# DRAFT

## 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

## February 1, 2019

### I. ISSUE

The issue is consideration of Supplement A to Amendment 1 to the N. C. Estuarine Striped Bass Fishery Management Plan (FMP) consisting of a no-possession limit for striped bass *(Morone saxatilis)* in the internal coastal and joint waters of the Central Southern Management Area (CSMA) while Amendment 2 to the N.C. Estuarine Striped Bass Fishery Management Plan is being developed and adopted. New information suggests there have been two recent successful striped bass spawning events in the Tar-Pamlico and Neuse rivers. The supplement objective is to protect these year classes of fish to help support specific goals of Amendment 1, which are to achieve sustainable harvest through science-based decision-making processes that conserve adequate spawning stock and provide and maintain a broad age structure.

### II. ORIGINATION

General Statute 113-182.1 provides a supplement mechanism to modify a FMP between the five-year scheduled reviews when the Secretary of the Department of Environmental Quality determines it is in the interest of the long-term viability of the fishery.

At the November 2018 N. C. Marine Fisheries Commission (NCMFC) business meeting the following motion was passed: *Motion to authorize staff to develop temporary management measures to supplement the N.C. Estuarine Striped Bass Fishery Management Plan with a no-possession limit in the Central Southern Management Area to protect important year classes while the next plan amendment is being developed.*

The draft supplement contains an analysis of the proposed management change including pertinent data with projected outcomes, and proposed proclamation measure necessary to implement that provision.

On December. 3, 2018, N.C. Division of Marine Fisheries (NCDMF) Director Stephen W. Murphey sent a recommendation to N.C. Department of Environmental Quality Secretary Michael S. Regan to develop a temporary management measure to supplement the N.C. Estuarine Striped Bass FMP consisting of a no-possession limit for striped bass in the CSMA. On December 19, 2018, Secretary Regan responded to Director Murphey that “after careful consideration, I concur with your recommendation”.

## III. BACKGROUND

Management History

The N. C. Estuarine Striped Bass FMP approved in May 2004 was the first FMP for striped bass developed under the criteria and standards of the 1997 Fisheries Reform Act (NCDMF 2004). The plan focused on identifying water flow, water quality, and habitat issues related to survival and reproduction throughout the state, reducing discard mortality in the commercial anchored gill-net fisheries, continued stocking of striped bass in the Tar-Pamlico, Neuse, and Cape Fear rivers of the CSMA, and developing creel surveys in the Tar-Pamlico, Neuse, and Cape Fear rivers to estimate recreational striped bass harvest in those systems.

CSMA Management Strategies Adopted in Amendment 1

Estuarine striped bass in North Carolina are managed under Amendment 1 to the N. C. Estuarine Striped Bass FMP and its subsequent revision (NCDMF 2014). It is a joint plan between the NCMFC and the N. C. Wildlife Resources Commission (NCWRC). Amendment 1, adopted in 2013, lays out separate management strategies for the Albemarle-Roanoke (A-R) stock in the Albemarle Sound Management Area (ASMA) and the Roanoke River Management Area (RRMA), and the CSMA stocks in the Tar-Pamlico, Neuse, and Cape Fear rivers (Figure 1). Management measures in Amendment 1 consist 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 maintain sustainable harvest and reduce regulatory discard mortality in all sectors. Amendment 1 also maintains the stocking measures in the major CSMA river systems and the harvest moratorium on striped bass in the Cape Fear River and its tributaries, including Snow's Cut (NCDMF 2013).

CSMA Regulations Adopted in Amendment 1

The following regulations are those contained in the jointly adopted Amendment 1 to the N. C. Estuarine Striped Bass FMP. Both commercial and recreational fisheries are subject to an 18-inch total length (TL) minimum size limit for striped bass within the CSMA. As an additional protective measure in joint and inland CSMA waters, it is unlawful for recreational fishermen to possess striped bass between 22 and 27 inches TL. The recreational harvest season for striped bass within the CSMA is October 1 through April 30. Recreational fishermen are constrained to a two fish per person per day possession limit.

Unlike the commercial fishery in the ASMA, the striped bass commercial fishery in the CSMA is a directed fishery, except in Pamlico Sound where bycatch restrictions are in place, and primarily uses anchored large mesh (≥5 inches stretched mesh (ISM) gill-nets. There is a commercial daily possession limit of 10 fish per person per day with a maximum of two limits per commercial operation enacted by proclamation annually. Daily reporting of the number and pounds of striped bass landed from all licensed striped bass dealers helps ensure the 25,000-pound total allowable landings (TAL) is not exceeded. The commercial harvest season opens by proclamation and may occur between January 1 and April 30 and is closed by proclamation once the annual 25,000-pound TAL is reached or on April 30, whichever occurs first. After the closure of the commercial harvest season and continuing through December 31, commercial fishermen are required to use three-foot tie downs in gill-nets with a stretch mesh length ≥5 inches in internal coastal fishing waters west of the 76 28.0000’ W longitude line. They must also maintain a minimum distance from shore (DFS) of 50 yards for these nets upstream of the existing DFS line (Figure 2).

In both fishery sectors it has been unlawful to possess striped bass taken from the internal coastal and joint waters of the Cape Fear River and its tributaries since 2008 per MFC Rules 15A NCAC 03M .0202 and 03Q .0107.

The following management change was developed and implemented solely under the purview of the NCWRC and was not developed through the joint FMP process. The NCWRC has jurisdiction in the inland waters of the CSMA, and on February 16, 2016, the NCWRC voted to modify the exception to the general statewide size regulation for striped bass in inland waters of the Tar-Pamlico, Pungo, and Neuse rivers and their tributaries by increasing the minimum size limit from 18 inches to 26 inches TL. The no-possession prohibition on fish between 22 and 27 inches TL was removed. The daily creel limit (two fish per person per day) and harvest season (October 1–April 30) were not changed. The new rule was scheduled to go into effect August 1, 2017, but 10 letters of objection requesting legislative review of the rule were received in March 2017. No action was taken during the mandatory legislative review period, and NCWRC Rule 15A NCAC 10C .0314 became effective on June 1, 2018.

*Stock Concerns*

The NCDMF’s 2018 stock overview http://portal.ncdenr.org/web/mf/stock-overview notes it is difficult to quantitatively assess the CSMA stocks relative to overfishing and overfished stock status. As stated in the CSMA 2010 stock assessment the large confidence intervals and lack of precision in the catch curves Z (total mortality rate) estimates make them unsuitable for making a stock status determination (NCDMF 2010). The FMP review for estuarine striped bass is underway and results from a benchmark stock assessment are expected in 2019. The need for continued conservation management efforts has been supported by persistent low overall abundance, minimal natural recruitment, multiple sources of mortality, the absence of older fish on the spawning grounds, non-optimal environmental conditions on the spawning grounds in the spring, potential impacts from stocked juveniles and hybrid striped bass, and the high percentage of stocked fish in the population.

A management strategy adopted in Amendment 1 continued the annual stocking program in the CSMA rivers. Specific objectives for stocking striped bass included attempts to increase spawning stock abundance while promoting self-sustaining population levels appropriate for various habitats (see Amendment 1, Section 11.2 Striped Bass Stocking In Coastal Rivers, NCDMF 2013). The adopted management strategy from Amendment 1 increased the annual numbers stocked to a goal of 100,000 hatchery reared striped bass in each of the major river systems (Tar-Pamlico, Neuse, and Cape Fear rivers) to aid in recovery of the stocks. From 2006 to 2009 stocking occurred on a rotating basis where only two out of the three systems were stocked annually. Prior to 2006 stocking was focused on the Tar-Pamlico and Neuse rivers with sporadic stocking in the Cape Fear River (Table 1). Various levels of stocking have been going on in these two systems since the 1950s (Woodroffe 2011), with the NCDMF’s formal involvement beginning in 1980 as the result of a cooperative agreement with the United States Fish and Wildlife Service (NCDMF 2013). The prior practice of cross-stocking (stocking of striped bass from one drainage system to another, e.g. Roanoke River striped bass offspring being stocked throughout the southeastern United States), has introduced non-endemic genetic strains to many striped bass populations. The effects of this long-standing practice remain largely undocumented and unquantified (Rulifson and Laney 1999; Bergey et al. 2003). It is now known the egg buoyancy of certain strains (e.g., Roanoke River and Chesapeake Bay) are ideally suited for certain flow types. The Chesapeake strain eggs are lighter and maintain their position in the water column of calmer tidal waters through neutral buoyancy, whereas the Roanoke River strain eggs are much heavier and use the more turbulent, high energy system of the Roanoke River to maintain their position in the water column (Bergey et al. 2003).

To determine the percent contribution of hatchery fish to the wild population, the long-standing convention was to chemically mark hatchery reared striped bass prior to stocking by holding fish at the hatchery in water treated with an antibiotic, oxytetracycline. The chemical leaves a mark on the otoliths (ear bones) of the fish which can be examined by researchers in later years to determine if the fish was hatchery reared or not. Results from the chemical marking methodology suggested hatchery reared striped bass stocked in the Tar-Pamlico, Neuse, and Cape Fear rivers contributed very little to the spawning populations. However, through the years and since the adoption of Amendment 1, researchers realized the chemical mark was not being retained in 100% of fish as previously thought, which led to underestimation of the percent of hatchery reared fish in the striped bass populations in the CSMA (Barwick et al. 2008; NCDMF 2013).

Beginning in 2010 a new method of identifying hatchery reared fish based on genetics, termed parental based tagging (PBT), was implemented by the NCWRC to more accurately determine the percent hatchery contribution to the striped bass on the spawning grounds in the CSMA. In 2016 the NCDMF started collecting striped bass fin clip samples for genetics analysis from the commercial and recreational fisheries and from areas away from the spawning grounds in the lower portions of the rivers to gain additional spatial coverage of samples. The genetics-based method has been proven to be greater than 99% accurate at determining if a fish was hatchery produced (Darden et al. 2012). By 2016, the results of this new genetics-based analysis since 2011 revealed that rather than contributing minimally to the CSMA stocks of striped bass as previously thought, hatchery stocked fish were nearing 100% on the spawning grounds and in internal coastal fishing waters of the Tar-Pamlico, Neuse, and Cape Fear rivers (O'Donnell and Farrae 2017).

Results from genetic testing of sampled fish in 2017, in contrast to prior years, revealed a noticeable decrease in contribution of hatchery stocked fish (Table 2; Farrae and Darden 2018). Of the fish identified as non-hatchery, approximately 23% were >23 inches TL, of which 59% came from the Cape Fear River where PBT testing started in 2010. Only one striped bass in the 2017 genetic results was larger than the size that would allow for PBT testing, therefore almost all of the striped bass sampled were of length that could have been identified through PBT analysis (Figure 3). However, the non-hatchery fish <22 inches in TL collected in 2017 were most likely wild and indicative of successful natural spawning events (Table 2; Figures 3 and 4; Farrae and Darden 2018). Otolith ages of the non-hatchery fish <22 inches TL (n=42) indicate they are all from the 2014 and 2015 year classes (Table 3). These two year classes represent the first significant evidence of successful natural reproduction in the Tar-Pamlico and Neuse rivers since PBT genetics analysis began in 2011.

Juvenile sampling in the Tar-Pamlico and Neuse rivers by the NCDMF with beach seine and trawl gear from 1977–1982 resulted in the collection of very few juveniles in some years and no juveniles in other years. Juvenile sampling by the NCWRC with beach seines and electrofishing gear in 2007 resulted in zero juveniles collected. Results from these sampling efforts supports the hypothesis of very limited, if any, natural reproduction occurring in the Tar-Pamlico and Neuse rivers for several decades (Hawkins 1979; Judy and Hawkins 1982; NCDMF 2005; Barwick et al. 2008; NCDMF 2013).

Characterization of the Fishery

*Recreational*

Recreational harvest in the CSMA has fluctuated since 2004 ranging from a low in 2008 of 2,990 pounds to highs of 22,958, 25,260 and 26,973 pounds in 2004, 2016, and 2017, respectively (Table 4; Figure 5). In recent years both the number of recreational trips and the hours spent targeting striped bass within the CSMA have increased. Since 2011, recreational harvest in the Tar-Pamlico and Neuse rivers has been similar, ranging from approximately 4,000 to 9,000 pounds, however starting in 2016 there was a sharp increase in recreational harvest. The number of legal sized striped bass recreational discards began increasing over the past six years, with the 2017 estimate of 26,487 fish nearly double the previous high of 13,621 fish in 2012. The number of slot limit sized fish released has fluctuated over the past ten years ranging from a low in 2015 of 813 fish to a high of 6,779 fish in 2016. In 2017, in addition to harvesting the highest number of striped bass in over 10 years, there was a twofold increase to more than 100,000 undersized striped bass discards (Table 4). There is also a significant recreational catch-and-release fishery during the summer closed harvest season in the middle reaches of the Tar-Pamlico and Neuse rivers. Total recreational releases during the last 10 years averaged 39,913 fish annually (Table 4).

The proportional standard error (PSE) expresses the standard error of an estimate as a percentage of the estimate and is a measure of precision. In general, PSEs greater than 50% represent imprecise estimates. The PSEs for striped bass harvest in numbers and pounds in the Tar-Pamlico and Neuse rivers range from 16.0 to 69.2%, and the PSEs of estimates of discarded fish range from 1.4 to 43.5% (Table 5).

*Commercial*

Commercial landings in the CSMA have been regulated by an annual TAL of 25,000 pounds since 1994. Over the past 10 years, commercial landings have closely followed the annual TAL, except for 2008 when less than half of the TAL was landed (Figure 6). About twice the number of landings come from the Tar-Pamlico and Pungo rivers compared to the Neuse and Bay rivers (Table 6). Since 2004 there has only been a spring harvest season, recently opening March 1 each year and closing when the TAL is reached, usually near the end of March (Table 7). Commercial discard estimates are lower for the Neuse and Bay rivers, ranging from 194 to 629 discarded fish annually compared to 199 to 1,431 fish from the Tar-Pamlico and Pungo rivers (Table 6). The PSEs of commercial live discard estimates range from 30.2 to 65.8%, and the PSEs for dead discard estimates range from 40.8 to 118.0% (Table 5). The aforenoted gill-net tie down and DFS regulations have helped to decrease commercial discards significantly compared to pre-2008 estimates (Rock et al. 2016). Additionally, other regulations developed to reduce regulatory discards of important estuarine finfish and protected species have also reduced regulatory discards of striped bass.

The following proclamations and rules for gill-nets are in effect in the CSMA (Figure 2).

In effect once the commercial striped bass harvest season closes through December 31 each year, for gill-nets with a stretched mesh length of five inches or greater in all internal coastal waters west (upstream) of the 76° 28.0000' W longitude line which passes near Roos Point at the mouth of Pungo River south to Point of Marsh at the mouth of the Neuse River:

- 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 so as to fish on the bottom and not exceed a vertical height of 36 inches.
- 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:
    - Neuse River - Upstream of a line beginning at a point at Cooper Point 35° 02.1433' N - 76° 55.9965' W; running southwesterly to a point at Fisher Landing Point 35° 00.1550' N - 76° 58.5738' W.
    - Pamlico River - Upstream of a line beginning at a point at Gum Point 35° 25.1669' N - 76° 45.5251' W; running southwesterly to a point at Fork Point at 35° 23.4453' N - 76° 46.4346' W.
    - Pungo River - Upstream of a line beginning at a point at Sandy Point 35° 26.8680' N - 76° 33.9520' W; running southwesterly to a point on the west shore at 35° 26.2810' N - 76° 35.5530' W.

In effect in the Tar-Pamlico, Neuse, and Bay rivers:

- The Pamlico, Pungo, Bay, and Neuse rivers all waters west of the 76° 30.0000'W longitude line). Within the areas above, gill-nets must be checked at least once during a 24-hour period and no later than noon each day.
- 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

In effect statewide:

- 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; NCDMF 2008).
- 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 2014).
- 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.
- As of September 1, 2014, individuals taking marine and estuarine resources with gill-nets (with an exception for run around, strike, drop or drift gill-nets) in Internal Coastal Waters are required to obtain an Estuarine Gill Net Permit (Proclamation M-24-2014).

## IV. AUTHORITY

G.S. 113-134. Rules.
G.S. 113-182. Regulation of fishing and fisheries.
G.S. 113-221.1. Proclamations; emergency review.
G.S. 143B-289.52. Marine Fisheries Commission – powers and duties.

15A NCAC 03H .0103 Proclamations, General
15A NCAC 03M .0202 Season, Size and Harvest Limit: Internal Coastal Waters
15A NCAC 03M .0512 Compliance with Fishery Management Plans
15A NCAC 03Q .0107 Special Regulations: Joint Waters
15A NCAC 03Q .0108 Management Responsibility for Estuarine Striped Bass in Joint Waters
15A NCAC 03Q .0109 Implementation of Estuarine Striped Bass Management Plans: Recreational Fishing

## V. DISCUSSION

No-possession Requirement

At the request of the NCDMF director, the Estuarine Striped Bass FMP Plan Development Team, composed of both NCDMF and NCWRC members, met in fall 2018 to review the most current information regarding CSMA striped bass. The meeting resulted in the division recommending the NCMFC adopt a no-possession requirement for striped bass that would apply to the Tar-Pamlico and Neuse rivers and other joint and internal coastal waters of the CSMA. In MFC rule 15A NCAC 03R .0201 the CSMA is defined as:

The CSMA is designated as all internal, coastal, joint, and contiguous inland waters south of a line beginning at a point 35° 48.5015' N - 75° 44.1228' W on Roanoke Marshes Point, running southeasterly to a point 35° 44 .1710' N - 75° 31 .0520' W on the north point of Eagle Nest Bay, to the South Carolina line.

The proposed supplement measure differs from this definition by omitting the contiguous inland waters which are under the sole jurisdiction of the NCWRC. Additionally, NCMFC Rules 15A NCAC 03M .0202 and 15A NCAC 03Q .0107 state "It is unlawful to possess striped bass from the coastal fishing waters of the Cape Fear River and its tributaries", and "It is unlawful to possess striped bass or striped bass hybrids taken from the joint fishing waters of the Cape Fear River", respectively. Amendment 1 of the FMP maintains the no possession measure on striped bass in the Cape Fear River and its tributaries that has been in place since 2008. The proposed supplement maintains these measures and does not modify these existing rules.

Upon adoption by the NCMFC of Supplement A to Amendment 1 to the N.C. Estuarine Striped Bass FMP, the division director, in compliance with a FMP as authorized by NCMFC Rules 15A NCAC 03M .0512 and 03H .0103, will implement the supplement measure by proclamation. As stated in N.C. General Statute 113-182.1, the urgency of the issue makes it impossible to address it the through the FMP amendment process. Also, the lengthy rule adoption process under the Administrative Procedure Act would negate the urgent nature of the supplement measures to address the long-term viability of the striped bass fishery.

Since May 2008 and as maintained in the adopted management strategy for CSMA striped bass in Amendment 1, the commercial gill-net restrictions requiring the tie-down and DFS measures that are implemented after the commercial striped bass harvest season closes and remain in effect through December 31 of each year are also implemented via proclamation (see Amendment 1, Section 11.6 and Figure 2). These Amendment 1 measures are stated as:

- After the closure of the commercial striped bass season through December 31, require the use of a 3 foot tie down in large mesh (>=5 inch stretch mesh) gill-nets in internal coastal fishing waters upstream of the 76° 28.0000' W longitude line.
- Maintain a minimum distance from shore of 50 yards for these nets upstream of the existing DFS line.

Consistent with Amendment 1, these gill-net measures would then apply year-round with the adoption of this supplement.

Rationale

Recent genetics-based evidence suggests two successful natural spawning events likely occurred in the Tar-Pamlico and Neuse rivers in 2014 and 2015 (Tables 2 and 3; Figures 3 and 4). Based on information available for the CSMA stocks this is an unusual event, although the occurrence of sporadic successful spawning events in the past is supported by other research, such as otolith microchemistry work suggesting that 53% of fish sampled from the Neuse River in 2010 were not of hatchery origin (Rulifson 2014). With the objective to protect these year classes of fish from harvest as they mature and enter the spawning stock, further restrictive measures could increase the abundance of older females in the spawning stocks of these two river systems, promoting self-sustaining populations.

One option explored to protect these fish was to complement the NCWRC rule in inland waters of the CSMA that states the minimum size limit is 26 inches total length with a daily creel limit of two fish per person (NCWRC Rule 15 NCAC 10C .0314).

In the following discussion the years 2012–2017 were chosen for analysis of harvest reduction scenarios to match available comparable data across the recreational and commercial sectors.

Creel clerks measured 1,337 striped bass in the Tar-Pamlico and Neuse rivers and their tributaries during the years 2012–2017. A 26-inch TL minimum size limit would have eliminated 96.9% of the recreational harvest during 2012–2017 across all jurisdictions combined, (inland, joint, and coastal) and in both river systems combined (Figure 7). Reductions of 100% would have occurred in individual years and jurisdictions, mostly in joint and internal coastal jurisdictions, as the majority of the fish harvested greater than 26 inches TL occurred in inland waters. For years 2012–2017, 57% of striped bass harvest occurred in inland waters, 16% occurred in joint waters, and 27% occurred in coastal waters (Figure 8).

For the commercial sector, a similar analysis was performed. Division staff sample commercially harvested striped bass at fish houses to determine the size, sex, weight, and age composition of the commercial harvest. There were 2,825 length measurements available for analysis from the commercial harvest during 2012–2017. A 26-inch TL minimum size limit would have reduced commercial harvest by 91.9% (Figure 9). While this reduction is slightly less than the reduction for the recreational sector, it is significant and in practicality eliminates the commercial fishery. Additionally, a no-possession measure would likely cause a decrease in gill-net effort during March.

Although there is only a slight difference in the amount of harvest reductions realized under a 26-inch TL minimum size limit compared to a no-possession provision, the increase in the stock's spawning potential ratio (SPR) is significant. Rachels and Ricks 2015 indicated a 26-inch minimum size limit equates to a SPR of 0.45; however, with a no-possession limit, 100% of the stock's SPR is realized (SPR=1.0). This is an increase in SPR of 0.55. Also, as female striped bass get older and larger, they produce not only more eggs but more viable eggs (Boyd, 2011; Knight 2015). Research has shown the largest females in a stock can have the greatest reproductive potential (Cowan et al. 1993; Barneche et al. 2018). A 26-inch TL minimum size limit would shift harvest, albeit a small amount, to the older, larger fish in the stock, while a no-possession provision protects these fish. With so few older fish observed on the spawning grounds and very limited natural recruitment observed in decades prior to 2014, it is important to protect not only these two recent year classes, but also the existing older, more fecund fish. In the Tar-Pamlico and Neuse rivers, 98% of striped bass are mature by age three. The length at which 50% of females are mature is 18 inches and length at 100% maturity is 21 inches (Knight 2015).

Understanding the influences that impact the annual mortality on the population is critical to rebuilding and sustaining the stock for long-term viability. Rachels and Ricks (2018) recently used a generalized linear model (GLM) approach to evaluate environmental conditions and commercial exploitation factors (i.e., commercial harvest and gill-net trips) that potentially could influence discrete annual mortality on the Neuse River from 1994–2015. Results indicated the relative annual variation in commercial effort and in commercial harvest were significant factors contributing to the relative annual variation in total mortality of striped bass in the Neuse River. To determine the impact of all sources of removals from all sectors that influence discrete annual mortality, division stock assessment scientists re-ran the analysis to include recreational metrics. Results from the additional analysis showed, along with the relative annual variation in commercial effort and in commercial harvest, the relative annual variation in recreational effort and in recreational discards were also significant factors contributing to the relative annual variation in total mortality of striped bass in the Neuse River.

If environmental conditions and egg viability are favorable during the spring spawning season in the coming years, any natural juvenile production occurring in the coming years should be observed in the NCDMF's striped bass juvenile seine and trawl survey conducted throughout the CSMA, which was re-initiated in 2017. The NCWRC's spring electrofishing survey on the spawning grounds in the CSMA should also observe increased numbers of striped bass in the coming years due to the no-possession provision. In addition, the NCDMF's gill-net survey should observe increased catches of the 2014 and 2015 year classes as they are protected from harvest. The NCDMF's juvenile seine and trawl and gill-net surveys, the NCWRC's electrofishing survey, as well as genetic analyses of fin clips, will all be used in determining if the no-possession limit has the intended effect of substantially increasing abundance of older fish in the stock, which should in turn lead to the potential for increased successful natural reproduction events.

Impacts

There are two sources of fishing mortality on any stock: 1) harvest and 2) dead discards. The combination of these is often referred to by fisheries scientists as "*total removals*". To be consistent with the 2012–2017 time block of years analyzed for the 26-inch minimum size limit reductions, all harvest and discard analyses utilized the same 2012–2017 time period.

Recreational striped bass harvest, discard, effort, and economics data for the Tar-Pamlico and Neuse rivers is collected through a recreational angler survey conducted by the NCDMF. Because the striped bass harvest in these systems occurs in internal coastal rivers as opposed to the ocean or sounds, this survey is conducted independent of the Marine Recreational Information Program (MRIP) administered through the National Oceanic and Atmospheric Administration (NOAA). The recent MRIP calibrations of harvest and effort statistics are not applicable to division estimates of striped bass harvest, effort, and economics in the Tar-Pamlico and Neuse rivers (NCDMF 2018).

Recreational discards of striped bass in the Tar-Pamlico and Neuse rivers come from several categories, including fish discarded because they are under the minimum size limit, within the 22–27 inch TL protective slot limit, because the angler reached the daily possession limit, because the harvest season was closed, or because the angler was simply practicing catch-and-release fishing with no intention of harvesting fish. Once total discards are determined that number is multiplied by a discard mortality rate, which is the number of fish that are expected to die within the next few days from the stress of being caught and released. In general, the discard mortality rate increases as salinity decreases and water temperature increases. Striped bass discard mortality rates vary as much as 0.0%–73.8% in freshwater (Wilde et al. 2000). While it is possible to calculate seasonal discard mortality rates, often scientists will use one rate to apply to all discards that captures the seasonal variability in discard mortality. A discard mortality rate of 6.4% is used for recreational striped bass releases in the Tar-Pamlico and Neuse rivers, though this rate comes from a study conducted in the spring and may not accurately reflect the discard mortality of catch and release fishing occurring during the summer months (Nelson 1998).

Commercial striped bass harvest data is collected through the N. C. Trip Ticket Program (TTP). Each time fish are sold to a licensed dealer, the dealer is required to fill out a trip ticket to record the species harvested and the total weight of each species harvested. Division staff go to fish houses weekly to collect biological information on harvested fish to determine the size, sex, weight, and age composition of the commercial harvest. The TTP is considered a census of commercial landings sold at fish houses, but there is potential for unreported commercial harvest if fish are used for personal consumption or donation (Hadley 2015).

Accurate discard estimates in any commercial fishery require the use of data collected through on-board observer trips in the fishery. Prior to 2012, striped bass commercial discards were estimated by using striped bass catch rates (e.g. number of fish caught per yard of gill-net set for 24 hours) from the NCDMF's independent gill-net survey as a proxy for striped bass catch rates in commercial gill-net fisheries, then multiplying that catch rate by the total number of gill-net trips that occurred in the Tar-Pamlico and Neuse rivers each year (See Amendment 1 Section 11.6 for a complete discussion of how striped bass discard estimates in the CSMA have been calculated through the years, NCDMF 2013). However, with implementation of the mandatory observer program in 2012 there are now many more on-board observer trips annually in the Tar-Pamlico and Neuse rivers to more accurately estimate striped bass discards from the commercial gill-net fisheries. The same methodology used by the NCDMF staff to develop commercial gill-net discard estimates for the sea turtle and Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) Incidental Take Permits, and used in the peer-reviewed stock assessments for red drum (*Sciaenops ocellatus*) and southern flounder (*Paralichthys lethostigma*), was used to estimate striped bass discards in the Tar-Pamlico and Neuse river commercial gill-net fisheries (Crawley 2007; Zuur et al. 2009, 2012; Lee et al. 2018). Discards from the commercial fisheries are broken into two categories, live and dead discards as recorded by the observer. Live discards are multiplied by a discard mortality rate, which for gill-net fisheries is estimated at 43% (Northeast Fisheries Science Center. 2013).

Striped bass total removals (harvest plus dead discards) from the recreational and commercial fisheries in the Tar-Pamlico and Neuse rivers during 2012–2017 were fairly even between sectors and stable between years, except for 2016 and 2017 when recreational dead discards increased in both years (Table 6; Figures 10 and 11). This increase in recreational dead discards is attributed to increased abundance of undersized striped bass from the two large, naturally spawned year classes available to the recreational fishery. From 2012 through 2015 undersized recreational discards averaged 21,840 fish annually, then increased to 57,874 fish in 2016 and 101,787 in 2017 (Table 4). Recreational dead discards of legal sized striped bass also increased in 2017 to 26,487 fish, the highest value in the time series, which would correspond to the 2014 year class reaching the 18-inch minimum size limit during 2017 (Table 3).

To explore how no possession will influence recreational discarded striped bass within the CSMA a statistical comparison between the catch rate (catch/trip) during the current open season (Oct 1 through Apr 30) and closed season (May 1 through Sep 30) from 2012-2017 was conducted. Specifically, a randomization test of catch rate (striped bass catch/trip) by Closed vs. Open season was performed. The results of this analysis demonstrate that there is no difference in catch rate as a function of seasonality ($p > 0.70$). This suggests that under a no-possession scenario all harvested fish will be transferred into regulatory discards, which will be an overall increase in discarded catch of ~9%. However, the total removals from the recreational sector will be approximately 43%

lower (based on 2012–2017 data) under a no-possession provision than under the current harvest regime. This assumes angler behavior stays the same. If angling pressure for striped bass is reduced due to the no-possession provision, then discards and total removals will be even lower, but there is no way to predict angler behavior. The CSMA creel survey in the coming years will provide actual estimates of recreational discards to evaluate.

To explore how a no-possession limit will change estimated discarded striped bass within the commercial gill-net fishery in the CSMA, a GLM framework was used to predict striped bass discards in North Carolina's estuarine gill-net fishery based on observer data collected during 2012–2017. Standard errors of the discard point estimates were calculated using a bootstrapping technique (2,000 iterations).

If the no-possession provision is implemented and gill-nets must adhere to the DFS and tie-down requirements throughout the entire year, then we can assume striped bass discards from gill-nets for the months of January, February, and March (i.e. the winter season, currently the only season in the discard model in which the gill-net requirements are not in place) will be similar to discard estimates for the spring season (which include the months April, May, and June) when the DFS and tie-down regulations are in place. Winter discard estimates for 2012–2017 averaged 657 total discards (live plus dead) per year, while spring discards estimates for the same time period averaged 261 fish per year. Assuming commercial fishermen's fishing behavior remains the same, striped bass discards should be expected to decrease by approximately 23%. Observer coverage in the coming years will provide actual estimates of discards to evaluate.

To evaluate potential economic impacts to the recreational and commercial fisheries under a no-possession provision, the striped bass recreational hook-and-line fisheries just in the Tar-Pamlico and Neuse rivers and all commercial fisheries occurring in the Tar-Pamlico and Neuse rivers were characterized in the Background Section. The following data analyses were also based on years 2012–2017.

Recreational anglers spent an average of 424,925 angler hours each year on all fishing trips for all species in the Tar-Pamlico and Neuse rivers during 2012–2017, while they spent an average of 107,029 angler hours each year specifically targeting striped bass during the same time period (Figure 12). There was a wide range of species anglers reported targeting, including catfish, sunfish, largemouth bass (*Micropterus salmoides*), spotted seatrout (*Cynoscion nebulosus*), red drum, and white perch (*Morone americana*) in addition to striped bass. The majority of anglers reported they had no particular target species in mind when going on a fishing trip (Figure 13).

The economic impact estimates presented for striped bass recreational fishing in the CSMA represent the economic activity generated from recreational trip expenditures. The NCDMF has been surveying recreational anglers in several of the major internal coastal river basins of the central and southern portions of eastern North Carolina since 2004, with a focus on gathering catch, effort, demographic, and economic information from anglers targeting anadromous species such as striped bass, American shad, and hickory shad. For a detailed explanation of the methodology used to estimate the economic impacts of recreational fishing activity occurring in the internal coastal waters of the CSMA please refer to the NCDMF's License and Statistics Section Annual Report (NCDMF 2018).

For the period 2012–2017 estimated expenditures associated with the recreational striped bass fishery in the Tar-Pamlico and Neuse rivers have ranged from $504,870 to $872,249. Income impacts ranged from $77,422 to $145,773, and output impacts ranged from $188,540 to $361,495 (Table 8).

Commercial gill-net fishermen in the Tar-Pamlico and Neuse rivers use both anchored and runaround gill-nets. Runaround gill-nets are set to encircle a school of fish and are then immediately retrieved. The primary species harvested in the runaround gill-net fishery is striped mullet (*Mugil cephalus*) in the fall. The primary species harvested from anchored gill-nets include flounder (Paralichthys spp.), Atlantic menhaden (*Brevoortia tyrannus*), spotted seatrout, and striped bass (Figure 14). For the years 2012–2017 commercial fishermen took an average of 3,303 anchored gill-net trips and 967 runaround gill-net trips per year (Figure 15). From those gill-net trips an average of 300,618 pounds of finfish was harvested from anchored gill-nets and 290,591 pounds of finfish was harvested from runaround gill-nets (Figure 16).

The economic impact estimates presented represent those of commercial seafood harvesters, dealers, wholesalers, and retailers of striped bass from the CSMA. These estimates are a product of IMPLAN regional inter-industry transactional data customized with data from NCDMF and economic multipliers originating from the NOAA Fisheries Commercial Fishing and Seafood Industry Input/Output Model (IMPLAN 2013; NOAA 2018). For a detailed explanation of the methodology used to estimate the commercial impacts of commercial fishing activity occurring in the CSMA, please refer to the NCDMF's License and Statistics Section Annual Report (NCDMF 2018).

For the period 2012–2017, the ex-vessel value for striped bass in the Tar-Pamlico and Neuse rivers has ranged from $51,119 to $83,466. Income impacts ranged from $81,819 to $134,847, and output impacts ranged from $198,196 to $321,360 (Table 9).

The potential of year-round tie-down and DFS regulations due to a striped bass no-possession measure would likely have the greatest impact on the commercial harvest of American shad, as most American shad are harvested in conjunction with the March striped bass fishery. The tie-down and DFS regulations are currently in effect each year from the time the striped bass commercial harvest season closes (typically near March 31) through December 31 of each year. During 2012–2017, commercial fishermen harvested an average of 16,805 pounds of American shad in the months of January–March in the Tar-Pamlico and Neuse rivers combined each year (Figure 17). During 2012–2017, the number of participants that landed striped bass from gill-nets in the Tar-Pamlico and Neuse rivers has ranged from 63 to 97 (Figure 18).

## VI. PROPOSED RULE(S)

There are no proposed rule changes for the supplement management measures.

## VII. RECOMMENDATION

The division recommends the NCMFC adopt the supplement as described herein which the director will implement by proclamation. The supplement will result in a no-possession requirement for striped bass as defined by NCMFC Rule 15A NCAC 03M .0201 that would apply to the Tar-Pamlico and Neuse rivers and other joint and internal coastal waters of the CSMA as described in NCMFC Rule 15NCAC 03R .0201, excluding the joint and internal coastal fishing waters of the Cape Fear River and tributaries (including Snow's Cut). Additionally, consistent with Amendment 1, commercial set gill-net restrictions requiring tie-downs and distance from shore (DFS) measures will apply year-round.

NCMFC Action

To be determined.

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| Prepared by: | N. C. Estuarine Striped Bass Plan Development Team |
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Table 1. Stocking numbers of Phase II (5–7 inches total length) striped bass by system and year for the Albemarle Sound, Tar-Pamlico and Neuse rivers.

| | Tar-Pamlico River | Neuse River | Cape Fear River |
|---|---|---|---|
| Year Class | Number stocked | Number stocked | Number stocked |
| 1979 | | | 14,874 |
| 1980 | | | |
| 1981 | | 47,648 | |
| 1982 | 76,674 | | |
| 1983 | | | 56,437 |
| 1984 | 26,000 | | |
| 1985 | | 39,769 | |
| 1986 | | | |
| 1987 | 17,993 | | |
| 1988 | | 71,092 | |
| 1989 | | | 77,242 |
| 1990 | | 61,877 | |
| 1991 | 30,801 | | |
| 1992 | | 116,820 | |
| 1993 | 118,600 | | |
| 1994 | 183,254 | 79,933 | |
| 1995 | 140,972 | | |
| 1996 | | 100,760 | |
| 1997 | 24,031 | | |
| 1998 | | 83,195 | 30,479 |
| 1999 | 17,954 | | |
| 2000 | | 108,000 | 8,915 |
| 2001 | 37,000 | | |
| 2002 | | 147,654 | |
| 2003 | 159,996 | | |
| 2004 | | 168,011 | 172,055 |
| 2005 | 267,376 | | |
| 2006 | | 99,595 | 102,283 |
| 2007 | 69,871 | 69,953 | |
| 2008 | 91,962 | | 92,580 |
| 2009 | 61,054 | 104,061 | 112,674 |
| 2010 | 114,012 | 107,142 | 210,105 |
| 2011 | 107,767 | 102,089 | 130,665 |
| 2012 | 45,667 | 90,178 | 127,078 |
| 2013 | 123,416 | 113,834 | 195,882 |
| 2014 | 92,727 | 78,899 | 141,752 |
| 2015 | 52,922 | 109,146 | 116,011 |
| 2016 | 121,190 | 134,559 | 63,914 |
| 2017 | 101,987 | 14203 * | 154,024 |

2010 first year of *in situ* broodstock collection from the Cape Fear River
2011 first year of *in situ* broodstock collection from all three Central-Southern rivers
* Poor spawning of broodstock led to low stocking numbers

Table 2. Percent hatchery contribution from striped bass genetic samples collected in the Tar-Pamlico and Neuse rivers by NCDMF and NCWRC staff. Source South Carolina Department of Natural Resources.

| Year | Agency | System | N Samples | Hatchery | "Wild" | % Hatchery | % "Wild" |
|---|---|---|---|---|---|---|---|
| 2016 | NCDMF | Tar-Pamlico | 190 | 164 | 26 | 86% | 14% |
| | | Neuse | 150 | 142 | 8 | 95% | 5% |
| 2016 | NCWRC | Upper Tar | 206 | 181 | 25 | 88% | 12% |
| | | Upper Neuse | 113 | 88 | 25 | 78% | 22% |
| 2017 | NCDMF | Tar-Pamlico | 147 | 102 | 45 | 70% | 30% |
| | | Neuse | 118 | 66 | 52 | 56% | 44% |
| 2017 | NCWRC | Upper Tar | 156 | 114 | 42 | 73% | 27% |
| | | Upper Neuse | 269 | 231 | 38 | 86% | 14% |

Table 3. Length at age information for striped bass collected by NCDMF staff in 2017 that genetic results determined to be not of hatchery origin (a.k.a. “wild”). Striped bass were aged using otoliths.

| Year Class | N | Age | Minimum total length (inches) | Mean total length (inches) | Maximum total length (inches) |
|---|---|---|---|---|---|
| 2014 | 6 | 3 | 13.6 | 16.7 | 18.7 |
| 2015 | 36 | 2 | 12.2 | 14.9 | 19.0 |

Table 4. Recreational effort, harvest, and discards estimates for striped bass in the Tar-Pamlico and Neuse rivers and tributaries.

| River | Year | Total Angler Fishing Trips | Total Fishing Effort (Angler hours) | Striped Bass Angler Trips | Striped Bass Effort (Angler hours) | Recreational Harvest (N) | Recreational Harvest (LB) | Striped Bass Discard (#over creel) | Striped Bass Discard (#under-sized) | Striped Bass Discard (#legal sized) | Striped Bass Discard (#slot sized) | Total Recreational Discards (N) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Neuse River | 2004 | 26,663 | 162,424 | 7,445 | 39,942 | 3,985 | 14,845 | 29 | 5,721 | 1,221 | 0 | 6,971 |
| | 2005 | 64,301 | 249,396 | 9,678 | 42,107 | 1,641 | 6,540 | 13 | 6,473 | 630 | 77 | 7,193 |
| | 2006 | 39,181 | 162,559 | 6,260 | 24,053 | 1,244 | 4,079 | 0 | 7,797 | 1,979 | 0 | 9,776 |
| | 2007 | 31,052 | 142,093 | 4,965 | 20,966 | 2,616 | 7,115 | 140 | 4,858 | 1,484 | 0 | 6,482 |
| | 2008 | 28,134 | 136,575 | 3,174 | 12,954 | 405 | 1,510 | 2,838 | 4,801 | 2,450 | 51 | 10,140 |
| | 2009 | 17,519 | 77,634 | 2,474 | 12,995 | 249 | 868 | 0 | 443 | 704 | 138 | 1,285 |
| | 2010 | 19,540 | 83,108 | 2,340 | 9,177 | 109 | 361 | 0 | 699 | 1,440 | 13 | 2,152 |
| | 2011 | 24,407 | 97,302 | 5,657 | 21,393 | 1,080 | 3,809 | 0 | 7,426 | 2,434 | 913 | 10,773 |
| | 2012 | 70,649 | 210,197 | 8,703 | 34,652 | 1,508 | 5,742 | 334 | 13,660 | 9,741 | 664 | 24,400 |
| | 2013 | 62,013 | 201,924 | 10,433 | 45,068 | 2,563 | 9,604 | 312 | 6,709 | 3,286 | 1,191 | 11,498 |
| | 2014 | 56,805 | 213,867 | 7,840 | 35,829 | 1,230 | 5,603 | 0 | 5,810 | 3,050 | 1,044 | 9,903 |
| | 2015 | 56,636 | 250,634 | 6,515 | 27,747 | 1,373 | 4,804 | 0 | 4,904 | 3,184 | 387 | 8,476 |
| | 2016 | 49,869 | 210,111 | 7,107 | 30,422 | 1,506 | 5,619 | 0 | 10,788 | 3,599 | 2,189 | 16,575 |
| | 2017 | 60,899 | 270,485 | 10,450 | 50,648 | 3,188 | 12,337 | 519 | 27,870 | 16,343 | 1,479 | 46,210 |
| | sub-total | 607,668 | 2,468,308 | 93,041 | 407,953 | 22,696 | 82,836 | 4,184 | 107,960 | 51,544 | 8,146 | 171,834 |
| Tar-Pamlico River | 2004 | 19,412 | 115,557 | 5,337 | 23,849 | 2,156 | 8,113 | 56 | 6,008 | 522 | 0 | 6,586 |
| | 2005 | 25,363 | 102,974 | 6,736 | 27,263 | 2,191 | 8,425 | 139 | 9,136 | 386 | 0 | 9,661 |
| | 2006 | 23,482 | 117,074 | 4,351 | 18,013 | 1,237 | 3,273 | 33 | 4,751 | 335 | 0 | 5,119 |
| | 2007 | 34,712 | 167,241 | 6,006 | 25,689 | 981 | 3,679 | 7 | 16,815 | 223 | 0 | 17,045 |
| | 2008 | 24,753 | 130,240 | 3,447 | 15,459 | 438 | 1,480 | 0 | 6,920 | 866 | 40 | 7,826 |
| | 2009 | 28,388 | 136,125 | 3,168 | 13,616 | 646 | 2,193 | 7 | 4,028 | 1,065 | 580 | 5,680 |
| | 2010 | 17,978 | 81,535 | 4,219 | 16,177 | 1,648 | 5,176 | 29 | 4,501 | 961 | 347 | 5,838 |
| | 2011 | 20,839 | 88,505 | 6,949 | 30,147 | 1,648 | 5,665 | 9 | 9,233 | 2,963 | 1,210 | 13,415 |
| | 2012 | 40,041 | 159,824 | 9,635 | 37,312 | 2,414 | 9,498 | 106 | 12,683 | 3,879 | 2,246 | 18,914 |
| | 2013 | 52,110 | 207,845 | 9,704 | 40,980 | 2,904 | 9,933 | 134 | 12,592 | 7,070 | 1,166 | 20,963 |
| | 2014 | 29,954 | 134,207 | 7,404 | 32,323 | 2,071 | 7,765 | 728 | 13,375 | 4,054 | 597 | 18,755 |
| | 2015 | 44,280 | 180,038 | 11,435 | 50,949 | 2,561 | 9,465 | 40 | 17,367 | 4,845 | 426 | 22,678 |
| | 2016 | 55,506 | 245,998 | 16,176 | 78,567 | 5,191 | 19,641 | 203 | 47,086 | 6,379 | 4,590 | 58,258 |
| | 2017 | 63,410 | 264,423 | 15,649 | 68,874 | 4,147 | 14,636 | 31 | 73,916 | 10,144 | 814 | 84,905 |
| | sub-total | 480,228 | 2,131,586 | 110,217 | 479,218 | 30,232 | 108,943 | 1,522 | 238,412 | 43,693 | 12,016 | 295,643 |
| All | 2004 | 46,075 | 277,981 | 12,782 | 63,791 | 6,141 | 22,958 | 85 | 11,729 | 1,743 | 0 | 13,557 |
| | 2005 | 89,664 | 352,370 | 16,414 | 69,370 | 3,832 | 14,965 | 152 | 15,609 | 1,016 | 77 | 16,854 |
| | 2006 | 62,663 | 279,633 | 10,611 | 42,066 | 2,481 | 7,352 | 33 | 12,548 | 2,314 | 0 | 14,895 |
| | 2007 | 65,764 | 309,334 | 10,971 | 46,655 | 3,597 | 10,794 | 147 | 21,673 | 1,707 | 0 | 23,527 |
| | 2008 | 52,887 | 266,815 | 6,621 | 28,413 | 843 | 2,990 | 2,838 | 11,721 | 3,316 | 91 | 17,966 |
| | 2009 | 45,907 | 213,759 | 5,642 | 26,611 | 895 | 3,061 | 7 | 4,471 | 1,769 | 718 | 6,965 |
| | 2010 | 37,518 | 164,643 | 6,559 | 25,354 | 1,757 | 5,537 | 29 | 5,200 | 2,401 | 360 | 7,990 |
| | 2011 | 45,246 | 185,807 | 12,606 | 51,540 | 2,728 | 9,474 | 9 | 16,659 | 5,397 | 2,123 | 24,188 |
| | 2012 | 110,689 | 370,021 | 18,338 | 71,964 | 3,922 | 15,240 | 439 | 26,343 | 13,621 | 2,910 | 43,313 |
| | 2013 | 114,123 | 409,768 | 20,136 | 86,049 | 5,467 | 19,537 | 447 | 19,302 | 10,356 | 2,357 | 32,461 |
| | 2014 | 86,759 | 348,074 | 15,244 | 68,153 | 3,301 | 13,368 | 728 | 19,185 | 7,104 | 1,641 | 28,658 |
| | 2015 | 100,916 | 430,672 | 17,950 | 78,696 | 3,934 | 14,269 | 40 | 22,272 | 8,029 | 813 | 31,154 |
| | 2016 | 105,375 | 456,109 | 23,283 | 108,989 | 6,697 | 25,260 | 203 | 57,874 | 9,977 | 6,779 | 74,833 |
| | 2017 | 124,309 | 534,908 | 26,100 | 119,522 | 7,334 | 26,973 | 549 | 101,787 | 26,487 | 2,293 | 131,115 |
| Total | | 1,087,896 | 4,599,895 | 203,258 | 887,171 | 52,929 | 191,778 | 5,707 | 346,372 | 95,237 | 20,162 | 467,477 |

* Source CSMA Creel survey live releases multiplied by 6.4% delayed mortality
‡ Source CSMA model results of observer data; dead discards plus live releases multiplied by 43% delayed mortality
Prior to August 2008 their was no season or creel limit in the CSMA waters. In August 2008 measures were implemented to reduce harvest.

Table 5. Proportional Standard Error (PSE) values for recreational estimates of striped bass harvest and discards and commercial estimates of striped bass discards for the Tar-Pamlico and Neuse rivers. Commercial striped bass harvest values are considered a census, not a survey, so PSEs are not available for those values.

| River | Year | Recreational Harvest (N) | PSE | Recreational Harvest (LB) | PSE | Total Recreational Discards (N) | PSE | Commercial Harvest (N) | Commercial Harvest (LB) | Commercial Live Discards (N) | PSE | Commercial Dead Discards‡ (N) | PSE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Neuse and Bay Rivers | 2004 | 3,985 | 26.1 | 14,845 | 26.1 | 6,971 | 20.8 | 1,553 | 7,820 | 161 | | 468 | |
| | 2005 | 1,641 | 23.3 | 6,540 | 23.3 | 7,193 | 34.4 | 857 | 5,173 | 89 | | 258 | |
| | 2006 | 1,244 | 39.3 | 4,079 | 39.3 | 9,776 | 24.3 | 984 | 7,090 | 102 | | 297 | |
| | 2007 | 2,616 | 31.8 | 7,115 | 31.8 | 6,482 | 18.4 | 1,273 | 6,731 | 132 | | 384 | |
| | 2008 | 405 | 46.6 | 1,510 | 46.6 | 10,140 | 34.6 | 479 | 4,828 | 50 | | 144 | |
| | 2009 | 249 | 56.8 | 868 | 56.8 | 1,285 | 43.5 | 1,364 | 8,285 | 141 | | 235 | |
| | 2010 | 109 | 69.2 | 361 | 69.2 | 2,152 | 33.8 | 2,070 | 11,226 | 214 | | 357 | |
| | 2011 | 1,080 | 33.2 | 3,809 | 33.2 | 10,773 | 14.9 | 2,203 | 15,612 | 228 | | 380 | |
| | 2012 | 1,508 | 26.1 | 5,742 | 24.9 | 24,400 | 25.3 | 412 | 4,291 | 122 | 53.3 | 203 | 118 |
| | 2013 | 2,563 | 21.4 | 9,604 | 21.6 | 11,498 | 19.9 | 1,533 | 11,747 | 230 | 46.3 | 322 | 52.8 |
| | 2014 | 1,230 | 43.0 | 5,603 | 43.0 | 9,903 | 24.0 | 1,084 | 6,176 | 123 | 42.0 | 172 | 46.1 |
| | 2015 | 1,373 | 42.6 | 4,804 | 39.8 | 8,476 | 29.1 | 1,236 | 8,363 | 66 | 44.6 | 187 | 56.2 |
| | 2016 | 1,506 | 57.3 | 5,619 | 36.1 | 16,575 | 18.3 | 1,571 | 9,384 | 147 | 42.5 | 170 | 40.8 |
| | 2017 | 3,188 | 24.5 | 12,337 | 23.1 | 46,210 | 2.0 | 2,087 | 13,012 | 118 | 63.3 | 316 | 54.1 |
| | sub-total | 22,696 | | 82,836 | | 171,834 | | 18,706 | 119,735 | 1,922 | | 3,893 | |
| Tar-Pamlico and Pungo Rivers | 2004 | 2,156 | 34.2 | 8,113 | 34.2 | 6,586 | 15.5 | 3,194 | 24,615 | 869 | | 848 | |
| | 2005 | 2,191 | 19.8 | 8,425 | 19.8 | 9,661 | 19.5 | 2,866 | 21,960 | 780 | | 761 | |
| | 2006 | 1,237 | 23.3 | 3,273 | 23.3 | 5,119 | 14.1 | 1,866 | 13,937 | 508 | | 495 | |
| | 2007 | 981 | 19.1 | 3,679 | 19.1 | 17,045 | 14.1 | 2,333 | 18,264 | 635 | | 619 | |
| | 2008 | 438 | 23.8 | 1,480 | 23.8 | 7,826 | 13.0 | 649 | 5,281 | 177 | | 172 | |
| | 2009 | 646 | 17.4 | 2,193 | 17.4 | 5,680 | 15.1 | 2,776 | 16,222 | 755 | | 421 | |
| | 2010 | 1,648 | 24.1 | 5,176 | 24.1 | 5,838 | 13.9 | 2,416 | 12,662 | 657 | | 367 | |
| | 2011 | 1,648 | 18.5 | 5,665 | 18.5 | 13,415 | 13.9 | 1,880 | 12,442 | 512 | | 285 | |
| | 2012 | 2,414 | 19.2 | 9,498 | 19.1 | 18,914 | 14.2 | 3,281 | 18,418 | 797 | 35.8 | 471 | 97.3 |
| | 2013 | 2,904 | 16.0 | 9,933 | 16.1 | 20,963 | 21.5 | 2,906 | 16,823 | 1,179 | 39.5 | 664 | 50.9 |
| | 2014 | 2,071 | 20.1 | 7,765 | 20.3 | 18,755 | 21.9 | 4,746 | 19,069 | 704 | 30.2 | 381 | 51.5 |
| | 2015 | 2,561 | 21.1 | 9,465 | 21.5 | 22,678 | 16.4 | 4,383 | 18,973 | 434 | 34.0 | 320 | 42.0 |
| | 2016 | 5,191 | 21.7 | 19,641 | 22.2 | 58,258 | 14.0 | 4,314 | 13,064 | 1,300 | 39.5 | 690 | 53.1 |
| | 2017 | 4,147 | 20.6 | 14,636 | 20.9 | 84,905 | 1.4 | 2,273 | 9,803 | 734 | 65.8 | 518 | 59.8 |
| | sub-total | 30,232 | | 108,943 | | 295,643 | | 39,883 | 221,532 | 10,041 | | 7,010 | |
| All | 2004 | 6,141 | 17.9 | 22,958 | 17.9 | 13,557 | 12.4 | 4,747 | 32,435 | 1,030 | | 1,316 | |
| | 2005 | 3,832 | 18.0 | 14,965 | 18.0 | 16,854 | 17.9 | 3,723 | 27,132 | 869 | | 1,019 | |
| | 2006 | 2,481 | 22.9 | 7,352 | 22.9 | 14,895 | 16.7 | 2,850 | 21,026 | 610 | | 792 | |
| | 2007 | 3,597 | 23.7 | 10,794 | 23.7 | 23,527 | 11.4 | 3,606 | 24,996 | 767 | | 1,003 | |
| | 2008 | 843 | 25.6 | 2,990 | 25.6 | 17,966 | 20.3 | 1,128 | 10,109 | 226 | | 316 | |
| | 2009 | 895 | 20.2 | 3,061 | 20.2 | 6,965 | 14.7 | 4,140 | 24,507 | 897 | | 656 | |
| | 2010 | 1,757 | 23.0 | 5,537 | 23.0 | 7,990 | 13.7 | 4,486 | 23,888 | 872 | | 723 | |
| | 2011 | 2,728 | 17.3 | 9,474 | 17.3 | 24,188 | 10.2 | 4,083 | 28,054 | 740 | | 665 | |
| | 2012 | 3,922 | 15.5 | 15,240 | 15.2 | 43,313 | 15.5 | 3,693 | 22,709 | 919 | | 674 | |
| | 2013 | 5,467 | 13.1 | 19,537 | 13.3 | 32,461 | 15.5 | 4,439 | 28,569 | 1,409 | | 986 | |
| | 2014 | 3,301 | 20.4 | 13,368 | 21.5 | 28,658 | 15.9 | 5,830 | 25,245 | 827 | | 553 | |
| | 2015 | 3,934 | 20.3 | 14,269 | 19.6 | 31,154 | 14.2 | 5,619 | 27,336 | 500 | | 507 | |
| | 2016 | 6,697 | 21.2 | 25,260 | 19.0 | 74,833 | 11.6 | 4,123 | 22,448 | 1,447 | | 860 | |
| | 2017 | 7,334 | 15.8 | 26,973 | 15.5 | 131,115 | 1.1 | 4,386 | 22,815 | 852 | | 833 | |
| Total | | 52,929 | | 191,778 | | 467,477 | | 56,853 | 341,268 | 11,963 | | 10,903 | |

*PSEs cannot be calculated for commercial discard estimates prior to 2012 because a different methodology was used to calculate discards in those years.

Table 6. Recreational and commercial effort, harvest, discards, recreational striped bass angler interviews and commercial gill net observer trips for striped bass in the Tar-Pamlico and Neuse rivers and tributaries.

| River | Year | Striped Bass Angler Trips | Striped Bass Effort (Angler hours) | Striped Bass Angler Interviews | Recreational Harvest (N) | Recreational Harvest (LB) | Total Recreational Discards | Recreational Dead Discards* | Total Recreational Removals (N) (Harvest + Dead Discards) | Commercial Gill Net Trips | Commercial Observer Trips | Commercial Harvest (N) | Commercial Harvest (LB) | Total Commercial Discards (N) | Commercial Dead Discards ‡ | Total Commercial Removals (N) (Harvest + Dead Discards) | Percent Removals Recreational | Percent Removals Commercial |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Neuse and Bay Rivers | 2004 | 7,445 | 39,942 | 21 | 3,985 | 14,845 | 6,971 | 446 | 4,431 | 2,446 | Insufficient observer coverage^ | 1,553 | 7,820 | 629 | 468 | 2,021 | 0.69 | 0.31 |
| | 2005 | 9,678 | 42,107 | 260 | 1,641 | 6,540 | 7,193 | 460 | 2,101 | 2,648 | | 857 | 5,173 | 347 | 258 | 1,115 | 0.65 | 0.35 |
| | 2006 | 6,260 | 24,053 | 116 | 1,244 | 4,079 | 9,776 | 626 | 1,870 | 3,323 | | 984 | 7,090 | 398 | 297 | 1,281 | 0.59 | 0.41 |
| | 2007 | 4,965 | 20,966 | 91 | 2,616 | 7,115 | 6,482 | 415 | 3,031 | 3,322 | | 1,273 | 6,731 | 515 | 384 | 1,657 | 0.65 | 0.35 |
| | 2008 | 3,174 | 12,954 | 57 | 405 | 1,510 | 10,140 | 649 | 1,054 | 2,405 | | 479 | 4,828 | 194 | 144 | 623 | 0.63 | 0.37 |
| | 2009 | 2,474 | 12,995 | 26 | 249 | 868 | 1,285 | 82 | 331 | 2,990 | | 1,364 | 8,285 | 316 | 235 | 1,599 | 0.17 | 0.83 |
| | 2010 | 2,340 | 9,177 | 30 | 109 | 361 | 2,152 | 138 | 247 | 1,932 | | 2,070 | 11,226 | 479 | 357 | 2,427 | 0.09 | 0.91 |
| | 2011 | 5,657 | 21,393 | 177 | 1,080 | 3,809 | 10,773 | 689 | 1,769 | 1,576 | | 2,203 | 15,612 | 510 | 380 | 2,583 | 0.41 | 0.59 |
| | 2012 | 8,703 | 34,652 | 185 | 1,508 | 5,742 | 24,400 | 1,562 | 3,070 | 2,170 | 60 | 412 | 4,291 | 273 | 203 | 615 | 0.83 | 0.17 |
| | 2013 | 10,433 | 45,068 | 169 | 2,563 | 9,604 | 11,498 | 736 | 3,299 | 3,275 | 80 | 1,533 | 11,747 | 453 | 322 | 1,855 | 0.64 | 0.36 |
| | 2014 | 7,840 | 35,829 | 138 | 1,230 | 5,603 | 9,903 | 634 | 1,863 | 2,625 | 128 | 1,084 | 6,176 | 242 | 172 | 1,256 | 0.59 | 0.41 |
| | 2015 | 6,515 | 27,747 | 140 | 1,373 | 4,804 | 8,476 | 542 | 1,915 | 1,763 | 79 | 1,236 | 8,363 | 225 | 187 | 1,423 | 0.58 | 0.42 |
| | 2016 | 7,107 | 30,422 | 125 | 1,506 | 5,619 | 16,575 | 1,061 | 2,567 | 2,071 | 89 | 1,571 | 9,384 | 254 | 170 | 1,741 | 0.60 | 0.40 |
| | 2017 | 10,450 | 50,648 | 197 | 3,188 | 12,337 | 46,210 | 2,957 | 6,145 | 2,575 | 129 | 2,087 | 13,012 | 383 | 316 | 2,403 | 0.72 | 0.28 |
| average | | 6,646 | 29,139 | 124 | 1,621 | 5,917 | 12,274 | 786 | 2,407 | 2,509 | 94 | 1,336 | 8,553 | 373 | 278 | 1,614 | 0.60 | 0.40 |
| Tar-Pamlico and Pungo Rivers | 2004 | 5,337 | 23,849 | 637 | 2,156 | 8,113 | 6,586 | 422 | 2,578 | 3,040 | Insufficient observer coverage^ | 3,194 | 24,615 | 980 | 848 | 4,042 | 0.39 | 0.61 |
| | 2005 | 6,736 | 27,263 | 578 | 2,191 | 8,425 | 9,661 | 618 | 2,809 | 2,968 | | 2,866 | 21,960 | 879 | 761 | 3,627 | 0.44 | 0.56 |
| | 2006 | 4,351 | 18,013 | 274 | 1,237 | 3,273 | 5,119 | 328 | 1,565 | 2,709 | | 1,866 | 13,937 | 573 | 495 | 2,361 | 0.40 | 0.60 |
| | 2007 | 6,006 | 25,689 | 380 | 981 | 3,679 | 17,045 | 1,091 | 2,072 | 3,010 | | 2,333 | 18,264 | 716 | 619 | 2,952 | 0.41 | 0.59 |
| | 2008 | 3,447 | 15,459 | 230 | 438 | 1,480 | 7,826 | 501 | 939 | 2,588 | | 649 | 5,281 | 199 | 172 | 821 | 0.53 | 0.47 |
| | 2009 | 3,168 | 13,616 | 238 | 646 | 2,193 | 5,680 | 364 | 1,010 | 3,134 | | 2,776 | 16,222 | 852 | 421 | 3,197 | 0.24 | 0.76 |
| | 2010 | 4,219 | 16,177 | 266 | 1,648 | 5,176 | 5,838 | 374 | 2,022 | 1,742 | | 2,416 | 12,662 | 741 | 367 | 2,783 | 0.42 | 0.58 |
| | 2011 | 6,949 | 30,147 | 306 | 1,648 | 5,665 | 13,415 | 859 | 2,507 | 1,607 | | 1,880 | 12,442 | 577 | 285 | 2,165 | 0.54 | 0.46 |
| | 2012 | 9,635 | 37,312 | 304 | 2,414 | 9,498 | 18,914 | 1,210 | 3,624 | 1,859 | 16 | 3,281 | 18,418 | 925 | 471 | 3,752 | 0.49 | 0.51 |
| | 2013 | 9,704 | 40,980 | 299 | 2,904 | 9,933 | 20,963 | 1,342 | 4,246 | 2,448 | 39 | 2,906 | 16,823 | 1,336 | 664 | 3,570 | 0.54 | 0.46 |
| | 2014 | 7,404 | 32,323 | 228 | 2,071 | 7,765 | 18,755 | 1,200 | 3,271 | 2,083 | 117 | 4,746 | 19,069 | 782 | 381 | 5,127 | 0.39 | 0.61 |
| | 2015 | 11,435 | 50,949 | 270 | 2,561 | 9,465 | 22,678 | 1,451 | 4,012 | 1,472 | 86 | 4,383 | 18,973 | 567 | 320 | 4,703 | 0.46 | 0.54 |
| | 2016 | 16,176 | 78,567 | 406 | 5,191 | 19,641 | 58,258 | 3,728 | 8,919 | 1,434 | 60 | 4,314 | 13,064 | 1,431 | 690 | 5,004 | 0.64 | 0.36 |
| | 2017 | 15,649 | 68,874 | 388 | 4,147 | 14,636 | 84,905 | 5,434 | 9,581 | 1,849 | 38 | 2,273 | 9,803 | 936 | 518 | 2,791 | 0.77 | 0.23 |
| average | | 7,873 | 34,230 | 343 | 2,159 | 7,782 | 21,117 | 1,352 | 3,511 | 2,282 | 59 | 2,849 | 15,824 | 821 | 501 | 3,350 | 0.51 | 0.49 |
| All | 2004 | 12,782 | 63,791 | 658 | 6,141 | 22,958 | 13,557 | 868 | 7,009 | 5,486 | Insufficient observer coverage^ | 4,747 | 32,435 | 1,609 | 1,316 | 6,356 | 0.52 | 0.48 |
| | 2005 | 13,205 | 44,313 | 838 | 3,832 | 14,965 | 16,854 | 1,079 | 4,911 | 5,616 | | 3,723 | 27,132 | 1,226 | 1,019 | 4,949 | 0.50 | 0.50 |
| | 2006 | 10,609 | 30,889 | 390 | 2,481 | 7,352 | 14,895 | 953 | 3,434 | 6,032 | | 2,850 | 21,026 | 971 | 792 | 3,821 | 0.47 | 0.53 |
| | 2007 | 10,974 | 37,088 | 471 | 3,597 | 10,794 | 23,527 | 1,506 | 5,103 | 6,332 | | 3,606 | 24,996 | 1,231 | 1,003 | 4,837 | 0.51 | 0.49 |
| | 2008 | 6,621 | 21,296 | 287 | 843 | 2,990 | 17,966 | 1,150 | 1,993 | 4,993 | | 1,128 | 10,109 | 393 | 316 | 1,521 | 0.57 | 0.43 |
| | 2009 | 5,642 | 20,695 | 264 | 895 | 3,061 | 6,965 | 446 | 1,341 | 6,124 | | 4,140 | 24,507 | 1,167 | 656 | 5,307 | 0.20 | 0.80 |
| | 2010 | 6,558 | 16,060 | 296 | 1,757 | 5,537 | 7,990 | 511 | 2,268 | 3,674 | | 4,486 | 23,888 | 1,220 | 723 | 5,706 | 0.28 | 0.72 |
| | 2011 | 12,608 | 33,353 | 483 | 2,728 | 9,474 | 24,188 | 1,548 | 4,276 | 3,183 | | 4,083 | 28,054 | 1,086 | 665 | 5,169 | 0.45 | 0.55 |
| | 2012 | 18,338 | 71,964 | 489 | 3,922 | 15,240 | 43,313 | 2,772 | 6,694 | 4,029 | 76 | 3,693 | 22,709 | 1,198 | 674 | 4,891 | 0.58 | 0.42 |
| | 2013 | 20,136 | 86,049 | 468 | 5,467 | 19,537 | 32,461 | 2,077 | 7,544 | 5,723 | 119 | 4,439 | 28,569 | 1,789 | 986 | 6,228 | 0.55 | 0.45 |
| | 2014 | 15,244 | 68,153 | 366 | 3,301 | 13,368 | 28,658 | 1,834 | 5,135 | 4,708 | 245 | 5,830 | 25,245 | 1,024 | 553 | 6,854 | 0.43 | 0.57 |
| | 2015 | 17,950 | 78,696 | 410 | 3,934 | 14,269 | 31,154 | 1,994 | 5,928 | 3,235 | 165 | 5,619 | 27,336 | 792 | 507 | 6,411 | 0.48 | 0.52 |
| | 2016 | 23,283 | 108,989 | 531 | 6,697 | 25,260 | 74,833 | 4,789 | 11,486 | 3,505 | 149 | 4,123 | 22,448 | 1,685 | 860 | 5,808 | 0.66 | 0.34 |
| | 2017 | 26,100 | 119,522 | 585 | 7,334 | 26,973 | 131,115 | 8,391 | 15,726 | 4,424 | 167 | 4,386 | 22,815 | 1,319 | 833 | 5,705 | 0.73 | 0.27 |
| Average | | 14,289 | 57,204 | 467 | 3,781 | 13,698 | 33,391 | 2,137 | 5,918 | 4,790 | 154 | 4,061 | 24,376 | 1,194 | 779 | 5,255 | 0.53 | 0.47 |

* Source CSMA Creel survey live releases multiplied by 6.4% delayed mortality

‡ Source CSMA model results of observer data; dead discards plus live releases multiplied by 43% delayed mortality

^ Insufficient observer coverage exists during these years in the rivers to use in the discard model, therefore estimates were hindcast using a ratio methodology

Table 7. Season open and close dates and commercial harvest of striped bass in the Central Southern Management Area.

| Year | TAL (lbs) | Spring season | # Days | Bag limit | Total Pounds landed |
|---|---|---|---|---|---|
| 2018 | 25,000 | Mar 1 - Apr 30 (Cape Fear Closed) | 60 days | 10 fish | 19,939 |
| 2017 | 25,000 | Mar 1 - Apr 3 (Cape Fear Closed) | 33 days | 10 fish | 23,018 |
| 2016 | 25,000 | Mar 1 - Mar 21 (Cape Fear Closed) | 21 days | 10 fish | 23,041 |
| 2015 | 25,000 | Mar 1 - Mar 18 (Cape Fear Closed) | 18 days | 10 fish | 27,336 |
| 2014 | 25,000 | Mar 1 - Mar 20 (Cape Fear Closed) | 20 days | 10 fish | 25,245 |
| 2013 | 25,000 | Mar 1 - Apr 15 (Cape Fear Closed) | 46 days | 10 fish | 28,597 |
| 2012 | 25,000 | Mar 1 - Mar 30 (Cape Fear Closed) | 30 days | 10 fish | 22,709 |
| 2011 | 25,000 | Mar 1 - Mar 25 (Cape Fear Closed) | 25 days | 10 fish | 28,054 |
| 2010 | 25,000 | Mar 1 - Mar 27 (Cape Fear Closed) | 26 days | 10 fish | 23,888 |
| 2009 | 25,000 | Mar 16 – Apr 10 (Cape Fear Closed) | 26 days | 7 fish | 24,407 |
| 2008 | 25,000 | Mar 3 - Apr 30 Jan 10 - Apr 30 (Cape Fear) | 137 days | 5 fish | 10,230 |
| 2007 | 25,000 | Mar 1 - Apr 3 Jan 10 - Apr 30 (Cape Fear) | 97 days | 5 fish | 24,040 |
| 2006 | 25,000 | Mar 1 - Mar 31 Jan 2 - Mar 31 (Cape Fear) | 137 days | 5 fish | 20,269 |
| 2005 | 25,000 | Feb 28 - Mar 24 Jan 3 - Apr 31 (Cape Fear) | 143 days | 5 fish | 25,620 |
| 2004 | 25,000 | Mar 8 - Apr 5 Jan 16 - Apr 30 (Cape Fear) | 142 days | 5 fish | 32,315 |

Table 8. Economic impact of recreational fishing in the Tar-Pamlico and Neuse rivers.

| Year | Estimated Angler Hours[1] | Estimated Expenditures [2] | Economic Impacts: Jobs[3,4] | Economic Impacts: Income Impacts [4] | Economic Impacts: Output Impacts[4] |
|---|---|---|---|---|---|
| 2017 | 119,522 | $872,249 | 4.1 | $145,773 | $361,495 |
| 2016 | 108,989 | $722,652 | 3.3 | $118,311 | $292,347 |
| 2015 | 78,696 | $582,458 | 2.6 | $92,718 | $230,204 |
| 2014 | 68,152 | $504,870 | 2.1 | $77,422 | $188,540 |
| 2013 | 86,049 | $746,993 | 3.4 | $118,234 | $288,232 |
| 2012 | 71,964 | $583,894 | 2.7 | $88,759 | $213,664 |

[1] Effort estimates as reported by the NCDMF Coastal Angling Program.
[2] Estimated fishing trip expenditures.
[3] Includes full time and part time jobs.
[4] Economic impacts calculated using the NCDMF coastal recreational fishing economic impact model and IMPLAN economic impact modeling software. Economic impact estimates are for the state economy of North Carolina.

Table 9. Economic impact of commercial harvesters of striped bass in the Central Southern Management Area.

| Year | Commercial Participants[1] | Pounds[1] | Ex-Vessel Value[1] | Economic Impacts: Jobs[2,3] | Economic Impacts: Income Impact [3] | Economic Impacts: Output Impacts[3,4] |
|---|---|---|---|---|---|---|
| 2017 | 100 | 23,018 | $66,033 | 5 | $124,211 | $303,093 |
| 2016 | 94 | 23,041 | $69,271 | 5 | $125,768 | $286,344 |
| 2015 | 104 | 27,336 | $84,226 | 7 | $136,075 | $324,288 |
| 2014 | 125 | 25,245 | $69,098 | 6 | $113,188 | $270,311 |
| 2013 | 97 | 28,597 | $84,824 | 7 | $136,327 | $325,958 |
| 2012 | 69 | 22,709 | $51,922 | 5 | $83,104 | $201,310 |

[1] As reported by the NCDMF Trip Ticket Program.
[2] Represents both full-time and part-time jobs.
[3] Economic impacts calculated using the NCDMF commercial fishing economic impact model and IMPLAN economic impact modeling software. Economic impact estimates are for the state economy of North Carolina.
[4] Represents sales impacts.

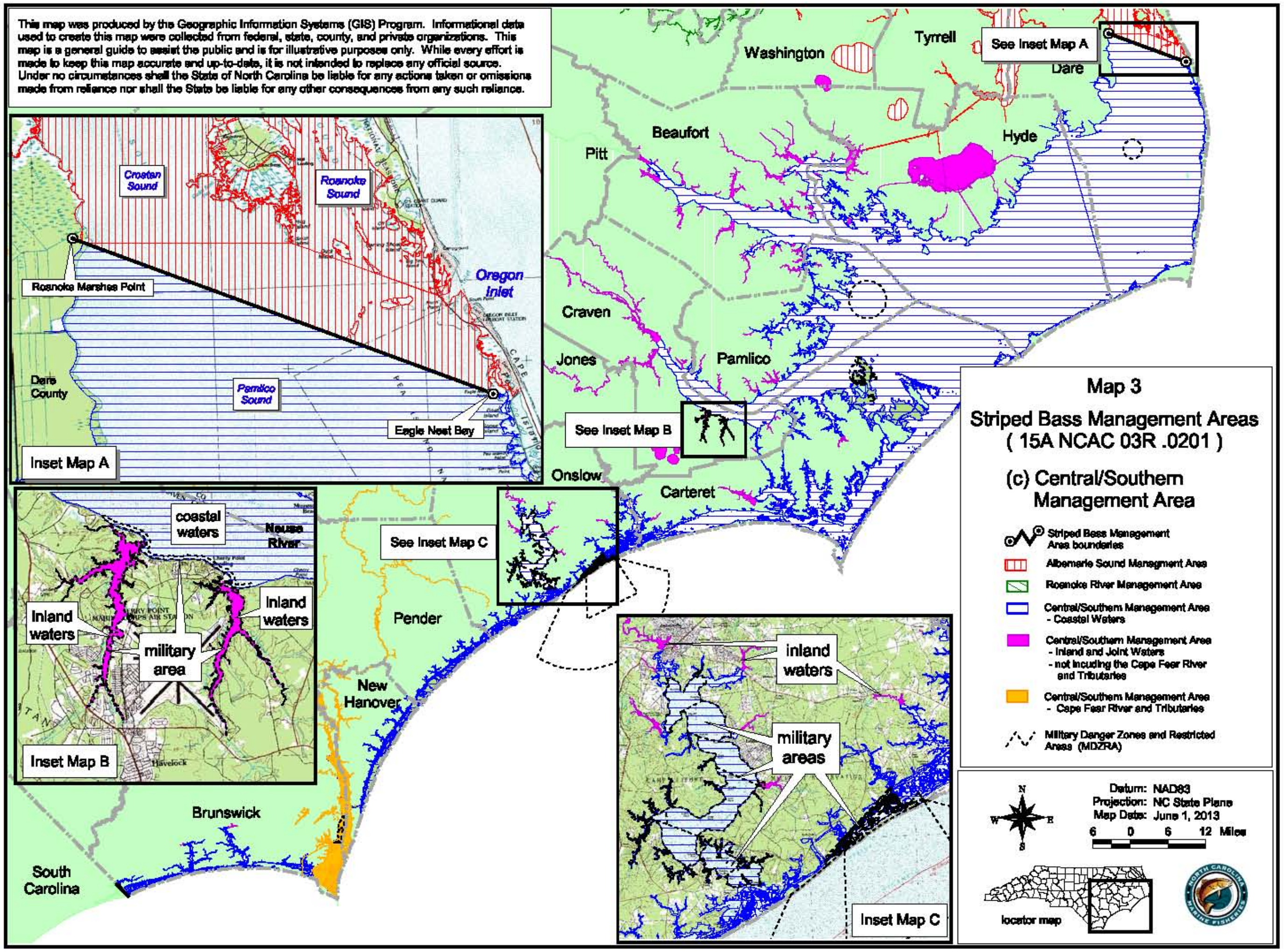


Figure 1. Boundary map for the Central Southern Striped Bass Management Area.

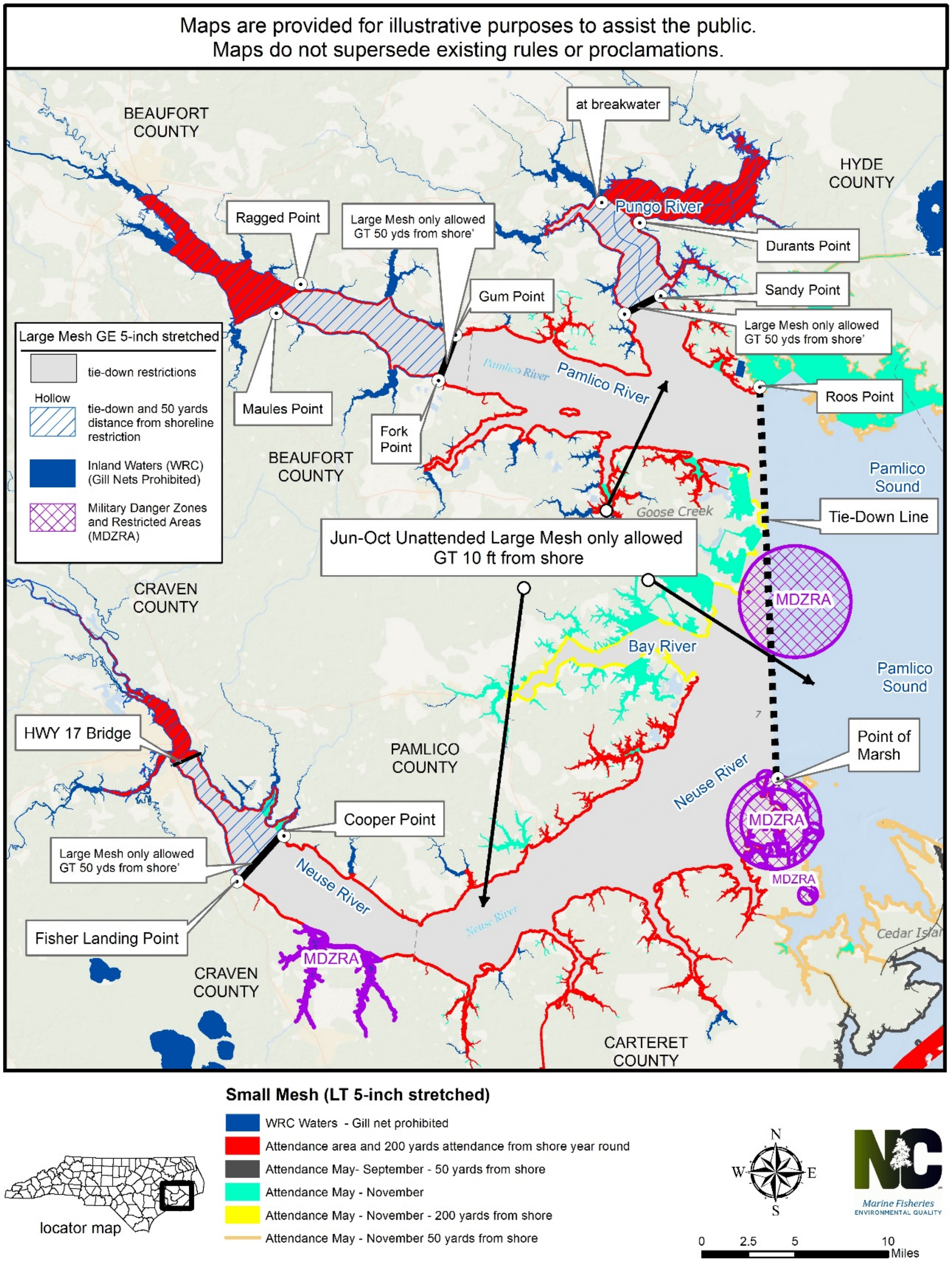


Figure 2. Gill-net regulation map for various gill-net types and seasons in the Central Southern Management Area.


Figure 3. Length frequencies of striped bass fin clips sampled in 2017 that were sent for genetic analysis. The “wild” fish were determined to be not of hatchery origin. All other fish were determined to be of hatchery origin. Bottom axis denotes year class and age. Source: Farrae and Darden 2018.

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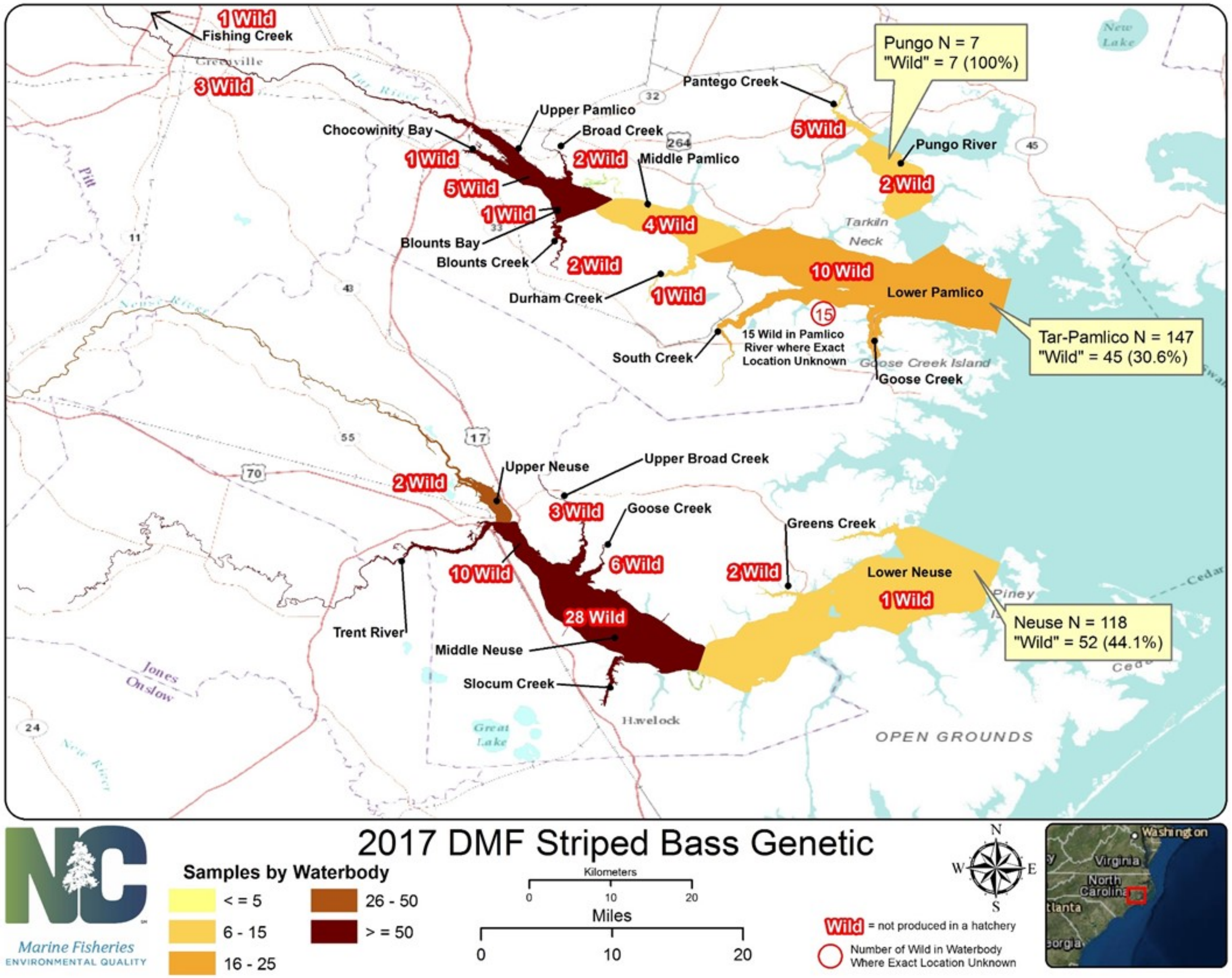


Figure 4. Map illustrating the number of genetic samples collected through NCDMF sampling sent for analysis and the results of hatchery versus non-hatchery (wild) fish.

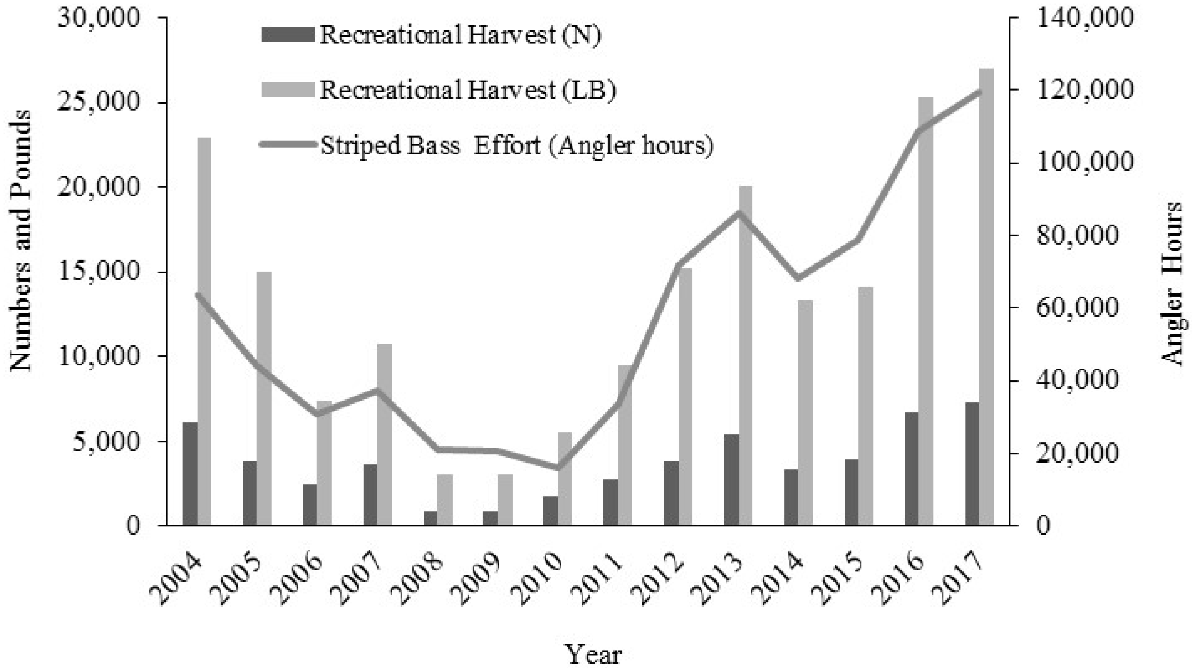


Figure 5. Recreational striped bass harvest in numbers and pounds and effort in angler hours for the Tar-Pamlico and Neuse rivers and tributaries.

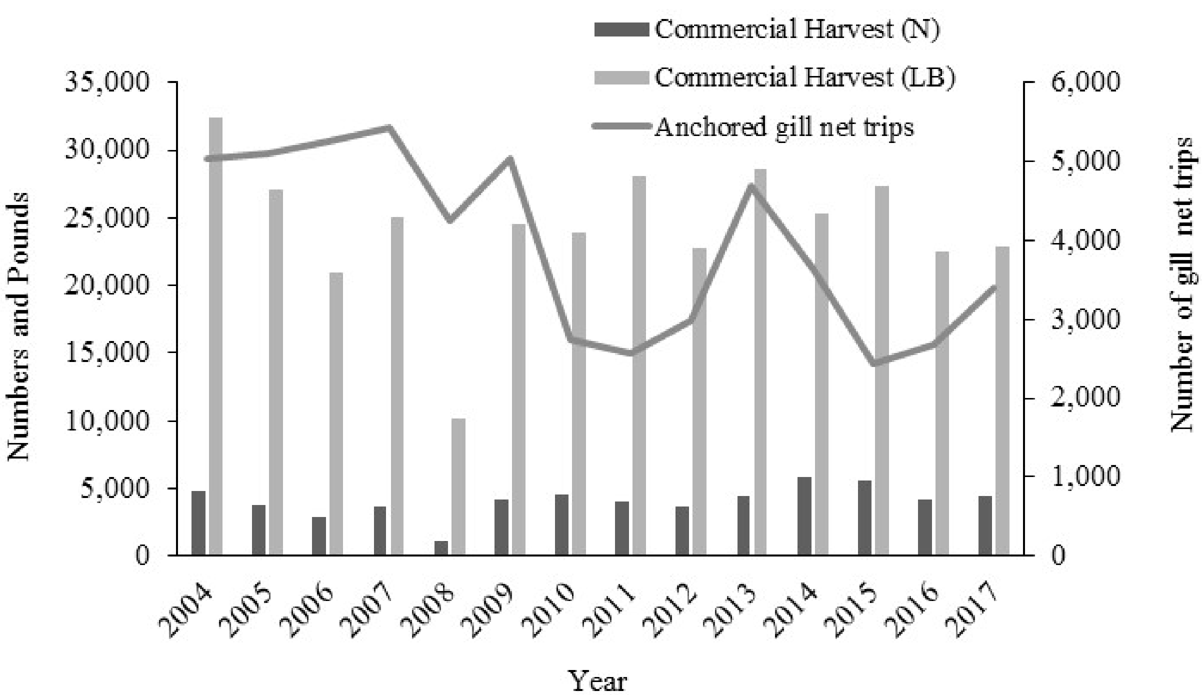


Figure 6. Commercial harvest in numbers and pounds and anchored gill-net trips for striped bass in the Tar-Pamlico and Neuse and Bay rivers.

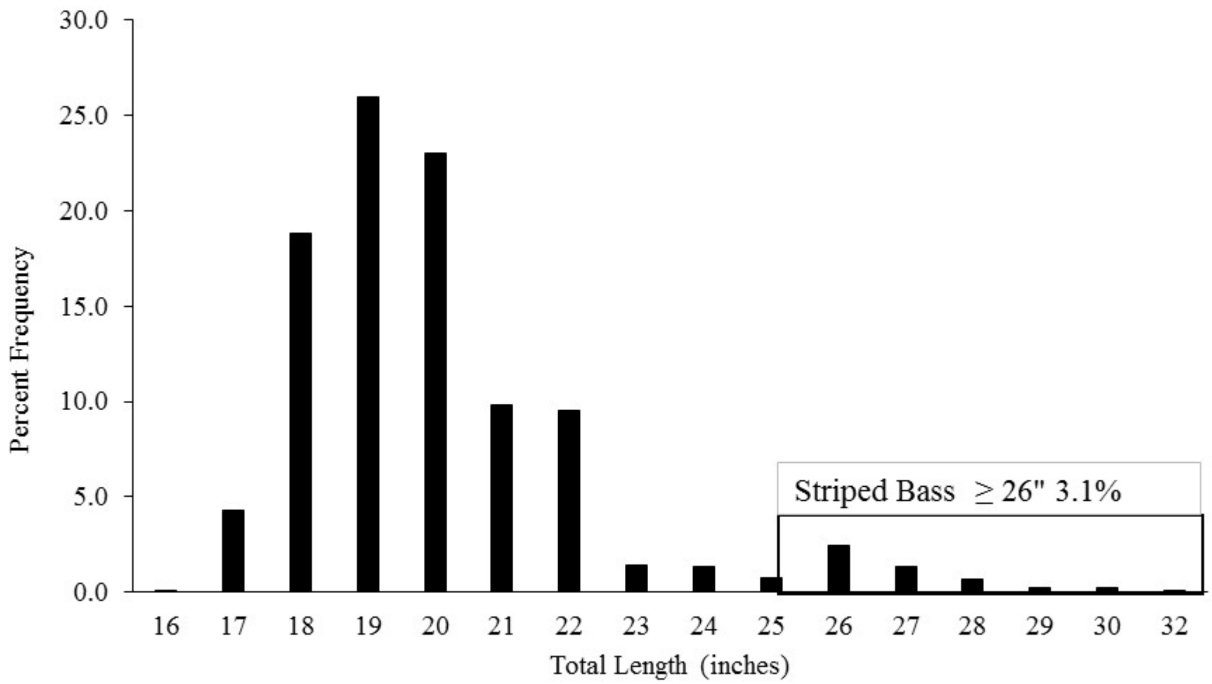


Figure 7. Recreational length distribution for striped bass sampled from the Tar-Pamlico and Neuse rivers, 2012–2017.

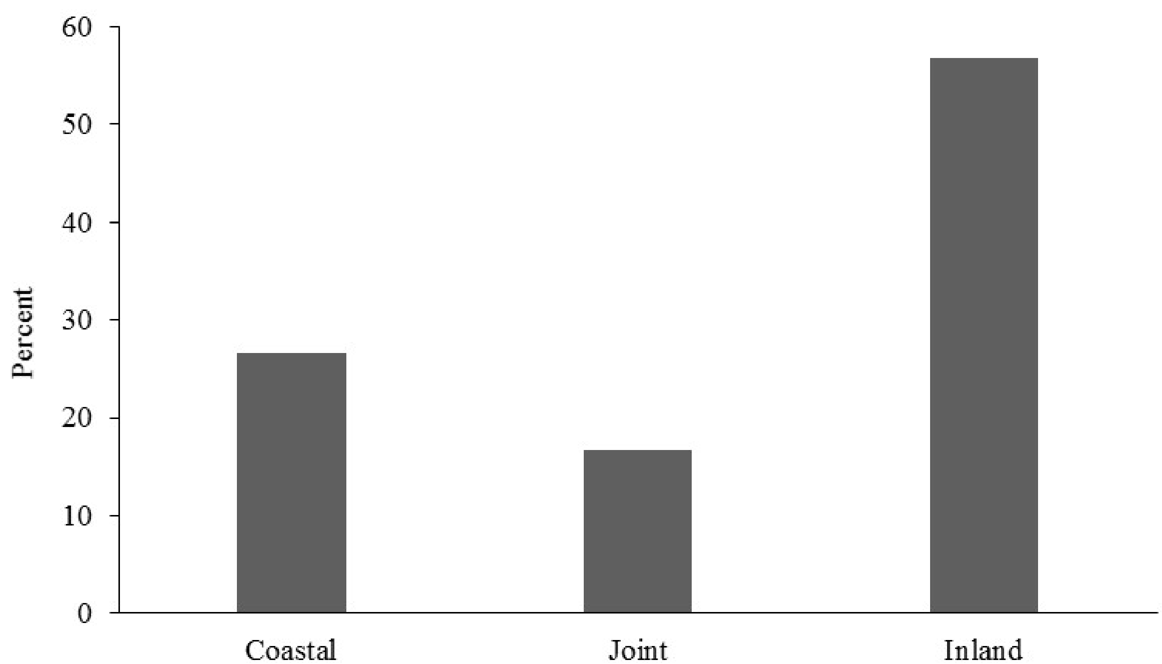


Figure 8. Percent recreational harvest of striped bass by coastal, joint, and inland jurisdictions in the Tar-Pamlico and Neuse rivers, 2012–2017.

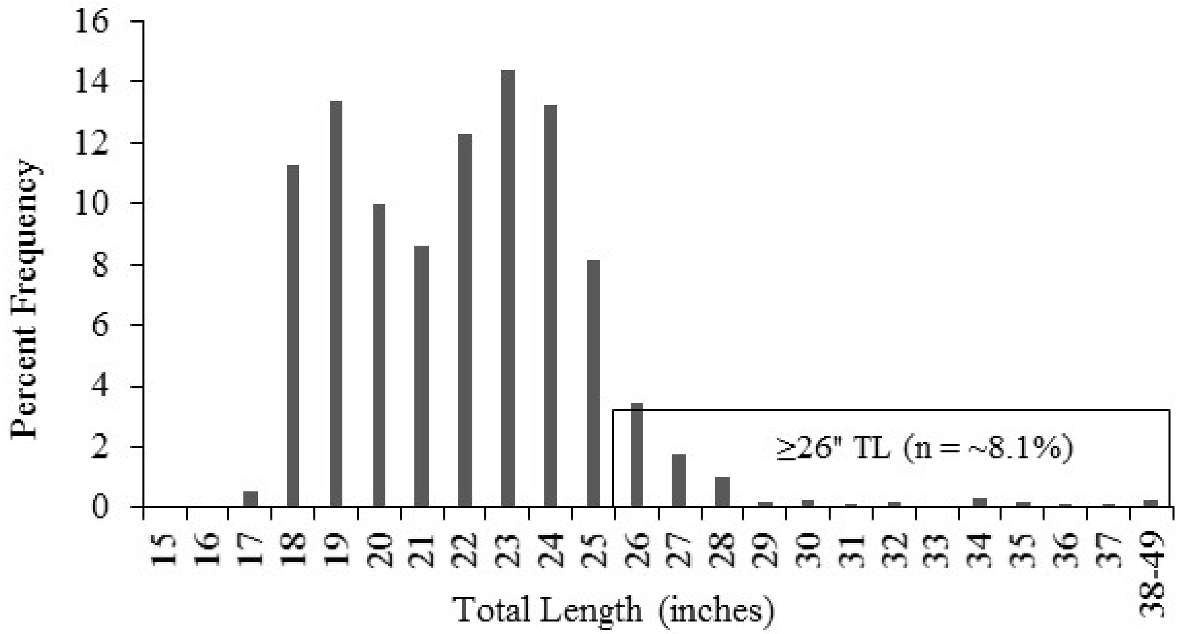


Figure 9. Commercial length distribution for striped bass sampled from the Tar-Pamlico, Neuse and Bay rivers, 2012–2017.

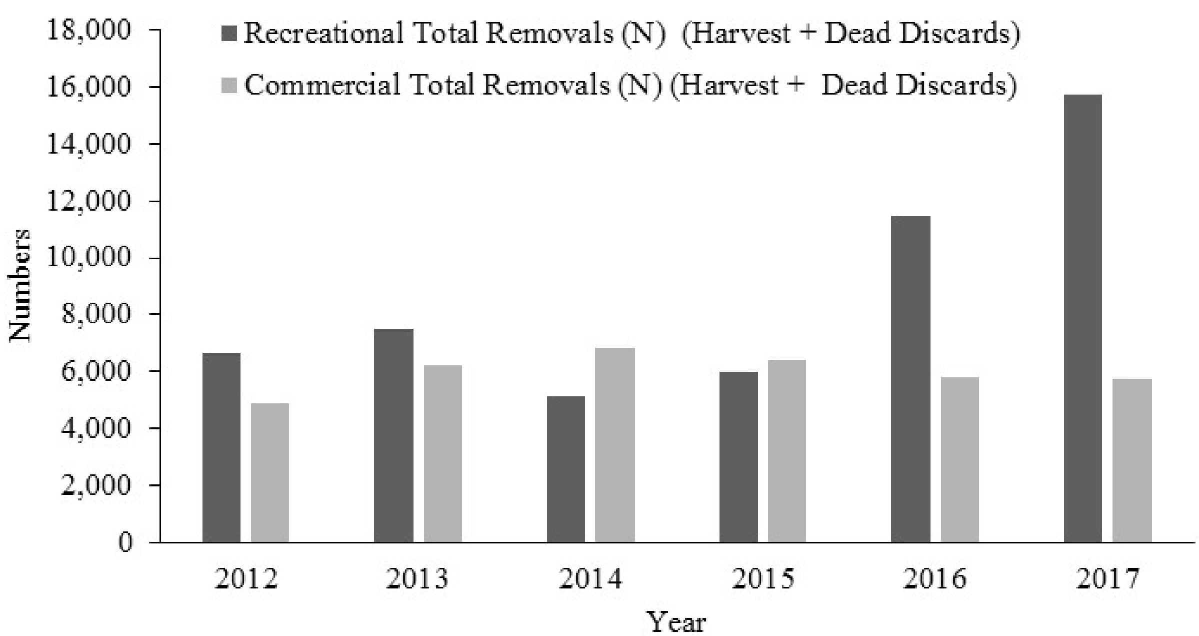


Figure 10. Commercial and recreational total removals of striped bass from the Tar-Pamlico and Neuse and Bay rivers.

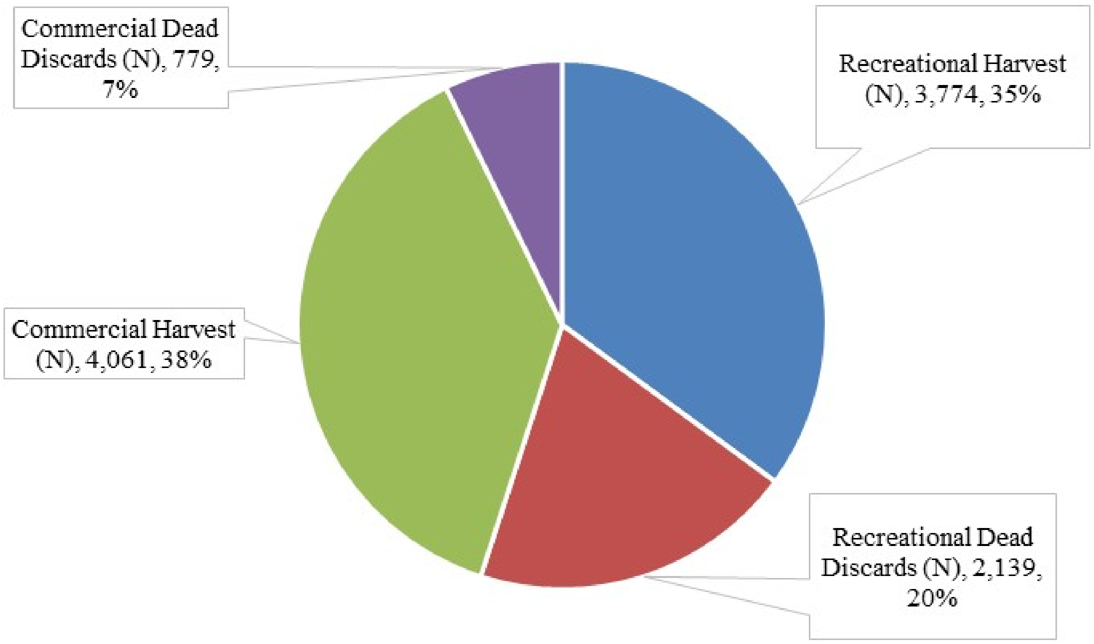


Figure 11. Average number of striped bass harvest and discards each year from the recreational and commercial sectors in the Tar-Pamlico and Neuse rivers, 2012–2017.

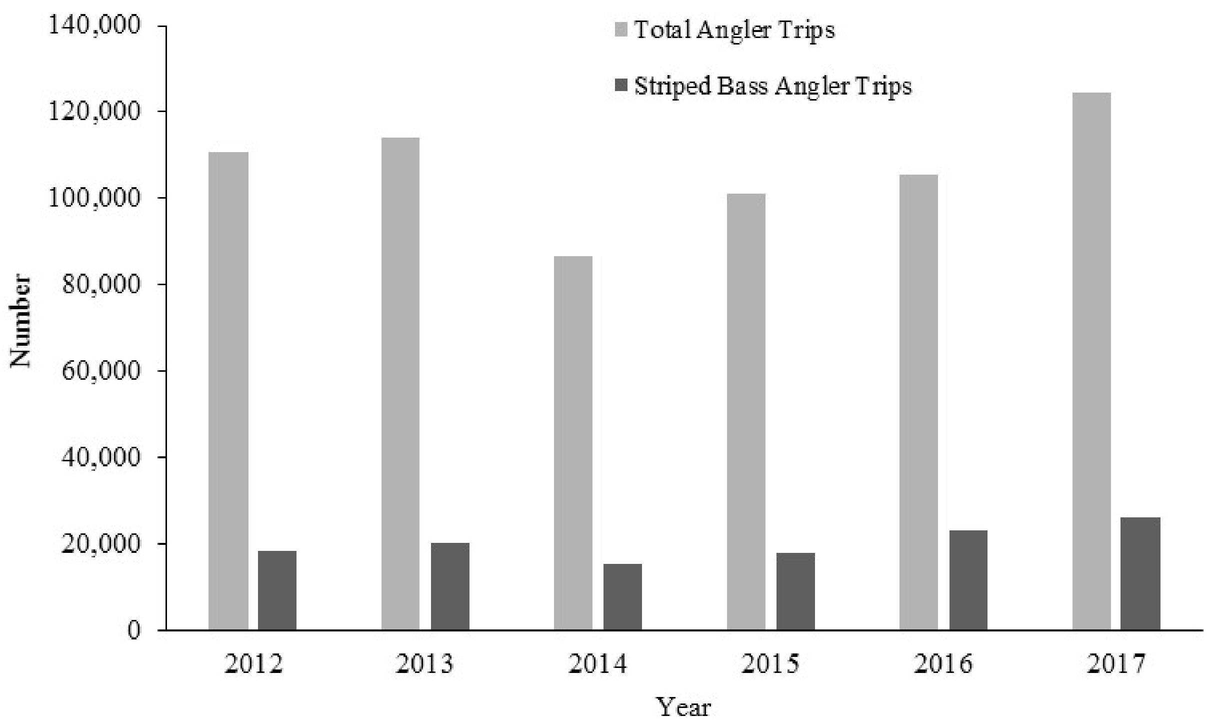


Figure 12. Total recreational angler trips and angler trips targeting striped bass the Tar-Pamlico and Neuse rivers.

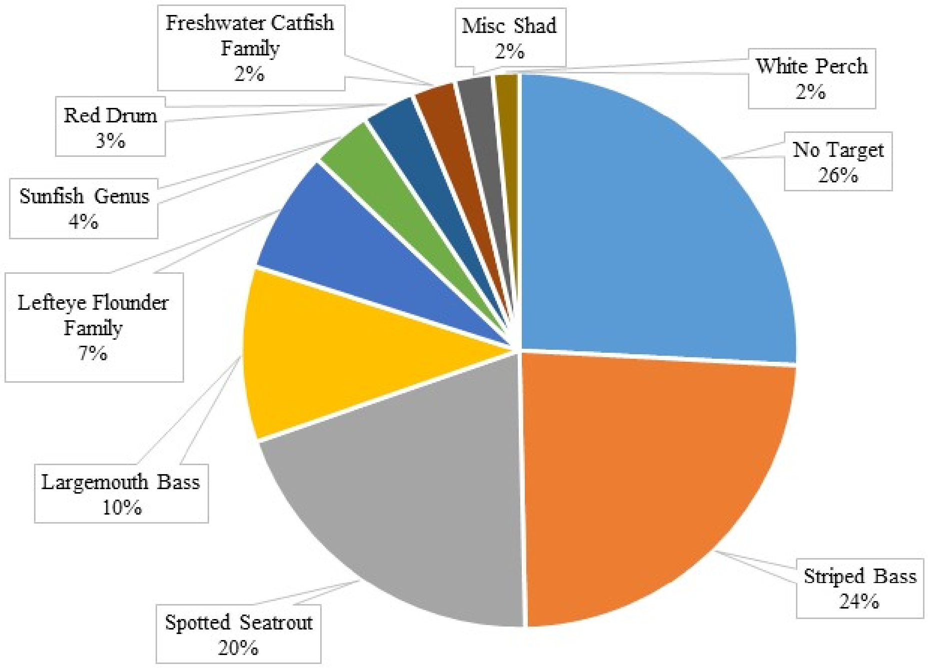


Figure 13. Top ten reported targeted species for recreational anglers fishing in the Tar-Pamlico and Neuse rivers, 2012–2017.

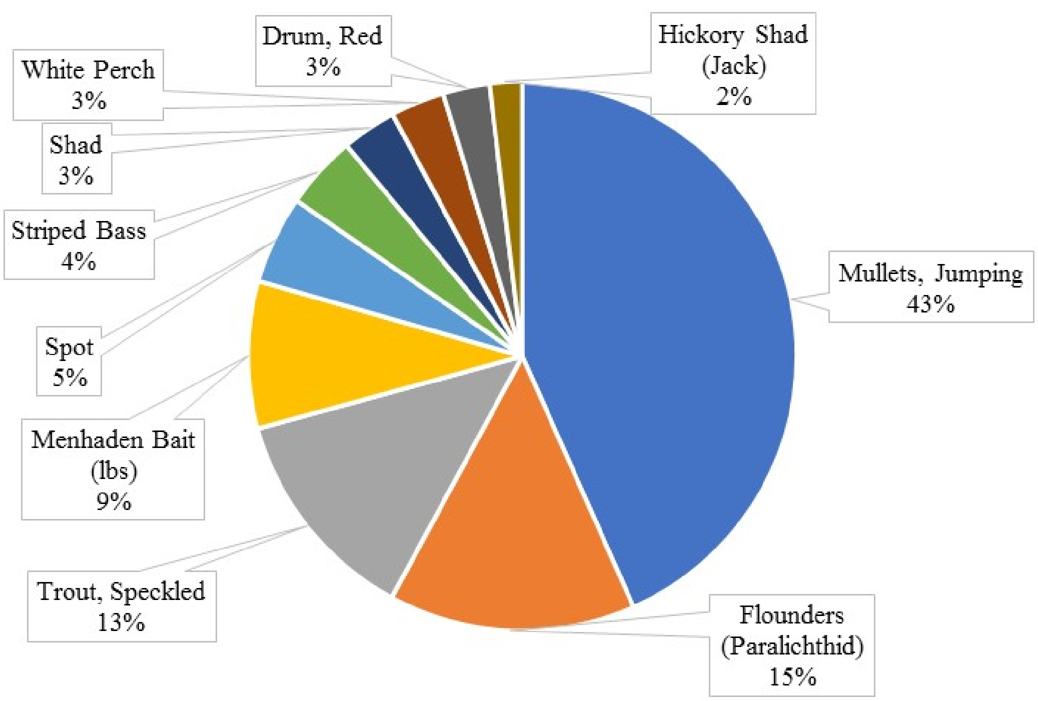


Figure 14. Top ten species harvested from all commercial gill-nets in the Tar-Pamlico and Neuse rivers, 2012–2017.

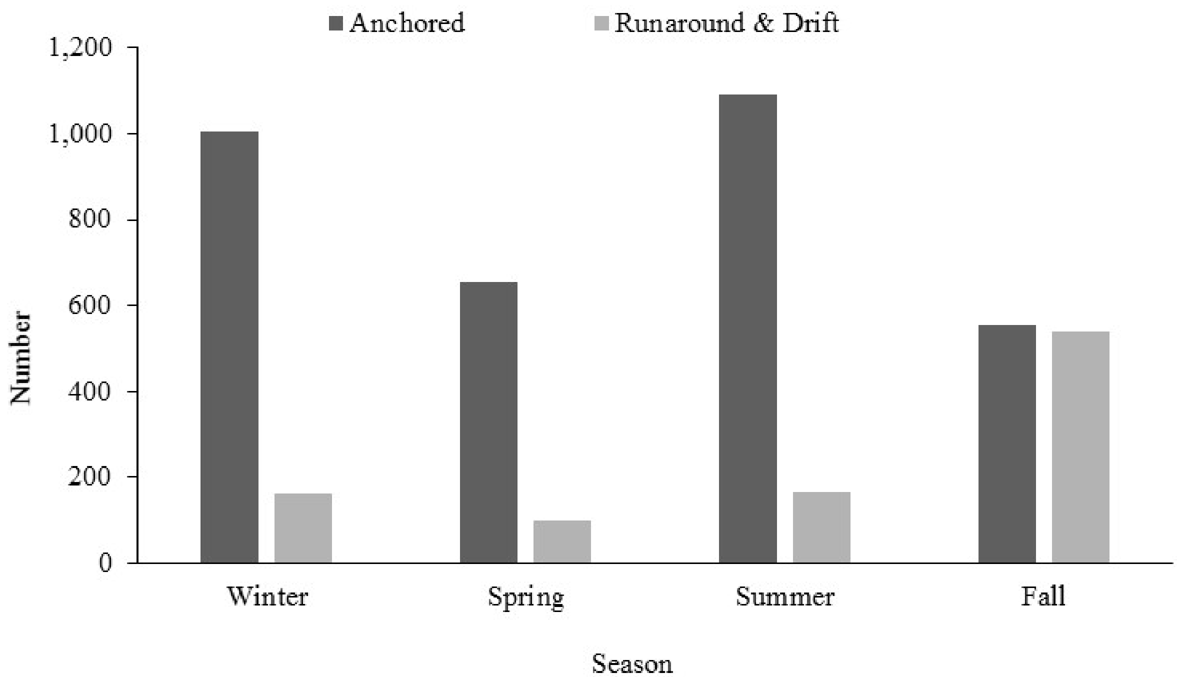


Figure 15. Average number of commercial gill-net trips per year by gill-net type in the Tar-Pamlico and Neuse and Bay rivers, 2012–2017.

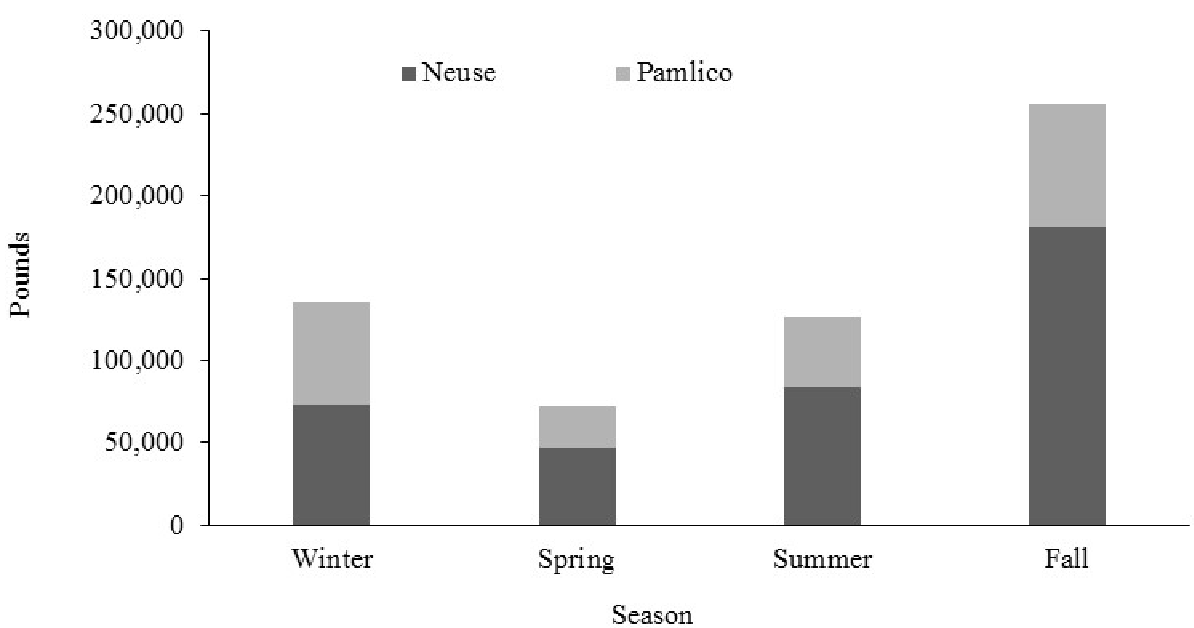


Figure 16. Average pounds of finfish harvested per year from commercial gill-nets in the Tar-Pamlico and Neuse and Bay rivers, 2012–2017.

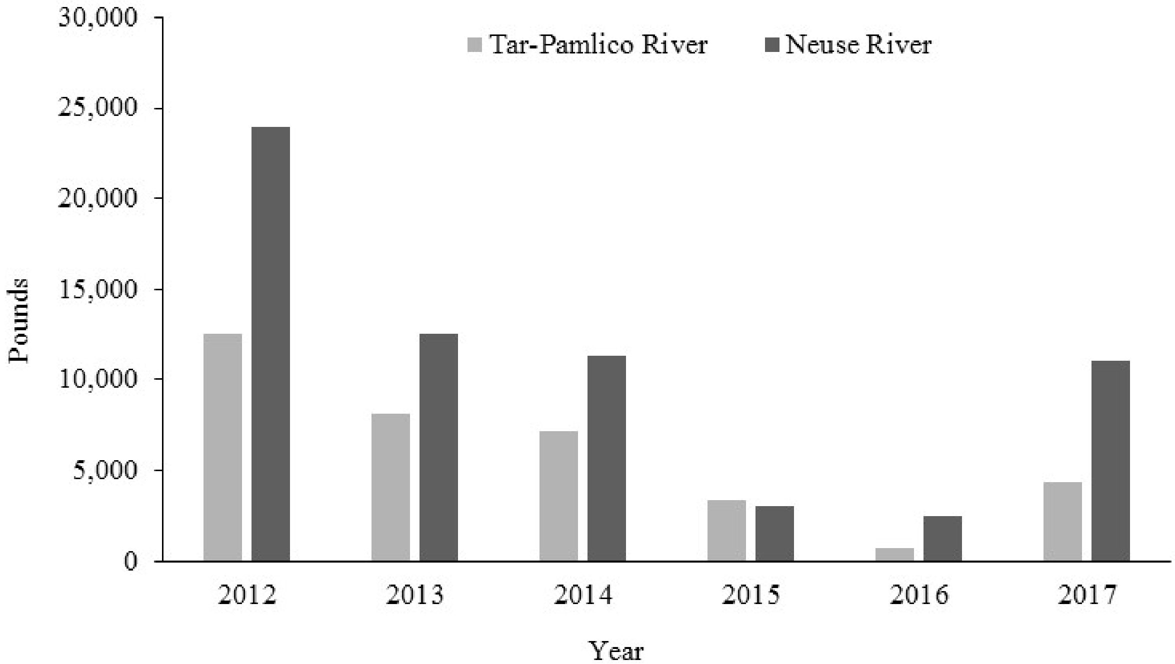


Figure 17. Total pounds of American Shad commercially harvested during the months of January–March in the Tar-Pamlico and Neuse and Bay rivers.

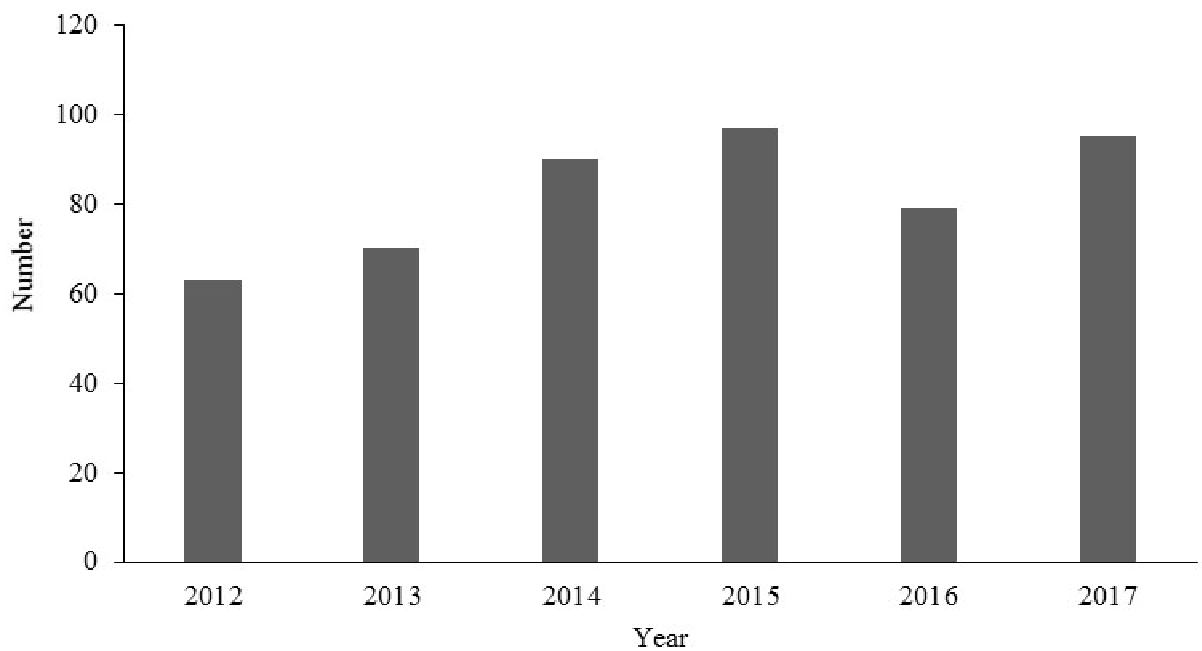


Figure 18. The number of participants that landed striped bass from the commercial gill-net fishery in the Tar-Pamlico and Neuse rivers.