field studies by the DMF has shown these large mesh regulations have decreased striped bass discards significantly (potentially up to 75%) compared to pre-2008 estimates of striped bass discards before the tie-downs and distance from shore regulations were implemented. Striped bass gill-net discards mortality estimates for 2012-2017 in the Tar-Pamlico and Neuse rivers combined, range from 507 to 986 fish annually.

**Regulations for gill nets with stretched mesh of 5 inches and greater:**

- It is unlawful to fail to equip gill nets with tie-downs spaced no farther apart than 10 yards to restrict the vertical distance between the top and bottom lines to 36 inches or less. If the vertical height of the net (distance between the top and bottom line) is 36 inches or less, no tie-downs are required. Nets must be set to fish on the bottom and not exceed a vertical height of 36 inches. (Tie- down regulation see map)
- It is unlawful for any portion of the net to be within 50 yards of any point on shore when set

or deployed in the following river areas: (distance from shore regulation - see map)

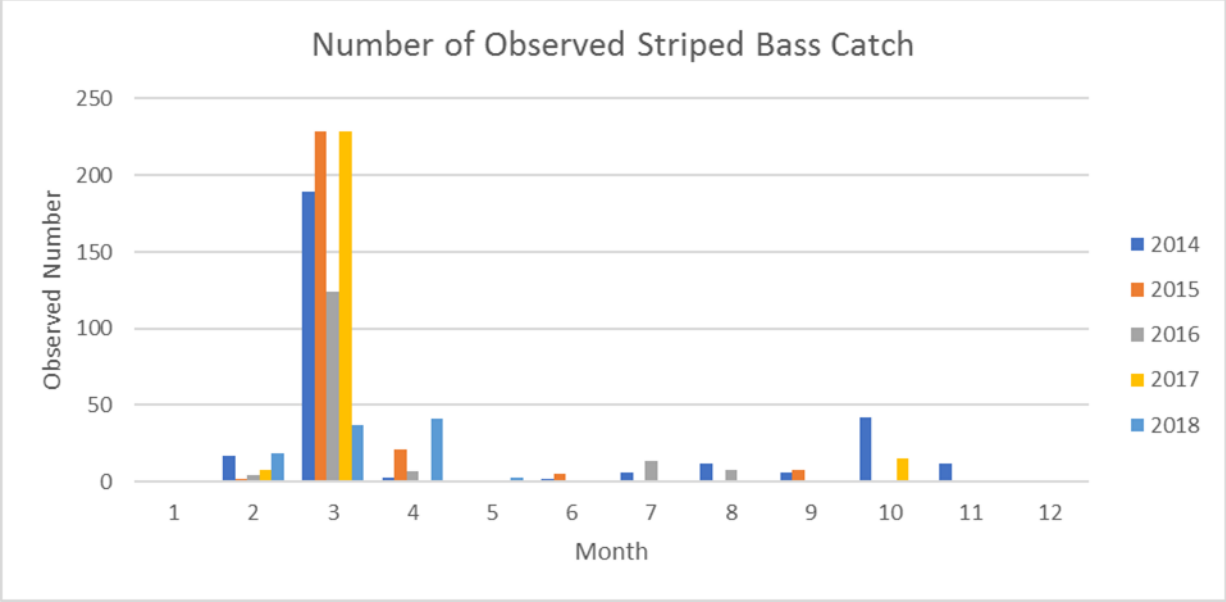
The previous years estuarine striped bass commercial seasons in the CSMA have been as follows:

| Year | Day Open | Day Closed* |
|---|---|---|
| 2014 | 03/01/14 | 03/20/14 |
| 2015 | 03/01/15 | 03/18/15 |
| 2016 | 03/01/16 | 03/21/16 |
| 2017 | 03/01/17 | 04/03/17 |
| 2018 | 03/01/18 | 04/30/18 |

*Closings before 4/30 of a year are early closures due to the 25,000 lb. quota being met or exceeded.

In the figure below, interactions with striped bass drop significantly in the large mesh gill net fishery above the tie-down line following the closure of the commercial striped bass season. Remember that the tie-down requirement and distance from shore requirements are not in place when the commercial season is open. With a no possession limit under Supplement A, the commercial season will not open and tie-down and distance from shore requirements will be in effect year-round. Gill net bycatch is anticipated to be more reflective of the May-February figures.

**Figure 1.** All striped bass (striped bass and hybrid bass) observed during Program 466 trips on the Pamlico, Neuse, Trent, and Pungo rivers. Data are from the previous 5-year period, 2014 to 2018. These data were selected to mirror the area that would be affected by the Proclamation requested at the February 2019 MFC meeting.




**<u>Regulations for gill nets with stretched mesh of less than 5 inches:</u>**

- Attendance of small mesh gill nets (<5 ISM) is required year-round in the following areas based on NCMFC rule 15A NCAC 3R.0112 (a):
    - Upper portions of the Pamlico, Pungo, Neuse, and Trent rivers
    - Within 200 yards of shore in the lower portions of the Pamlico, Pungo, Neuse, and

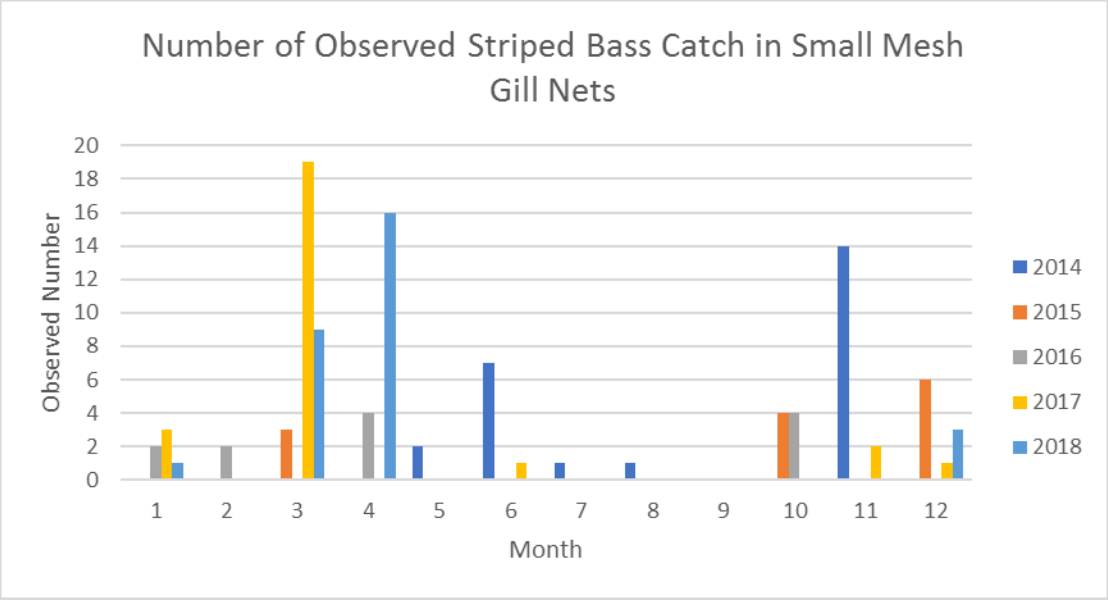
Trent rivers

**Regulations in effect statewide, large and small mesh gill nets:**

- All unattended gill nets ≥ 5 ISM must be at least 10 feet from shore from June through November (NCDMF 2008).
- Gill nets with a mesh size ≥ 5 ISM and <5 ½ ISM is prohibited from April 15 through December 15 (NCDMF 2005).
- 2,000 yard/vessel limit on gill nets ≥ 5 ISM (NCDMF 2005).
- Gill nets with a mesh size < 5 ISM must be attended in all primary and secondary nursery areas and no-trawl areas described in NCMFC Rule 15A NCAC 3R.0106(2), (4), (5), (7), (8), (10), (11), and (12) from May 1 through November 30 (NCDMF 2001).
- It is unlawful to set gill nets in joint waters from midnight on Friday to midnight on Sunday each week, except in Albemarle Sound and Currituck Sound north of the Highway 158 Wright Memorial Bridge (NCDMF 2012).
- The use of gill nets > 6 ½ ISM stretch mesh is prohibited in all waters.
- It is unlawful to use gill nets with a mesh size < 2 ½ inches ISM stretch mesh.

In the figure below, interactions with striped bass are more mixed in the small mesh gill net fishery above the tie-down line. This data is less robust due to lower observation numbers in the small mesh fishery and these data do not indicate whether fish were alive or dead. However, there are attendance requirements in place for small mesh nets above the tie-down line which are put in place to reduce dead discards in the small mesh fishery as outlined above (see map – attachment 1).

**Figure 3.** Data included are all striped bass (striped bass and hybrid bass) observed during Program 466 trips on the Pamlico, Neuse, Trent, and Pungo rivers. Data are from the previous 5-year period, 2014 to 2018 and are for small mesh gill nets. These data were selected to mirror the area that would be affected by the Proclamation requested at the most recent MFC meeting.



In conclusion, the implementation of gill net restrictions is best served through the continued development of the Estuarine Striped Bass Fishery Management Plan. The Supplement A measures will certainly not stop discards and dead discards from occurring in the commercial or recreational fishery. However, the DMF's data supports that Supplement A will reduce the overall number of fish being removed from the stock, thereby providing additional and more conservative protection to the two successful spawning year classes moving through the area of the CSMA. Observer coverage will continue, and we will try to increase observer coverage as much as is feasible during 2019. If significant spikes of discards are observed, I certainly reserve the right to consider additional measures if warranted.

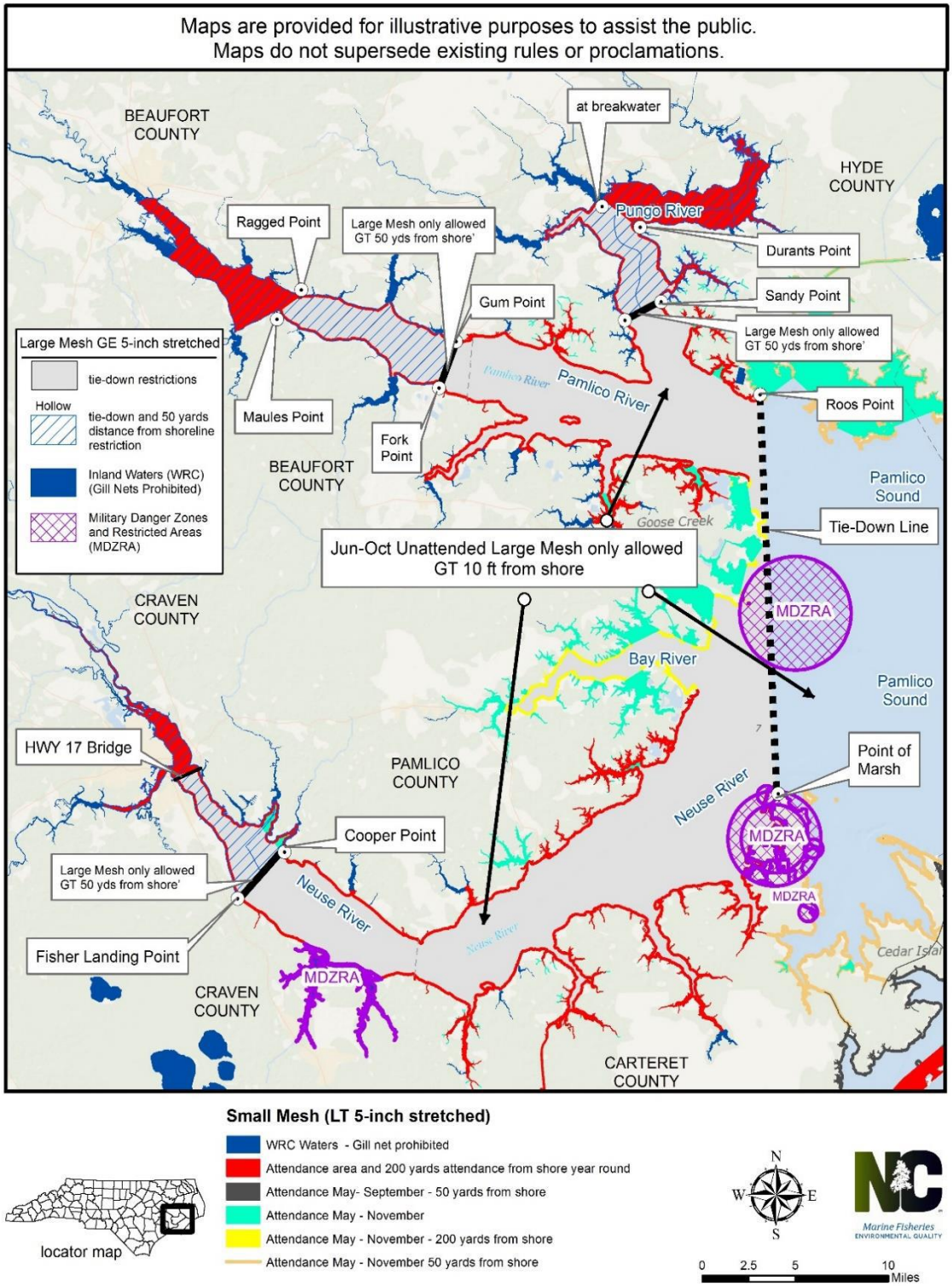
Sincerely,
Steve Murphey, Director

NC Division of Marine Fisheries

Cc: Marine Fisheries Commission
John Nicholson
Shawn Maier
John Batherson
Gordon Myers

**Attachment 1**

Gill-net regulation map for various gill-net types and seasons in the Central Southern Management




Appendix 3

November 1, 2022

**MEMORANDUM**

**TO:** North Carolina Marine Fisheries Commission

**FROM**: Todd Mathes, Striped Bass Fishery Management Plan Co-Lead

**SUBJECT**: Acoustic Tagging Striped Bass in the Tar-Pamlico and Neuse Rivers Summary of Results

*Goal*
To deploy acoustic tags in striped bass from the 2014 and 2015 year-classes captured in the Tar-Pamlico and Neuse rivers to determine movement patterns during the summer, fall, and winter months and spring spawning migrations.

*Background*
Parentage based tagging (PBT) of striped bass stocked in the Central Southern Management Area (CSMA) began in 2010. Genetic stock identification of striped bass captured in the Central Southern Management area since 2010 indicates the stocks are near 100% hatchery origin, suggesting there has been minimal successful natural reproduction in these systems (NCDMF 2019). However, more recent PBT analysis of striped bass collected in 2017 shows there may have been successful ‘‘wild’’ striped bass spawning events in 2014 and 2015 in the Tar-Pamlico and Neuse rivers (Farrae and Darden 2018). Results of PBT analysis from fish captured in 2017 revealed a decrease in the contribution of hatchery fish found in these rivers. Striped bass <22 inches total length (TL) identified by PBT analysis as non-hatchery or ‘‘wild’’ fish collected in 2017 are potentially the result of successful natural spawning events in the Tar-Pamlico and Neuse rivers. Otolith ages of the non-hatchery fish <22 inches TL indicate these fish collected in 2017 are all from the 2014 and 2015 year classes (Farrae and Darden 2018; NCDMF 2019).

Based on this information, the North Carolina Marine Fisheries Commission (MFC) approved Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass Fishery Management Plan in February 2019 implementing a no-possession limit for striped bass in the Internal Coastal and Joint fishing waters of the CSMA. In March 2019, the North Carolina Wildlife Resources Commission (NCWRC) passed a concurrent measure prohibiting the possession of striped bass in Inland and Joint Fishing Waters. Supplement A to Amendment 1 was adopted by the MFC to protect these two important year classes of striped bass while Amendment 2 to the N.C. Estuarine Striped Bass Fishery Management Plan was being developed.

Though a portion of striped bass collected from this period in the CSMA are classified as non-hatchery produced, it is not possible to identify the river system where these ‘‘wild’’ striped bass were spawned. Conventional tag return data suggests density-dependent movement occurs from Albemarle-Roanoke stock striped bass moving into the CSMA rivers (Callihan et al. 2014). Juvenile sampling for striped bass in the Albemarle Sound indicated above average abundance of juveniles for the 2014 and 2015 year-classes (Figure 1), so it is possible the increased abundance of ‘‘wild’’ striped bass from the 2014 and

2015 year classes observed in the Tar-Pamlico and Neuse Rivers are actually related to an expansion from the Albemarle-Roanoke stock for these two year-classes. If these fish are from the Albemarle-Roanoke stock, they will likely not make spawning runs in the Tar-Pamlico and Neuse rivers. Albemarle-Roanoke stock striped bass exhibit size dependent migrations to the ocean and exhibit natal homing to the Roanoke River (Callihan et al. 2015) whereas CSMA striped bass stocks are considered non-migratory and do not exhibit the anadromous behavior of the Albemarle-Roanoke stock. Alternatively, Rock et al. (2018) noted that some larger acoustic tagged striped bass in the Tar-Pamlico and Neuse rivers later migrated to the ocean and at least one was detected in the Chowan River and Albemarle Sound providing additional evidence for overlap between the Albemarle-Roanoke and CSMA stocks. It is also possible the presence of the 2014 and 2015 cohorts were the result of spawning success from one of either the Tar-Pamlico or Neuse rivers, and not in both systems. If this is the case, it is critical to determine the river system these fish were spawned in and understand movement patterns between the Tar-Pamlico and Neuse rivers to guide future management should natural reproduction continue to occur.

Understanding the movement and migration patterns of these two year classes of striped bass is important in gauging the success of Supplement A and directing future management. Striped bass from these year classes were tagged with acoustic transmitters following the methods of Rock et al. (2018) and movements within the Tar-Pamlico and Neuse rivers are tracked using existing acoustic receiver arrays in place in these rivers. In addition, any movement of these fish in the Albemarle Sound and Roanoke River is detected from existing acoustic arrays in that system. If these striped bass were naturally produced in the CSMA rivers this acoustic study would collect initial migration data for these cohorts of striped bass from these rivers. If these striped bass were naturally produced in the Albemarle-Roanoke, additional data about movement patterns of striped bass between the CSMA and Albemarle Sound will provide valuable information to inform future assessment and management of this stock.

Because there is a no-possession limit for striped bass in the CSMA, fishing mortality on tagged striped bass should be minimized allowing for maximum rates of detection. Tagging fish with Vemco V16 (10-year tags) allows for long term monitoring of movement patterns and potentially multiple spawning runs.

*Objectives*

The objectives of this project are:

1. Insert acoustic tags, as well as conventional tags, into striped bass from the 2014 and 2015 year classes captured in the Tar-Pamlico and Neuse rivers.
2. Determine if these striped bass make spawning runs in the Tar-Pamlico and Neuse rivers.
3. Determine if these striped bass move between the CSMA and ASMA and RRMA.
4. Determine if these striped bass migrate to the ocean.

*Methods*

Striped bass were collected using electrofishing gear in the Tar-Pamlico and Neuse rivers. Effort was made to capture fish throughout the river and to deploy tags across multiple tagging days. Only fish at lengths that would be in the 2014 and 2015 year classes (ages 4 and 5) were tagged (Table 1). All striped bass were tagged with Vemco V16 (10-year tags) acoustic tags following the methods of Rock et al. (2018), along with a PIT tag and an internal anchor tag. All acoustic tagged fish were measured to the nearest millimeter (FL and TL), weighed, and a fin clip was collected to determine hatchery origin. When possible, sex was recorded. Acoustic tags were deployed during the winter when low water temperatures provided the greatest chance of survival and provided time for the fish to recover prior to the spawning period (March–May).

Receiver downloads in RRMA, ASMA, and CSMA rivers occurred quarterly, and this schedule has been maintained to collect additional detections.

*Results*

All acoustic tagging occurred in the Tar-Pamlico and Neuse rivers. Between December 2019 and January 2020, Division staff tagged 50 striped bass (25 from the Tar-Pamlico River and 25 from the Neuse River) with acoustic, PIT, and conventional tags. In addition, 48 striped bass (23 from the Tar-Pamlico River and 25 from the Neuse River) were collected and sacrificed in conjunction with the acoustic tagged fish to provide ages of ''wild'' striped bass. Since ages derived from PBT analysis can only be achieved with fish of hatchery origin, there was a need to sample a subset of fish to determine ages for ''wild'' fish from structures (otoliths). Results from length and age data indicate success in targeting fish from the 2014 and 2015 year classes. Acoustic tagged striped bass varied in size from 20.8 to 25.6 inches TL, with a mean of 22.7 inches TL (Table 2). Striped bass that were determined to be ''wild'' varied in size from 20.8 to 25.0 inches TL, with a mean of 22.9 inches TL (Table 2). Additionally, ''wild'' striped bass that were collected and sampled for age determination using otoliths ranged in age from four to six and had a modal age of four years old in the Neuse River, and five years old in the Tar-Pamlico River.

The acoustic tag detection data for this analysis covers a period beginning in December 2019 through March 2022.

PBT analysis from the 50 acoustically tagged striped bass revealed that 30 were non-hatchery origin and classified as ''wild'', with the remaining 20 fish being classified as hatchery origin. Twenty of the 25 fish tagged in the Tar-Pamlico River were classified as ''wild'' while 10 of the 25 fish tagged in the Neuse River were classified as ''wild''. Of the 20 fish determined to be hatchery fish, five were tagged in the Tar-Pamlico River and 15 were tagged in the Neuse River.

*''wild'' origin striped bass*

Of the 30 total tagged ''wild'' striped bass, 70% (n=21) were determined to likely be ''wild'' Roanoke River striped bass because they left the CSMA river systems where they were tagged and were detected within the Albemarle Sound and/or Roanoke River (Figure 2). Most of the ''wild'' Roanoke River striped bass that left the CSMA and moved into the Albemarle Sound migrated up the Roanoke River (60%; n=18) and were ultimately detected on the spawning grounds near Weldon, N.C. (53%; n=16). Many of the ''wild'' Roanoke River striped bass had detection patterns indicating these fish reside in CSMA rivers throughout the year prior to undertaking migrations to the spawning grounds in the Roanoke River in the spring, then returning to the CSMA rivers after spawning is complete. The three remaining ''wild'' Roanoke River striped bass that left the CSMA system, were only detected as far as the Alligator River end of the Intracoastal Waterway (ICW) and the Alligator River Bridge. One of these was presumed dead due to repeated detections at the same location for an extended period and the other two had limited detections during the study period.

The remaining ''wild'' acoustic tagged striped bass (n=9) did not move out of the CSMA rivers and were not detected in Albemarle Sound; however, six of these fish did not have enough detection data to analyze movement patterns. Results indicate that a limited number of ''wild'' striped bass make spawning runs in the Tar-Pamlico and Neuse rivers. A single ''wild'' striped bass tagged in the Tar-Pamlico River was later detected on the spawning grounds in the spring near Rocky Mount, N.C. and one ''wild'' striped bass tagged in the Neuse River was later detected on the spawning grounds in the Neuse River (Figure 2). Additionally, one ''wild'' striped bass tagged in the Neuse River was later detected in the Tar-Pamlico River and ultimately on the spawning grounds near Rocky Mount, N.C. ''wild'' fish moving to the spawning grounds within the river systems they were tagged, or adjacent CSMA rivers, suggests some striped bass from other stocks may stray into CSMA rivers to attempt spawning or some low level of successful natural reproduction occurs.

Noteworthy movement data of ‘‘wild’’ striped bass:

- 53% (n=16) of the ‘‘wild’’ fish were detected on the spawning grounds near Weldon, N.C. Several of these ‘‘wild’’ striped bass (n=5) made repeated annual migrations in the spring back to the Roanoke River spawning grounds.

- 50% (n=4) of the ‘‘wild’’ fish tagged in the Neuse River were detected moving through Manns Harbor, and 13% (n=1) moved into the Albemarle Sound through the Pungo River/Alligator River ICW.

- 31% (n=4) of the ‘‘wild’’ striped bass tagged in the Tar-Pamlico River entered the Albemarle Sound through the Pungo River/Alligator River ICW

- One ‘‘wild’’ striped bass tagged in the Tar-Pamlico River was detected two years in a row on the Roanoke River spawning grounds and resided in the Tar-Pamlico the first year and in the Neuse River the second year.

- One ‘‘wild’’ striped bass after being detected on the spawning grounds at Weldon, NC, was later detected at Oregon Inlet presumably out-migrating to join the Atlantic migratory stock.

- One ‘‘wild’’ striped bass was commercially harvested in Edenton Bay on May 14, 2020.

*Hatchery origin striped bass*

Movement patterns of hatchery origin striped bass (n=20) show they did not leave the river system where they were tagged. Results indicate hatchery striped bass make spawning runs in the Tar-Pamlico and Neuse rivers. Due to the low sample size of hatchery origin fish collected in the Tar-Pamlico River (n=5) there is minimal data to infer movement patterns; however, a single hatchery origin striped bass was detected on the spawning grounds (n=1; 20%; Figure 3). In the Neuse River, 10 of 15 hatchery origin striped bass (62%) were detected on the spawning grounds (Figure 4).

*Next Steps*

All striped bass were tagged with 10-year acoustic tags; however, detections decreased substantially within the first two years after tagging (Figure 5). Currently, there are approximately seven ‘‘wild’’ and four hatchery origin striped bass that are still being detected routinely on acoustic receivers throughout the tracking area. A total of three striped bass are considered mortalities because they have been detected at the same location for an extended period, and one striped bass was harvested in the commercial fishery in the ASMA. Division staff will continue to download the acoustic receiver array to monitor for additional striped bass detections for the duration of the tag life.

*Literature Cited*

Callihan, J.L., C.H. Godwin, and J.A. Buckel. 2014. Effect of demography on spatial distribution: movement patterns of the Albemarle Sound-Roanoke River stock of striped bass (*Morone saxatilis*) in relation to their recovery.

Callihan, J.L., J.E. Harris, and J.E. Hightower. 2015. Coastal migration and homing of Roanoke River striped bass. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 7(1):301-315.

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

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.

Rock, J, D. Zapf, J. Facendola, 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.

Table 1. Striped bass length at age (2016-2017 PBT ages) for the Neuse and Tar-Pamlico rivers. Shaded cells are size ranges that were targeted for acoustic tagging.

| | | | TL (mm) | | | TL (inch) | | |
|---|---|---|---|---|---|---|---|---|
| **Age** | **River System** | **n** | **Mean** | **Min** | **Max** | **Mean** | **Min** | **Max** |
| 3 | Neuse | 70 | 517 | 446 | 616 | 20.4 | 17.6 | 24.3 |
| | Tar-Pamlico | 18 | 498 | 460 | 568 | 19.6 | 18.1 | 22.4 |
| 4 | Neuse | 54 | 572 | 451 | 641 | 22.5 | 17.8 | 25.2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Tar-Pamlico | 119 | 574 | 473 | 659 | 22.6 | 18.6 | 25.9 |
| 5 | Neuse | 30 | 632 | 489 | 717 | 24.9 | 19.3 | 28.2 |
| | Tar-Pamlico | 79 | 618 | 528 | 681 | 24.3 | 20.8 | 26.8 |
| 6 | Neuse | 21 | 669 | 573 | 735 | 26.3 | 22.6 | 28.9 |
| | Tar-Pamlico | 40 | 657 | 587 | 718 | 25.9 | 23.1 | 28.3 |
| 7 | Neuse | 7 | 704 | 651 | 766 | 27.7 | 25.6 | 30.2 |
| | Tar-Pamlico | 2 | 696 | 668 | 723 | 27.4 | 26.3 | 28.5 |

Table 2. Acoustic tagged striped bass lengths for the Neuse and Tar-Pamlico rivers separated by treatment (tagged or sampled for aging structure) and origin.

| | | | | TL (mm) | | | TL (inch) | | |
|---|---|---|---|---|---|---|---|---|---|
| **River** | **Treatment** | **Origin** | **n** | **Mean** | **Min** | **Max** | **Mean** | **Min** | **Max** |
| Neuse | tagged | hatchery | 15 | 581 | 537 | 650 | 22.9 | 21.1 | 25.6 |
| | | 'wild' | 10 | 597 | 539 | 635 | 23.5 | 21.2 | 25.0 |
| | sampled | hatchery | 16 | 591 | 527 | 665 | 23.3 | 20.7 | 26.2 |
| | | 'wild' | 9 | 586 | 533 | 641 | 23.1 | 21.0 | 25.2 |
| Tar-Pamlico | tagged | hatchery | 5 | 545 | 531 | 572 | 21.5 | 20.9 | 22.5 |
| | | 'wild' | 20 | 572 | 529 | 633 | 22.5 | 20.8 | 24.9 |
| | sampled | hatchery | 7 | 558 | 535 | 626 | 22.0 | 21.1 | 24.6 |
| | | 'wild' | 16 | 567 | 533 | 642 | 22.3 | 21.9 | 25.3 |

Table 3. Striped bass ages (otolith and PBT) for the Neuse and Tar-Pamlico rivers separated by treatment (tagged or sampled for aging structure) and origin.

| | | | Age | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Modal | | Min | | Max | | Total Number Aged | |
| **River** | **Treatment** | **Origin** | **otolith** | **PBT** | **otolith** | **PBT** | **otolith** | **PBT** | **otolith** | **PBT** |
| Neuse | tagged | hatchery | - | 4 | - | 4 | - | 6 | - | 15 |
| | | 'wild' | - | - | - | - | - | - | - | - |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | harvested | hatchery | 4 | 4 | 3 | 3 | 7 | 7 | 16 | 16 |
| | | ‘wild’ | 4 | - | 4 | - | 6 | - | 9 | - |
| Tar-Pamlico | tagged | hatchery | - | 4 | 4 | - | 4 | - | - | 5 |
| | | ‘wild’ | - | - | - | - | - | - | - | - |
| | harvested | hatchery | 4 | 4 | 4 | 4 | 6 | 6 | 7 | 7 |
| | | ‘wild’ | 5 | - | 5 | - | 6 | - | 16 | 0 |

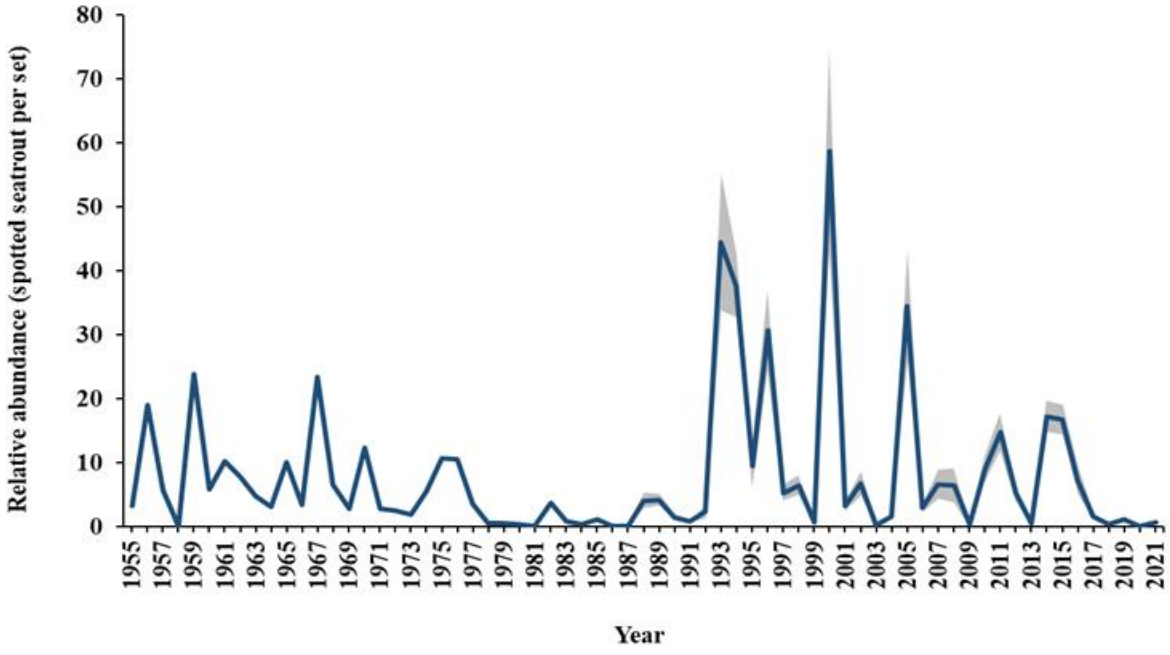



Figure 1. Juvenile abundance index (JAI) of Albemarle-Roanoke striped bass from the NCDMF juvenile trawl survey, western Albemarle Sound, NC, 1955–2021.

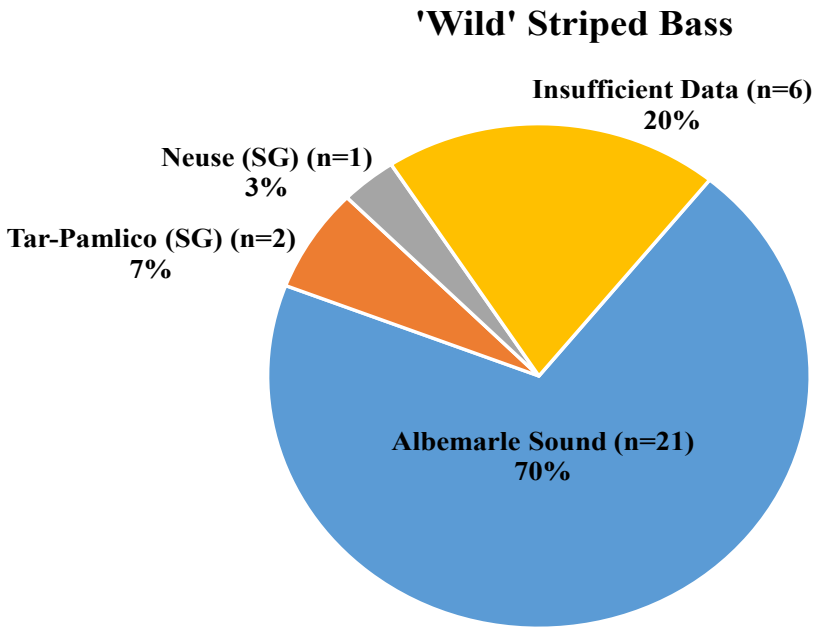



Figure 2. Detection location (%) of all acoustic tagged ‘‘wild’’ striped bass (n=30) by area (Tar-Pamlico and Neuse Rivers spawning grounds (SG), and Albemarle Sound). All original tagging events occurred in the Tar-Pamlico and Neuse River systems.

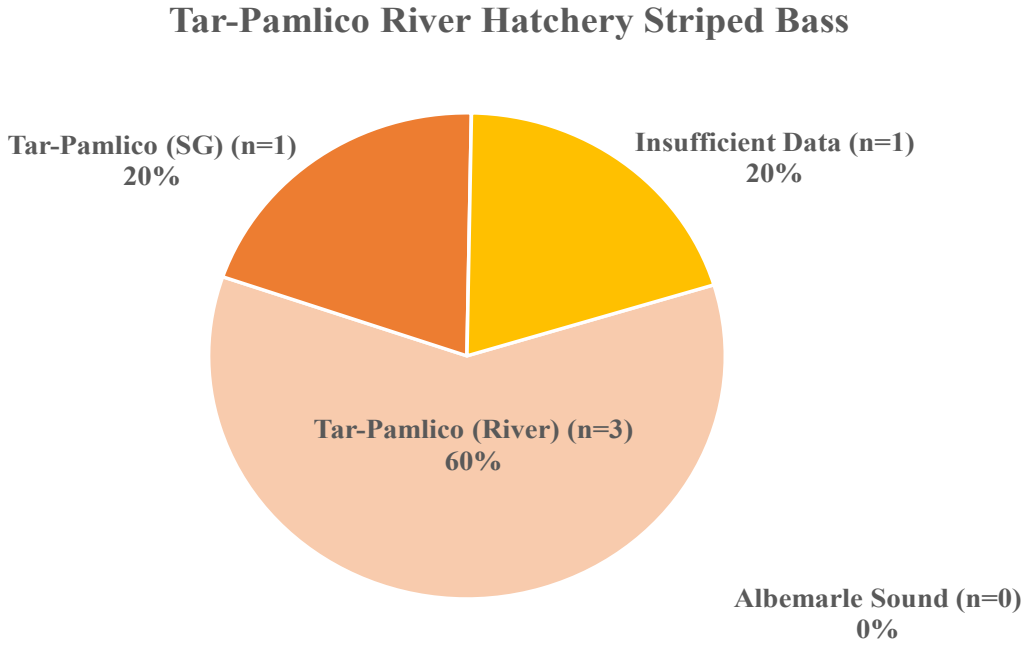



Figure 3. Detection location (%) for acoustic tagged hatchery origin striped bass in the Tar-Pamlico River system (n=5) by area (detection on spawning grounds (SG) or river residence). No hatchery origin fish from the Tar-Pamlico River system were detected in the Albemarle Sound area.

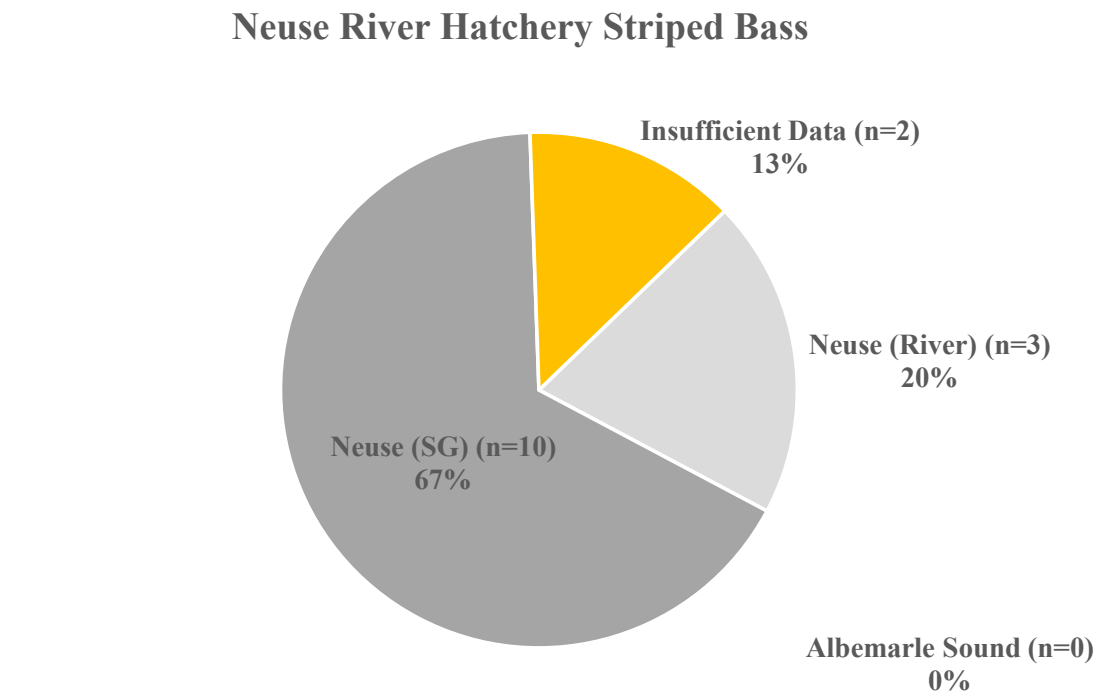



Figure 4. Detection location (%) for acoustic tagged hatchery origin striped bass in the Neuse River system (n=15) by area (detections on the spawning grounds (SG) or river residence). No hatchery origin fish from the Neuse River system were detected in the Albemarle Sound area.

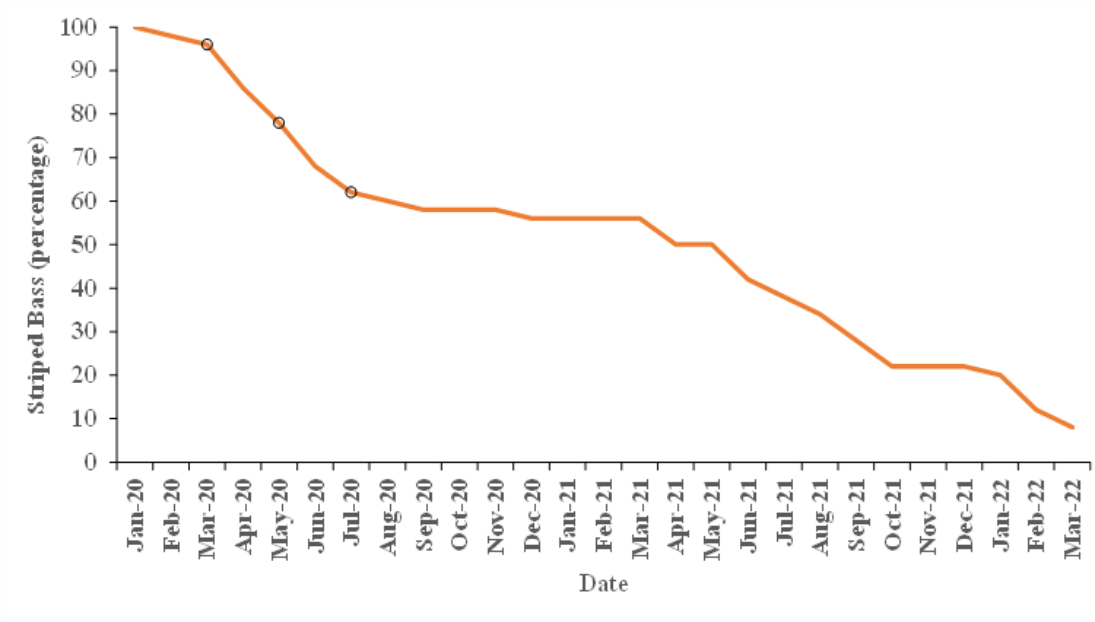



Figure 5. Tag detection loss (%) of acoustic tagged striped bass. Black circles represent known mortalities (n=4).