

**FISHERY MANAGEMENT PLAN UPDATE
SHRIMP
AUGUST 2021**

STATUS OF THE FISHERY MANAGEMENT PLAN

Fishery Management Plan History

Original FMP Adoption:	April 2006
Amendments:	Amendment 1 – February 2015
Revisions:	May 2018 May 2021
Supplements:	None
Information Updates:	None
Schedule Changes:	Timeline moved forward one year to start Amendment 2 in 2019 for the comprehensive review
Comprehensive Review:	Five years after adoption of Amendment 2

The N.C. Shrimp Fishery Management Plan (FMP) was adopted in April 2006 by the N.C. Marine Fisheries Commission (NCMFC; NCDMF 2006). The plan included a 90-foot headrope limit in some internal waters and area closures to protect habitats and juvenile finfish. Shrimp management by size was also developed to optimize the use of the resource. Other strategies were also implemented to minimize waste through gear modifications, culling practices, and harvest restrictions. The plan also allowed the use of skimmer trawls as a Recreational Commercial Gear License (RCGL) gear as well as established a 48-quart (heads-on) recreational limit. A restriction on the use of shrimp trawls above the Highway 172 Bridge over New River took effect in 2010 and this area above the bridge is now limited to skimmer trawls only. This strategy was codified into rule through Amendment 1.

Amendment 1 was adopted in February 2015 and was limited in scope to bycatch issues in the commercial and recreational fisheries (NCDMF 2015). It recommended a wider range of certified bycatch reduction devices (BRD) to choose from, and the requirement of two BRDs in shrimp trawls and skimmer trawls beginning June 1, 2015 (Proclamation SH-2-2015). It increased the daily harvest limit for cast nets in closed areas. Amendment 1 also established a maximum combined headrope length of 220 feet in all internal coastal waters where there were no existing maximum combined headrope requirements, allowing for a phase-out period until January 1, 2017. Shrimp trawling was also prohibited, effective May 1, 2015, in the Intracoastal Waterway (IWW) channel from the Sunset Beach Bridge to the South Carolina line, including the Shallotte River, Eastern Channel, and lower Calabash River, to protect small shrimp.

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Amendment 1 also permitted a live bait shrimp fishery to allow live bait fishermen with a permit to fish until 12:00 p.m. (noon) on Saturdays; effective May 1, 2017.

An industry workgroup was formed to test gear modifications to reduce bycatch, to the extent practicable, with a 40% target reduction in the shrimp trawl fishery. In 2015, five experimental gear combinations were tested during the summer on large vessels in the Pamlico Sound. During the summer and fall of 2016, four additional gear combinations were tested on large vessels in the Pamlico Sound. In the final year of the study, 2017, three gear combinations were tested on both small and large vessels in the Atlantic Ocean and the Pamlico Sound. Gear combinations with larger tailbag mesh sizes (>1 ½-inches), reduced TED grid size (3-inch), and larger fisheyes were found to significantly reduce finfish bycatch. Four of the 12 gear combinations tested met or exceeded the 40% target reduction in finfish bycatch while also minimizing shrimp loss (Brown et al. 2017, 2018). Overall, finfish bycatch reductions ranged from 4.5% to 57.2%. Differences in shrimp catch between the control and experimental nets ranged from a 16.2% loss to a 9.9% gain.

Results from the industry workgroup testing as well as the workgroup recommendation were adopted as a revision to Amendment 1 by the NCMFC in May 2018 (NCDMF 2018). Under the May 2018 Revision to Amendment 1 fishermen are required to use one of four gear combinations tested by the workgroup that achieved at least 40% finfish bycatch. These gears were found to reduce finfish bycatch by 40.1% to 57.2%. The new gear configurations are required in all shrimp trawls, except skimmer trawls, used in inside waters where up to 220 feet of combined headrope is allowed (Pamlico Sound and portions of the Pamlico, Bay, and Neuse rivers) and became effective July 1, 2019 through proclamation SH-3-2019. The commission also recommended to continue the shrimp industry workgroup and explore funding options for more studies, to survey fishermen to determine what bycatch reduction devices the shrimp trawl industry currently uses, and to begin development of Amendment 2 to the Shrimp FMP.

The North Carolina Wildlife Federation submitted a petition for rulemaking on November 2, 2016 and a modification to the petition on January 12, 2017. The Petitioner put forth seven rules to designate nursery areas, restrict gear and seasonality in the shrimp trawl fishery to reduce bycatch of fish (including spot, Atlantic croaker, and weakfish), and establish an 8-inch minimum size limit for spot and a 10-inch minimum size limit for Atlantic croaker. In February 2017, the NCMFC approved the petitioned rules to begin the rulemaking process. Upon review by the Office of State Budget and Management it was determined that sufficient state funds were not available to implement the proposed rule changes without undue detriment to the agency's existing activities and the rules were never adopted.

With the adoption of Amendment 1, a management strategy was also included for the Habitat and Water Quality Advisory Committee (AC) to provide input on changing the designation of certain Special Secondary Nursery Areas (SSNAs) that have not been opened to trawling since 1991 to permanent Secondary Nursery Areas (SNAs). Due to overlapping issues associated with petitions for rulemaking related to nursery area designations and shrimp management the development of this management measure was delayed. At its February 2020 business meeting the NCMFC selected its preferred management option to change the designation of 10 SSNAs that had not been opened to trawling in many years to permanent SNAs. Under the May 2021

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Revision to Amendment 1 (NCDMF 2021a) the designation of SSNAs in Pungo, Scranton, Slade, South, Bond/Muddy, and Saucepan creeks as well as the Newport, Cape Fear and Lockwood Folly rivers were changed to permanent SNAs.

In August 2019, the FMP schedule was approved to move the timeline forward one year to start development of Amendment 2. The focus of the amendment is to further reduce bycatch of non-target species and minimize habitat impacts in the shrimp trawl fishery. In January 2020, a scoping period and three scoping meetings were held to receive input from the public on potential management strategies for Amendment 2. The Shrimp FMP AC was appointed in February 2021 and a series of AC workshops were held in March 2021. At its May 2021 business meeting, the NCMFC approved draft Amendment 2 to be sent out for public and NCMFC standing and regional AC review. In June 2021, the standing and regional ACs meet to develop recommendations for Amendment 2 to present to the commission at their August 2021 business meeting. Once the NCMFC has selected its preferred management options, the draft plan will be sent to NCDEQ Secretary and legislature for review prior to final adoption. Final adoption is tentatively scheduled for November 2021.

Management Unit

The management unit includes the three major species of shrimp: brown (*Farfantepenaeus aztecus*), pink (*F. duorarum*), and white (*Litopenaeus setiferus*) and its fisheries in all coastal fishing waters of North Carolina, which includes the Atlantic Ocean offshore to three miles.

Goal and Objectives

The goal and objectives of draft Amendment 2 (NCDMF 2021b) were approved by the NCMFC at its February 2020 business meeting. The goal of the Amendment 2 to N.C. Shrimp FMP is to manage the shrimp fishery to provide adequate resource protection, optimize long-term harvest, and minimize ecosystem impacts. The following objectives will be used to achieve this goal.

1. Reduce bycatch of non-target species of finfish and crustaceans, as well as protected, threatened, and endangered species.
2. Promote the restoration, enhancement, and protection of habitat and environmental quality in a manner consistent with the Coastal Habitat Protection Plan (CHPP).
3. Develop a strategy through the CHPP to review current nursery areas and to identify and evaluate potential areas suitable for designation.
4. Use biological, environmental, habitat, fishery, social, and economic data needed to effectively monitor and manage the shrimp fishery and its ecosystem impacts (i.e., bycatch, habitat degradation).
5. Promote implementation of research and education programs designed to improve stakeholder and the general public's understanding of shrimp trawl bycatch impacts on fish population dynamics.

DESCRIPTION OF THE STOCK

Biological Profile

There are three shrimp species that make up the shrimp fishery in North Carolina. They are the brown shrimp (*Farfantepenaeus aztecus*), pink shrimp (*F. duorarum*) and white shrimp (*Litopenaeus setiferus*). The lifecycles of these species are similar in that adults spawn offshore and eggs are hatched into free-swimming larvae. Larvae develop through several stages into post-larvae. Once post-larval shrimp enter estuaries, growth is rapid and is dependent on salinity and water temperature. As shrimp increase in size, they migrate from the upper reaches of small creeks to deeper saltier rivers and sounds. By late summer and fall, they return to the ocean to spawn. The maximum life span of shrimp can range from 16 to 24 months and may reach a size of 7 to 11 inches, depending on species (Eldred et al. 1961; Gunter 1961; McCoy 1968, 1972; McCoy and Brown 1967; Williams 1984).

Stock Status

Population size is controlled by environmental conditions, and while fishing reduces the population size over the season, fishing is not believed to impact year class strength unless the spawning stock has been reduced below a minimum threshold level by environmental conditions. Annual variations in catch are presumed to be due to a combination of environmental conditions, fishing effort, and the effects of changes in the economics of the fishery. Because of high fecundity and migratory behavior, the three species are capable of rebounding from very low population sizes in one year to large populations the next, provided environmental conditions are favorable (MacArthur and Wilson 1967; McCoy and Brown 1967; McCoy 1968, 1972; Perez-Farfante 1969; Purvis and McCoy 1972; Whitaker 1981, 1983).

Stock Assessment

Estimates of population size are not available but since the fishery is considered an annual crop and fished at near maximum levels, annual landings are probably a good indication of relative abundance. Annual variations in catch are presumed to be due to a combination of prevailing environmental conditions, fishing effort, and the effects of changes in the economics of the fishery.

DESCRIPTION OF THE FISHERY

Current Regulations

The NCMFC has established several rules that directly govern the harvest of shrimp and the use of trawls. Below are rules and excerpts from rules that directly affect the shrimp fishery. The rules below do not cover all gear, area, or other rules which may impact the shrimp fishery. As state and federal regulations may change, please contact the North Carolina Division of Marine Fisheries (NCDMF) for the most current regulations.

Shrimp cannot be taken by nets until the division Director opens the season by proclamation

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(NCMFC Rule 15A NCAC 03L .0101). The Director has the proclamation authority to specify hours of day or night or both and any other conditions appropriate to manage the fishery. Areas open to trawling are also considered open areas for shrimp harvest for all other gears including cast nets. Proclamations identifying areas open and closed to the harvest of shrimp can be found at: <https://deq.nc.gov/fisheries-management-proclamations#currentprocs>.

Area Restrictions

Shrimp and crab trawl nets cannot be used in any primary or permanent SNA; however, the NCDMF director can open SSNAs to trawling by proclamation from August 16 through May 14 (NCMFC Rule 15A NCAC 03N .0104 and .0105). In the Albemarle Sound and its tributaries, the use of shrimp trawls is prohibited (NCMFC Rule 15A NCAC 03J .0104). Additional trawl net prohibited areas are established in parts of Pamlico, Core, and Back sounds (NCMFC Rule 15A NCAC 03J .0104 and 03R .0106). Shrimp trawling is prohibited in military danger zone and restricted areas throughout all internal coastal waters (NCMFC Rule 15A NCAC 03R .0102).

Trawling is prohibited at all coastal inlets in crab spawning sanctuaries from March 1 through August 31 (NCMFC Rule 15A NCAC 03L .0205 and 03R .0110). In designated pot areas, the use of trawls is prohibited from June 1 to November 30 (NCMFC Rule 15A NCAC 03J .0104(b)(6), 03J .0301(a)(2), 03R .0107 and Proclamation SH-1-2020) and within the shoreline to the depth of six feet [NCMFC Rule 15A NCAC 03J .0104(6)]. Trawling is prohibited in oyster seed management areas (NCMFC Rule 15A NCAC 03K .0208 and 03R .0116) and oyster sanctuaries (NCMFC Rule 15A NCAC 03K .0209 and 15A NCAC 03R .0117). In the Pamlico, Pungo, and Neuse rivers as well as portions of New Hanover and Brunswick counties, shrimp trawl prohibited areas were implemented as part of the 2006 Shrimp FMP and Amendment 1 to protect habitat, reduce bycatch, reduce use conflict, and protect small shrimp (NCMFC Rule 15A NCAC 03L .0103(e) and 03R .0114).

In the Atlantic Ocean, the use of commercial gears is prohibited within 750 feet of licensed fishing piers [NCMFC Rule 15A NCAC 03J .0402(a)(1)(ii)]. Commercial fishing gears are also restricted within 750 feet from piers at specified times of the year in Onslow, Pender, New Hanover counties [NCMFC Rule 15A NCAC 03J .0402(a)(2)(A)(B)(i)(ii)(iii)]. Additional area restrictions have been implemented in the Southport Boat Harbor, Brunswick County and at the Progress Energy intake canal at the Brunswick County Nuclear Power Plant for public safety (NCMFC Rule 15A NCAC 03J .0206 and .0207).

Gear Restrictions

The use of otter trawls upstream of Highway 172 Bridge in the New River was prohibited as part of the 2006 Shrimp FMP, limiting trawling to skimmer trawls [NCMFC Rule 15A NCAC 03J .0208(a)(b)]. The 2006 FMP also established a maximum combined headrope limit of 90 feet in internal coastal waters of North Carolina, except in the Pamlico Sound and mouths of the Pamlico and Neuse rivers where up to 220 feet of combined headrope may be used [NCMFC Rule 15A NCAC 03L .0103(c)(d)]. The 220 feet maximum headrope limit was implemented in Pamlico Sound to cap fleet capacity as part of Amendment 1 [NCMFC Rule 15A NCAC 03L .0103(d)(1)(2)(3)]. Recreational fishermen possessing a Recreational Commercial Gear License (RCGL) are limited to one shrimp trawl with a maximum headrope length of 26 feet [NCMFC Rule 15A NCAC 03O .0302(2)].

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Minimum mesh size requirements for shrimp trawls (otter and skimmer) is one and one-half inches (NCMFC Rule 15A NCAC 03L .0103L). However, in the Pamlico Sound and portions the Pamlico and Neuse rivers where up to 220 feet of headrope is allowed the minimum tail bag mesh size is one and three-quarter inches (Proclamation SH-3-2019). Net material used as chafing gear must be four inches mesh length, except smaller mesh may be used along the bottom half of the tailbag (NCMFC Rule 15A NCAC 03L .0103). The minimum mesh size for channel nets, float nets, butterfly nets, and hand seines is one and one-quarter inches [NCMFC Rule 15A NCAC 03L .0103L(a)(2)]. The minimum mesh size for shrimp pots is one and one-fourth inches stretch or five-eighths inch bar [NCMFC Rule 15A NCAC 03J .0301(e)].

BRDs are required in all trawls used to harvest shrimp [NCMFC Rule 15A NCAC 03J .0104(d)]. Proclamation SH-3-2019 describes the BRD requirements for otter trawls in Pamlico Sound and the Pamlico, Bay, and Neuse rivers where up to 220 feet of combined headrope is allowed. Otter and skimmer trawls in all other waters statewide are required to have two BRDs installed on each net. Primary and secondary BRD requirements for the Croatan and Roanoke sounds, portions of the Pamlico, Bay, and Neuse rivers, and Core Sound to the SC-NC state line are listed in Proclamation SH-4-2019.

All shrimp trawls must conform with the federal requirements for Turtle Excluder Devices (TEDs) [NCMFC Rule 15A NCAC 03L .0103(h)]. All otter trawl nets are required to have a federally approved TED with bar spacing up to four inches if using mechanical retrieval methods. Federally approved TEDs are listed in United States Code of Federal Regulations Title 50, Section 223.207. Effective August 1, 2021, all skimmer trawls 40 feet and greater must have a federally approved TED installed with a bar spacing no greater than three inches in each net. Skimmer trawls less than 40 feet will not be required to use TEDs but must limit tow times to 55 minutes from April 1 through October 31, and 75 minutes from November 1 through March 31 [50 CFR 223.206(d)(2)(ii)(A)].

Channel nets or other fixed or stationary nets in the IWW are prohibited from blocking more than two-thirds of any natural or manmade waterway, in the middle third of any marked navigation channel [NCMFC Rule 15A NCAC 03J .0101(1)(2)(3)]. Channel nets cannot be set with any portion of the set within 50 feet of the center line of the IWW channel or in the middle third of any navigation channel marked by the Corps of Engineers or the Coast Guard. Channel nets must be always attended [NCMFC Rule 15A NCAC 03J .0106(a)(3)(4)(5)] and not exceed 40 yards in length. No channel net, net buoys or stakes can be left in coastal waters from December 1 through March 1. From March 2 through November 30, cables and any attached buoy must be connected with a non-metal line when not attached to the net; metallic floats or buoys to mark sets are prohibited [NCMFC Rule 15A NCAC 03J .0106(b)(c)(d)(e)].

The leads or any fixed or stationary net or device to direct shrimp into shrimp pots is prohibited [NCMFC Rule 15A NCAC 03J .0301(l)]. Recreational fishermen holding a RCGL may use up to five shrimp pots [NCMFC Rule 15A NCAC 03O .0302(a)(3)]. Recreational pots must be marked with a hot pink buoy and owner's identifying information [NCMFC Rule 15A NCAC 03J .0302(a)]. The use of more than one shrimp pot attached to the shore along privately owned land or to a privately owned pier is prohibited without possessing a valid RCGL [NCMFC Rule 15A NCAC 03J .0302(b)]. A pound net permit is required to deploy a shrimp pound and the set must

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be operational for a minimum of 30 consecutive days during the permit period [NCMFC Rule 15A NCAC 03J .0501(b)(1)(2)]. Shrimp pounds are defined as pound net set with all pounds (holding pen) constructed of stretch mesh equal to or greater than one and one-fourth inches and less than or equal to two inches [15A NCAC 03J .0501(6)]. RCGL holders may use one pound net with leads up to 10 feet in length with an enclosure up to 36 inches; attendance is required at all times and all gear must be removed from the water when not being fished [NCMFC Rule 15A NCAC 03O .0302(8)]. Shrimp pound sets must be properly marked with the permittee's identification and Pound Net Set Permit number, marked with a yellow light reflective tape or yellow light reflective devices on each pound, and have a marked navigational opening at least 25 feet wide at the end of every third pound [NCMFC Rule 15A NCAC 03J .0501(b)(c)]. Shrimp pound net sets must be set a minimum of 100 yards from a RCGL shrimp pound net set or 300 yards from an operational permitted shrimp pound net set [NCMFC Rule 15A NCAC 03J .0501(d)(2)].

Effort Restrictions

Shrimp trawling is prohibited in internal coastal waters from 9:00 p.m. on Friday through 5:00 p.m. on Sunday [NCMFC Rule 15A NCAC 03J .0104(b)(1)]. However, weekend shrimp trawling is allowed in Atlantic Ocean; with the use of fixed and channel nets, hand, seines, shrimp pots, and cast nets; or with for a holder of a Permit for Weekend Trawling for Live Shrimp [NCMFC Rule 15A NCAC 03L .0102, 03O .0503(1)(2)(3)]. In portions of the Pungo, Pamlico, Bay, Neuse, and New rivers the use of trawl nets is prohibited from one hour after sunset to one hour before sunrise prohibited from December 1 through February 28 [NCMFC Rule 15A NCAC 03J .0208]. Upstream of the Highway 172 Bridge in New River shrimp trawling (skimmer only) is prohibited from 9:00 p.m. through 5:00 a.m. when opened by proclamation from August 16 through November 30 (NCMFC Rule 15A NCAC 03J .0208).

Incidental Catch

The possession of more than 500 pounds of finfish from December 1 through February 28 and 1,000 pounds of finfish from March 1 through November 30 is prohibited while using a trawl in internal waters [NCMFC Rule 15A NCAC 03J .0104(a)]. Shrimp trawls cannot be used to take blue crabs in internal waters, except when the weight of the crabs does not exceed 50% of the total weight of the combined crab and shrimp catch or 300 pounds, whichever is greater [NCMFC Rule 15A NCAC 03J .0104(f)(2)]. From December 1 through March 31, it is unlawful to possess finfish caught incidental to shrimp and crab trawling in the Atlantic Ocean unless the weight of the combined catch of shrimp and crabs exceeds the weight of finfish; except that crab trawlers working south of Bogue Inlet may keep up to 300 pounds of kingfish, regardless of their shrimp or crab catch weight [NCMFC Rule 15A NCAC 03J .0202(5)]. Channel nets are prohibited from taking blue crabs in internal waters, except when the weight of the crabs does not exceed 50% of the total weight of crab and shrimp or 300 pounds, whichever is greater [NCMFC Rule 15A NCAC 03J .0106(h)(1)(A)(B)].

Recreational Creel Limits

In areas open to shrimp harvest (see current shrimp proclamations) recreational fishermen are limited to no more than 48 quarts (heads on) or 30 quarts (heads off) of shrimp per person per day or per vessel per day if a vessel is used [NCMFC Rule 15A NCAC 03L .0105(1)]. However, if more than one RCGL holder is aboard a vessel they are limited to no more than 96 quarts (heads on) or 60 quarts (heads off) of shrimp per vessel per day [NCMFC Rule 15A NCAC 03O

.0303(e)(f)]. In areas closed to the harvest of shrimp, no more than four quarts (heads on) or two and one-half quarts (heads off) of shrimp per person per day may be taken by cast net only [NCMFC Rule 15A NCAC 03L .0105(2)].

Commercial Fishery

Landings in the North Carolina shrimp fishery vary from year to year and are dependent primarily on environmental conditions. Environmental factors, especially severity of winter temperatures, and salinity can have a major influence on the yearly harvest. North Carolina's shrimp fishery is unusual in the southeast because all three species are taken here and most of the effort occurs in internal waters. While South Carolina, Georgia, and Florida allow limited inside waters shrimping, much of their fisheries are conducted in the Atlantic Ocean and white shrimp comprise most of their harvest (NCDMF 2015).

Commercial activity occurs in all waters. The shrimp fishery in the northern portion of the state is conducted in Pamlico, Croatan, and Roanoke sounds and Pamlico, Pungo, Bay, and Neuse rivers. The otter trawl is the predominant gear used in this portion of the state. The shrimp fishery in the central coastal area of the state occurs in Core and Bogue sounds, and the North, Newport, and White Oak rivers. A variety of methods are used to catch shrimp including otter trawls, skimmer trawls, channel nets, shrimp pounds, and cast nets. Otter trawls derived their name from the two trawl doors (otter doors/boards) that attach to the bridle that are hydro-dynamically designed to hold the wings of the net open. As the net is pulled along the bottom, the otter boards plane in opposite directions holding the net open. Otter trawls are used for all three species in both the estuary and the ocean. Two-seam trawls are used for brown and pink shrimp and four-seam and tongue trawls for white shrimp, which tend to swim higher in the water column and will jump to the surface when disturbed. Skimmer trawls consists of two rigid frames attached to each side of a vessel with nets attached along the two sides of the frame. Metal skids keep the frames off the bottom as the nets are pushed through the water column. Unlike otter trawls, the tailbags of skimmer trawls can be checked while fishing. Skimmer trawls are primarily used for white shrimp and are capable of fishing waters as shallow as two feet.

In the southern portion of the state, the fishery is characterized by a large number of small boats fishing internal waters (primarily the IWW, New and Cape Fear rivers) and larger vessels fishing the Atlantic Ocean primarily off New River, Carolina Beach, and Brunswick County. Many of the small boats are fished by individuals who shrimp part-time or for personal consumption. Use of gears other than trawls has increased primarily in the area from New River to Rich's Inlet. Channel nets are stationary nets that use tidal currents to fish the surface and middle depths of the water column. The mouth of the nets is held open by upright wooden shafts attached to a buoy and anchor on one side and a small vessel on the other. Float and butterfly nets also make use of tidal currents to push shrimp into the nets and offer the advantages of less fuel consumption and less bycatch than traditional shrimp trawls. To shrimp with a "float net", fishermen attach large floats to the doors and top lines of trawls to make the net fish up in the water column and are pulled slowly forward to harvest shrimp that are migrating to the inlets at night. Butterfly nets use this same harvest strategy but are attached to a metal frame and are held stationary in the water column to capture shrimp as the current carries them into the net. Trawls, cast nets, and seines are used to harvest live shrimp for the commercial bait fishery.

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Landings provided by the trip ticket program are combined for the three shrimp species (Figure 1). Total landings from 1994 to 2020 have averaged 7,514,936 pounds per year. In 2020, 9,709,761 pounds of shrimp were landed. Total landings increased 5% from 2019 to 2020. In 2020, 54% of the harvest occurred in estuarine waters, with the remainder occurring in the Atlantic Ocean (less than 3 miles from shore). Landings in the Atlantic Ocean (less than 3 miles from shore) decreased 27% in 2020 but were above the times series average (Figure 2). Annual shrimping effort (number of trips) has fluctuated with shrimp abundance, but it appears to have gradually declined since 1994 (NCDMF 2015). This may be due to a number of things including cheaper imported shrimp prices, increasing fuel prices, and fishermen retiring. Landings in 2005 were lowest on record, likely from several reasons; many large trawlers remained scalloping instead of shrimping because prices were high and the days at sea were extended (NCDMF 2015). Hurricanes Katrina (8/29/05) and Rita (9/4/05) hit the Gulf Coast, negatively affecting the fishing industry. Shrimp breeding operations in the Gulf shut down with only one operational in September and some North Carolina shrimpers could not sell their product (NCDMF 2015). Hurricane Florence (9/17/18) directly hit North Carolina, likely contributing to the decrease in landings in 2018. The number of trips increased nearly 2% from 2019 to 2020 (Figure 3).

Recreational Landings

Shrimp are harvested recreationally throughout the state by otter trawls, skimmer trawls, seines, cast nets, shrimp pots and shrimp pounds with specific gear limitations. The NC Coastal Angling Program uses multiple surveys to obtain recreational harvest and landings data; however, the recreational harvest of shrimp is limited to the Cast Net and Seine Mail Survey and the RCGL Survey.

Anyone wishing to harvest shrimp recreationally with commercial gear is required to purchase a Recreational Commercial Gear License (RCGL). The RCGL is an annual license that allows recreational fishermen to use limited amounts of commercial gear to harvest seafood for their personal consumption. Seafood harvested under this license cannot be sold. Fishermen using this license are held to recreational size and possession limits, gear marking and gear limit and configuration requirements. Many of the species taken by recreational users of commercial gear are included in fisheries management plans. Until 2002, the influence that RCGL holders may have on these species was unknown. Two surveys were used to collect information from RCGL holders; a socioeconomic survey, conducted in 2001, 2004, and 2007, and a catch and effort survey conducted monthly from 2002 through 2008. Both surveys were terminated in 2008 due to budget constraints. RCGL holders harvested an average of 52,352 pounds of shrimp a year from 2002 to 2008 (Table 1; NCDMF 2015). The highest landings occurred in 2002 (101,766 pounds), followed by 2008 (54,359 pounds) and 2003 (50,961 pounds). Recreational landings of shrimp from RCGL gears are currently unknown since this survey was discontinued in 2008.

In October of 2011, NCDMF began surveying Coastal Recreational Fishing License (CRFL) holders to determine if they used cast nets or seines. This mail survey was implemented to develop catch and effort estimates for recreational harvest with these specific gear types, including recreational shrimp harvest. Catch refers to the number of shrimp harvested by each angler and effort is the number of trips taken by the angler. This data is then extrapolated to

represent the population of CRFL holders and presented as catch and effort estimates. The estimated annual average number of shrimp caught (harvest and released) using a cast net and/or seine was 197,164 shrimp from 2012 to 2020 (Figure 4). In 2020, 262,304 shrimp were caught. The total number of shrimp harvested increased 85% and the number released increased 64% from 2019 to 2020; however, the number of trips only increased 5%.

MONITORING PROGRAM DATA

Fishery-Dependent Monitoring

Currently, the only data available for the stock in all areas are the commercial landings and associated effort from the N.C. Trip Ticket Program. No fishery dependent monitoring program exists for shrimp.

Fishery-Independent Monitoring

The Estuarine Trawl Survey (Program 120) is a fishery-independent multispecies monitoring program that has been ongoing since 1971 in the months of May and June. One of the key objectives of this program is to provide a long-term data base of annual juvenile recruitment for economically important species. This survey samples fixed stations, a set of 104 core stations with additional stations as needed. The core stations are sampled from western Albemarle Sound south through the South Carolina border each year without deviation two times in the months of May and June. This survey targets juvenile finfish, blue crabs, and penaeid shrimp. A two-seam 10.5 foot headrope trawl with a 1/4-inch mesh in the body and 1/8-inch mesh in the tailbag is used. A one-minute tow is conducted covering a distance of 75 yds. All species taken are sorted, identified, and a total number is recorded for each species. For target species, a subset of at least 30 to 60 individuals is measured. Environmental data are collected, including salinity, dissolved oxygen, temperature, wind speed, and direction. During 2020, sampling was impacted due to the COVID pandemic. Executive Order (EO) 116, issued on March 10, 2020, declared North Carolina under a State of Emergency and was soon followed by EO 120 which implemented a statewide Stay at Home Order for all non-essential State employees. During this time, sampling did not occur in May, but did occur in early and late-June.

Annual trends in brown shrimp relative abundance, measured as the number of brown shrimp per station in Program 120 sampling, shows fluctuations from year to year (Figure 5). The annual brown shrimp index of relative abundance decreased 23% from 2019 to 2020; however, this decrease may be attributed to sampling only occurring in June in 2020 due to the COVID restrictions (Table 2; Figure 5). The proportional standard error was below 20 in all but four years from 1988 to 2020 (Table 2). As indicated in the stock status section, annual landings are a good indication of relative abundance of shrimp in the coastal fishing waters of North Carolina. Estimates of recruitment calculated from the annual brown shrimp index of relative abundance can also be used to determine year class strength. Trends in overall shrimp landings from June and July, months that brown shrimp make up most of the harvest, show similar trends as the Program 120 data (Figure 6). Currently, there are no juvenile indices of abundance for white and pink shrimp in North Carolina.

RESEARCH NEEDS

Research needs from draft Amendment 2 to the N.C. Shrimp FMP (NCDMF 2021b) include (status provided in parenthesis):

- Create a long-term shrimp trawl observer program to characterize bycatch across all strata (for example: dominant species, protected species, season, areas, gear type, vessel type, number of nets/rigs, headrope length, TED position, etc.). HIGH (needed)
- Improve accuracy of self-reported license gear survey data or investigate other means of accurately obtaining shrimp fleet characteristics. HIGH (needed)
- Collect improved effort data (e.g., headrope length, number of nets, tow time, number of tows) to provide bycatch estimates based on actual time fished (or number of tows), rather than number of trips. HIGH (needed)
- Determine the cumulative impacts of shrimp trawl bycatch on individual species population dynamics and the ecosystem. HIGH (needed)
- Create and validate juvenile abundance indices for white and pink shrimp.
- Determine the spatial, temporal, and biological characteristics of submerged aquatic vegetation that maximize their ecological value to shrimp for restoration and conservation purposes. HIGH (needed)
- Determine how the resuspension of sediment, siltation, and non-point source pollution from adjacent land use practices impacts trends in shrimp abundance and habitat degradation.
- Develop alternative non-bottom disturbing gears to efficiently catch shrimp. HIGH (needed)
- Determine the influence of current bottom disturbing gears patterns (location, frequency, etc.) on sub-tidal shell, and SAV in Pamlico Sound. MEDIUM (needed)
- Continue to locate, map, and quantify the bottom habitat structure, bathymetry, and sediment types in North Carolina estuaries. MEDIUM (ongoing)
- Measure the effects of trawling on sediment size distribution and organic carbon content.
- Establish continuous water quality monitoring in the Pamlico system to evaluate water quality effects on shrimp and the fish habitats they rely. MEDIUM (needed)
- Initiate research to determine the impacts of endocrine disrupting chemicals (EDCs) on the various life stages of shrimp. LOW (needed)
- Develop research methods to understand costs and benefits of maintaining shrimp habitat and water quality to inform decision-making on shrimp management. MEDIUM (needed)
- Expand current social and economic surveys to specifically collect information on shrimp fishermen. LOW (needed)

MANAGEMENT STRATEGY

There are no management triggers or methods to track stock abundance, fishing mortality, or recruitment between benchmark reviews from the current FMP. Landings and effort have decreased over time (NCDMF 2015). There are no data to track the recreational fishery.

Until Amendment 2 is approved for management, shrimp are managed under Amendment 1 and the May 2018 and 2021 revisions to Amendment 1 of the Shrimp FMP (Table 3; NCDMF 2018, 2021a).

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The management strategies under Amendment 1 for the shrimp fisheries in North Carolina is to continue to: 1) optimize resource use over the long-term, and 2) minimize waste. The first strategy is accomplished by protection of critical habitats, and gear and area restrictions to protect the stock. Minimization of waste is accomplished by gear modifications, bycatch reduction devices, area closures, and harvest restrictions.

More specifically the management strategies for Amendment 1 included a wider range of certified BRDs to choose from, the requirement of two BRDs in shrimp trawls and skimmer trawls, and increased the daily harvest limit for cast nets in closed areas. It also established a maximum combined headrope length of 220 feet in all internal coastal waters where there was no existing maximum combined headrope requirements, allowing for a phase-out period until January 1, 2017. Shrimp trawling was also prohibited in the IWW channel from the Sunset Beach Bridge to the South Carolina line, including the Shallotte River, Eastern Channel and lower Calabash River, to protect small shrimp beginning May 1, 2015. A live bait permit was also developed under this amendment to allow permitted fishermen to fish until 12:00 p.m. (noon) on Saturdays. The Habitat and Water Quality AC was also tasked to provide input on changing the designation of certain SSNAs not opened to trawling since 1991 to permanent SNAs. An industry workgroup was formed also through Amendment 1, to test gear modifications to reduce bycatch, to the extent practicable, with a 40% target reduction in the shrimp trawl fishery.

Following the completion of the industry workgroup gear testing, several management strategies were adopted under the May 2018 Revision to Amendment 1 (NCDMF 2018). Shrimp trawls (except skimmer trawls) were required by July 1, 2019 to install one of four approved gear combinations in inside waters where up to 220 feet of combined headrope is allowed (Pamlico Sound and portions of the Pamlico, Bay and Neuse rivers). The shrimp industry workgroup will continue and explore funding options for this work. It was also recommended to survey fishermen to characterize gear configurations used in the shrimp trawl fishery and to begin development of Amendment 2 to the Shrimp FMP. In June 2019, a phone survey was funded through the North Carolina Commercial Fishing Resource Fund to characterize BRDs and TEDs used in the commercial shrimp fishery. Results from the survey were used in the development of Amendment 2. Following the development of an issue paper and input from the Habitat and Water Quality AC, the NCMFC changed designation of 10 SSNAs to permanent SNAs under the May 2021 Revision to Amendment 1 (NCDMF 2021a).

FISHERY MANAGEMENT PLAN RECOMMENDATION

Draft Amendment 2 the Shrimp FMP is currently under development. Once the NCMFC has selected its preferred management options, the draft plan will be sent to NCDEQ Secretary and legislature for review prior to final adoption. Final adoption is tentatively scheduled for November 2021.

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TABLES

Table 1. Harvest (lbs) and pounds per trip of shrimp (three species combined) by RCGL gear from 2002 through 2008 (NCDMF 2015).

Year	Pounds	Pounds/trip
2002	101,766	19.1
2003	50,961	18.5
2004	43,698	9.3
2005	32,542	13.4
2006	49,362	20.3
2007	33,778	15.2
2008	54,359	22.3
Mean	52,352	16.8

STATE-MANAGED SPECIES – SHRIMP

Table 2. Program 120 annual sampling for brown shrimp from core stations in May and June combined. Number of samples (stations), brown shrimp index of relative abundance (number per station), standard error, standard deviation, coefficient of variation (CV), minimum number caught at a station, maximum number caught at a station, total number caught, and proportional standard error (PSE), 1988-2020.

Year	Number of stations	Relative abundance (No. per station)	Standard error	Standard deviation	CV	Minimum number per station	Maximum number per station	Total number of shrimp	PSE
1988	209	21.2	3.2	46.3	218.0	0	348	4,440	15
1989	207	29.2	5.4	77.7	265.8	0	775	6,050	18
1990	206	44.2	6.8	98.0	222.0	0	1,094	9,098	15
1991	207	48.6	5.4	77.2	158.9	0	520	10,055	11
1992	210	25.8	5.0	72.9	282.2	0	664	5,428	19
1993	205	23.8	4.4	62.3	262.0	0	348	4,876	18
1994	205	29.9	4.3	61.4	205.2	0	459	6,134	14
1995	208	38.6	5.7	82.5	213.7	0	615	8,032	15
1996	207	34.8	6.4	91.9	264.2	0	696	7,199	18
1997	207	25.6	6.2	89.8	350.5	0	856	5,304	24
1998	208	13.0	2.8	40.0	306.7	0	369	2,712	21
1999	206	49.7	7.5	108.3	218.1	0	675	10,233	15
2000	209	56.8	7.1	102.1	179.8	0	759	11,865	12
2001	209	42.8	6.3	91.0	212.6	0	717	8,947	15
2002	208	59.7	6.9	99.4	166.5	0	793	12,414	12
2003	208	31.2	4.3	62.3	199.9	0	563	6,484	14
2004	208	24.9	4.0	57.6	231.1	0	334	5,185	16
2005	208	23.2	4.4	62.8	270.8	0	551	4,820	19
2006	208	25.9	3.4	49.7	191.9	0	308	5,383	13
2007	208	18.5	1.9	27.2	147.2	0	170	3,845	10
2008	208	95.7	13.4	193.9	202.6	0	1,718	19,908	14
2009	208	60.3	8.2	117.7	195.3	0	1,001	12,540	14
2010	208	75.2	13.2	190.0	252.5	0	1,622	15,651	18
2011	208	52.2	7.4	106.8	204.7	0	930	10,852	14
2012	208	40.1	4.3	61.5	153.2	0	343	8,347	11
2013	208	27.5	4.4	63.3	229.8	0	459	5,726	16
2014	208	35.0	4.5	64.5	184.3	0	409	7,276	13
2015	208	103.8	25.9	373.2	359.6	0	5,053	21,587	25
2016	208	19.9	3.2	46.8	235.0	0	319	4,146	16
2017	208	18.9	3.6	52.0	274.5	0	467	3,940	19
2018	208	33.6	5.5	79.0	235.2	0	714	6,985	16
2019	208	31.6	11.7	168.4	532.4	0	2,237	6,580	37
2020	208	24.5	18.9	30.1	168.5	0	284	5,088	12

STATE-MANAGED SPECIES – SHRIMP

Table 3. The N.C. Marine Fisheries Commission selected management strategies, and implementation status to reduce bycatch as mandated by Amendment 1 as well as the May 2018 and 2021 revisions to Amendment 1.

Management Strategy	Implementation Status
Status quo (continue to prohibit otter trawls in the New River special secondary nursery area above the Highway 172 Bridge).	Rule change implemented May 1, 2015; 15A NCAC 03J .0208
Allow hand cast netting of shrimp in all closed areas and increase the limit to four quarts, with heads on per person.	Rule change implemented May 1, 2015; 15A NCAC 03L .0105
Status quo on a license requirement to fish a cast net for shrimp.	No action required
Upon federal adoption of TEDs in skimmer trawls, the division will support the federal requirement.	No action required
Establish a permitted live shrimp bait fishery and for NCDMF to craft the guidelines and permit fees after reviewing permitted operations in other states, and to allow live bait fishermen with a permit to fish until 12 p.m. (noon) on Saturday.	Rule change implemented May 1, 2017; 15A NCAC 03J .0104, 03L .0102, 03O .0105, 03O .0503
Allow any federally certified BRD in all internal and offshore waters of NC.	Existing proclamation authority; Proclamation issued with complete list of BRDs, SH-2-2015
Update the scientific testing protocol for the state’s BRD certification program.	Plans to update the testing protocols to use the federal standards.
<p>Convene a stakeholder group to initiate industry testing of minimum tail bag mesh size, T-90 panels, skylight panels, and reduced bar spacing in TEDs to reduce bycatch to the extent practicable with a 40% target reduction.</p> <ul style="list-style-type: none"> • Upon securing funding, testing in the ocean and internal waters will consist of three years of data using test nets compared to a control net with a Florida fish eye, a federally approved TED and a 1.5-inch mesh tail bag. • Results should minimize shrimp loss and maximize reduction of bycatch of finfish. Promising configurations will be brought back to the commission for consideration for mandatory use. • The stakeholder group may be partnered with the division and Sea Grant. • Members should consist of fishermen, net/gear manufacturers and scientific/gear specialists. 	<p>Stakeholder group convened in 2015 and industry testing completed in 2017. Results presented to NCMFC in May 2018. Proclamation issued for Pamlico Sound and portions of the Pamlico, Bay, and Neuse rivers (where up to 220 feet of combined headrope is allowed) requiring the use of gear combinations tested by the workgroup that achieve at least 40% finfish bycatch, effective July 1, 2019, SH-3-2019, http://portal.ncdenr.org/web/mf/proclamation-sh-03-2019</p> <p>Plans to continue shrimp industry workgroup and explore funding options for more studies.</p>

STATE-MANAGED SPECIES – SHRIMP

Table 3. Continued

Management Strategy	Implementation Status
Require either a T-90/square mesh tailbag or other applications of square mesh panels (e.g., skylight panel), reduced bar spacing in a TED, or another federal or state certified BRD in addition to existing TED and BRD requirements in all skimmer and otter trawls.	Existing proclamation authority Rule change required in 15A NCAC 03I .0101 to modify definition of mesh length; Rule change implemented May 1, 2015. Proclamation issued for second BRD requirement to begin on June 1, 2015, SH-2-2015, http://portal.ncdenr.org/web/mf/proclamation-sh-02-2015
Status quo on effort management (no change in season, weekend, or nighttime fishing).	No action required
In order to put a cap on fleet capacity as a management tool, establish a maximum combined headrope length of 220 feet in all internal coastal waters where there is no existing maximum combined headrope requirements with a two-year phase out period.	Rule change implemented May 1, 2015; 15A NCAC 03L .0103
Prohibit shrimp trawling in the IWW channel from Sunset Beach to the SC state line, including Eastern Channel, lower Calabash River and Shallotte River.	Rule change implemented May 1, 2015; 15A NCAC 03R .0114
Establish a permitted live bait shrimp fishery and allow live bait fishermen with a permit to fish until 12 p.m. (noon) on Saturday	Rule change implemented May 1, 2017; 15A NCAC 03O .0503
Recommend the NCMFC Habitat and Water Quality Advisory Committee to consider changing designation of special secondary nursery areas that have not been opened to trawling since 1991 to permanent secondary nursery areas.	Rule changes required and scheduled to be effective May 1, 2021; 15A NCAC 03R .0104, 03R .0105

STATE-MANAGED SPECIES – SHRIMP

FIGURES

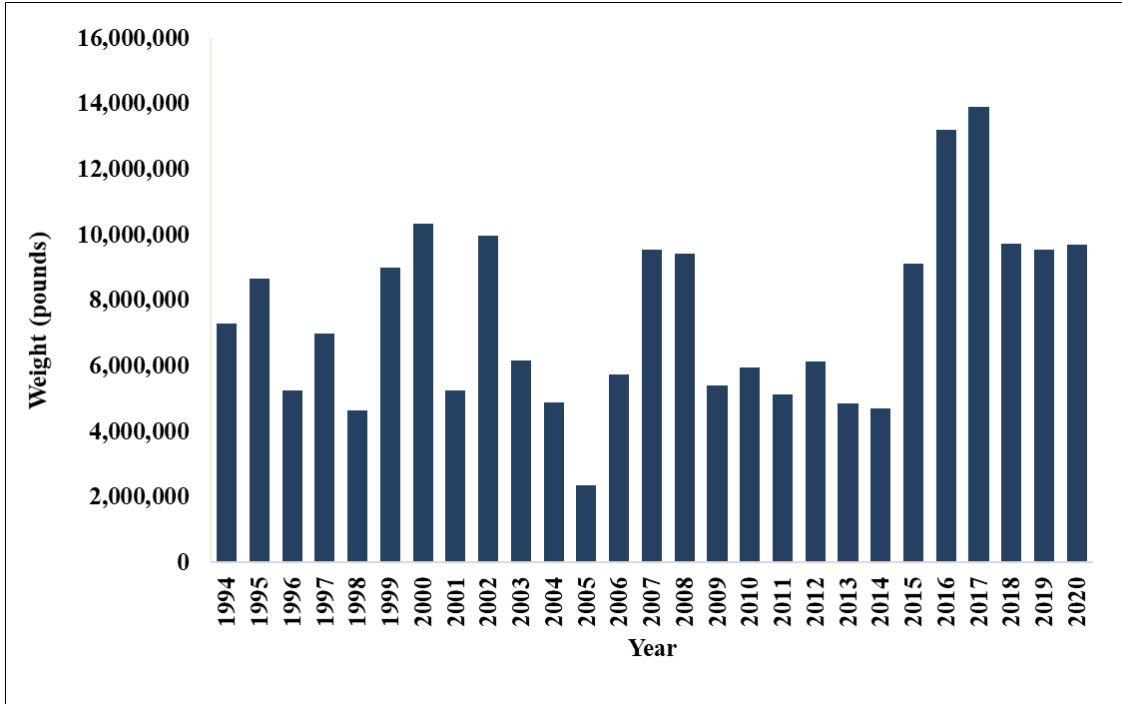


Figure 1. Annual commercial shrimp landings (lbs) from all three shrimp species combined in North Carolina, 1994-2020. Data from the NCDMF Trip Ticket Program.

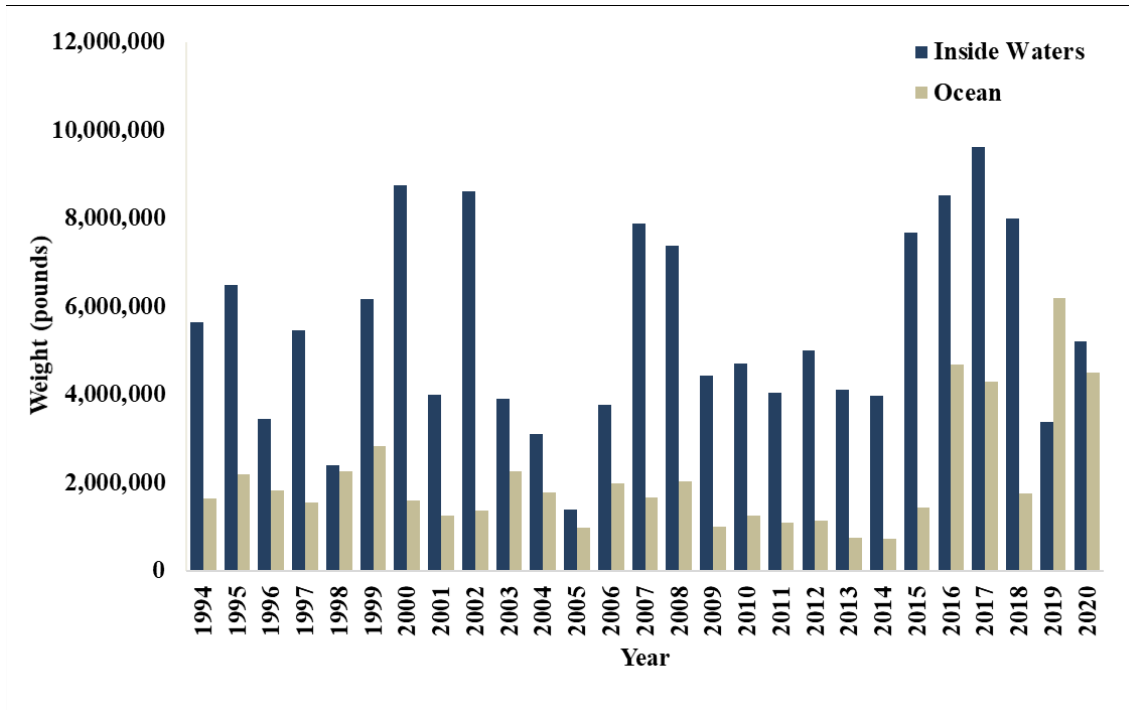


Figure 2. Annual commercial shrimp landings (lbs) by area from all three shrimp species combined in North Carolina, 1994-2020. Data from the NCDMF Trip Ticket Program.

STATE-MANAGED SPECIES – SHRIMP

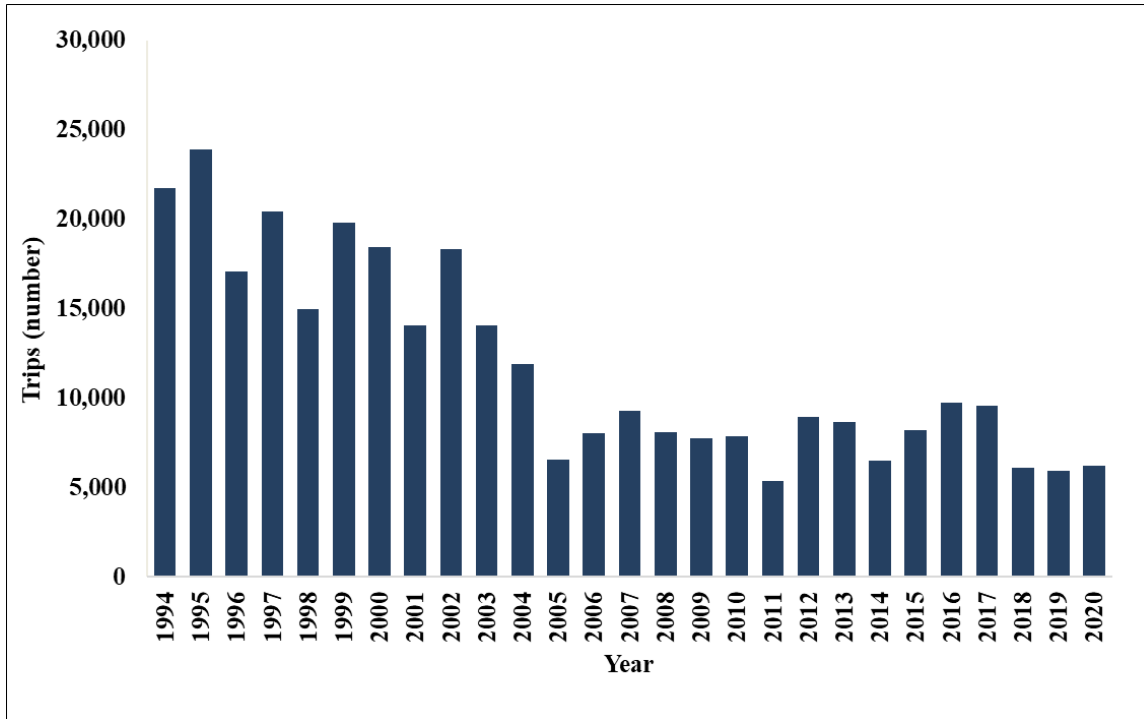


Figure 3. Annual number of commercial trips reported for all three species combined in inside and ocean waters, 1994-2020. Data from the NCDMF Trip Ticket Program.

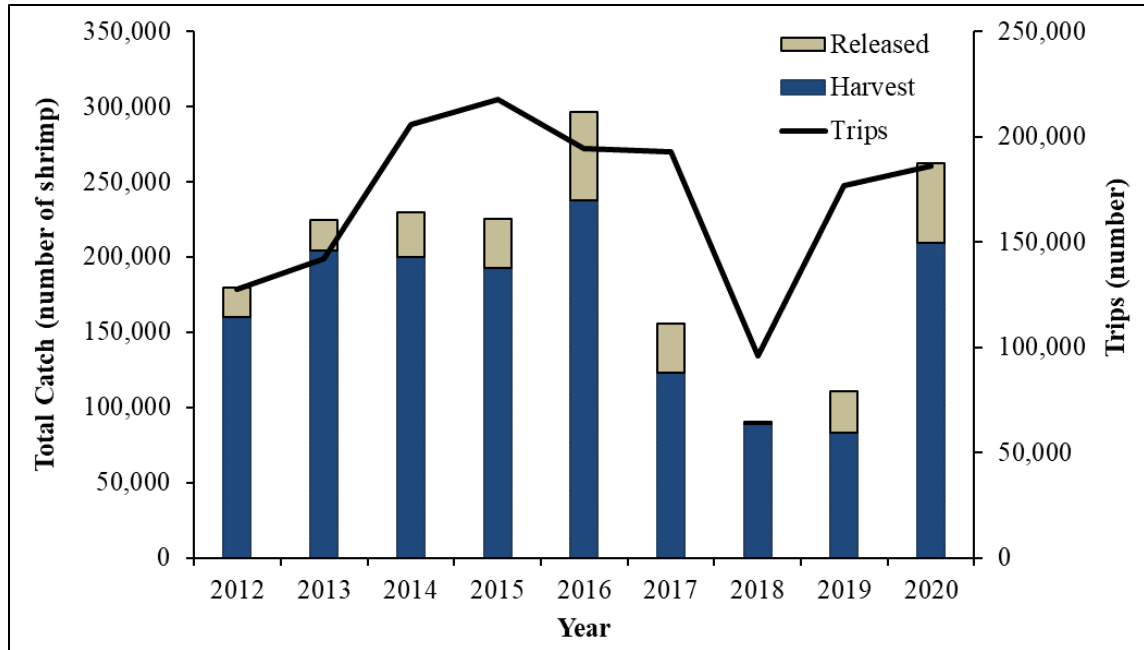


Figure 4. Annual number of shrimp harvested and trips taken from cast nets and seines for recreational purposes, 2012-2020.

STATE-MANAGED SPECIES – SHRIMP

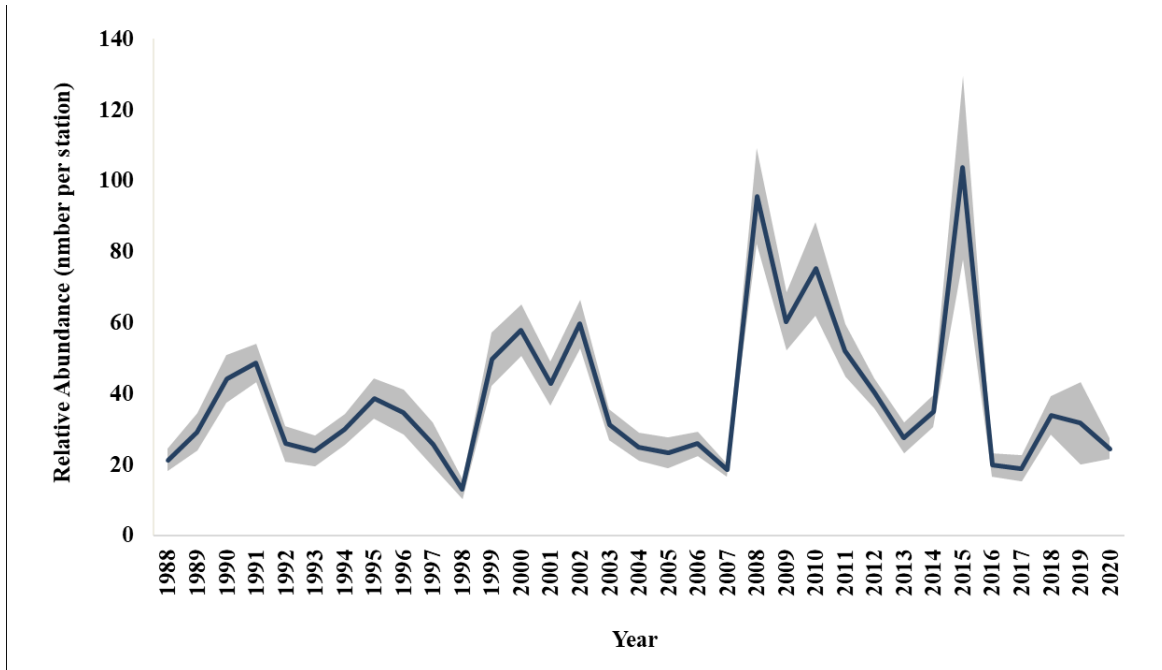


Figure 5. Annual index of relative abundance (number per station) of brown shrimp from Program 120 estuarine trawl survey, 1988-2020. Shaded area represents standard error.

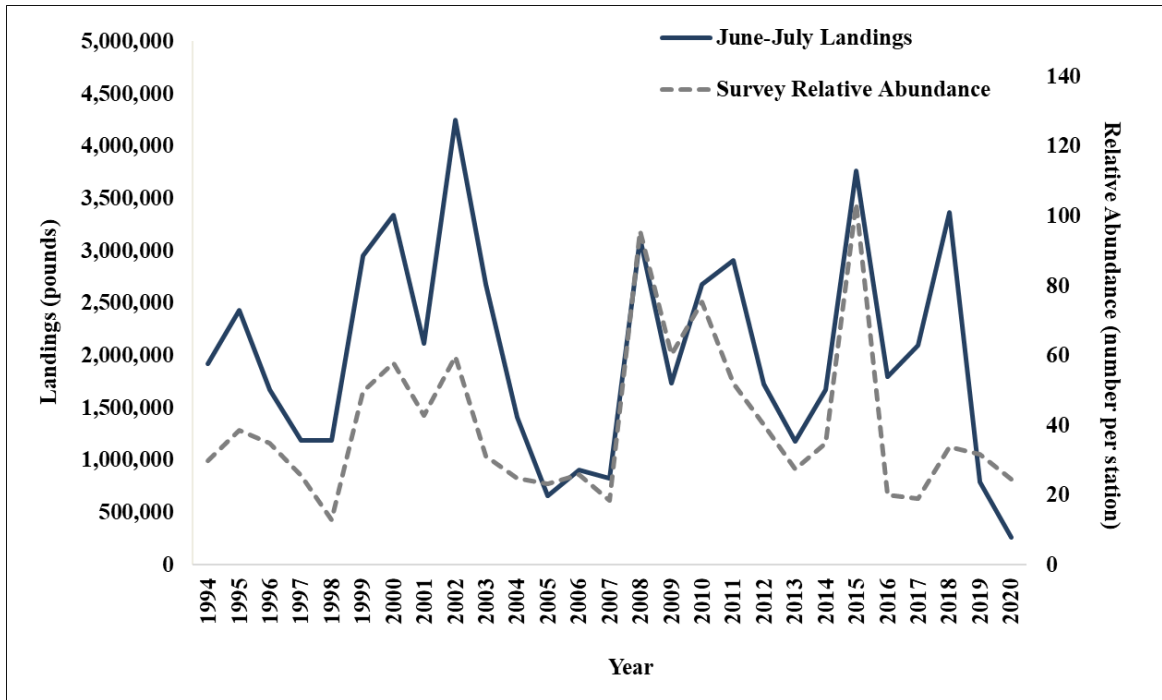


Figure 6. Comparison of shrimp commercial shrimp landings in the months of June and July to the brown shrimp Program 120 index of relative abundance (number per station), 1994-2020. Commercial landings include unclassified shrimp 1994-1999 and brown shrimp 2000-2020.