FISHERY MANAGEMENT PLAN UPDATE
SHRIMP
AUGUST 2019

STATUS OF THE FISHERY MANAGEMENT PLAN

Fishery Management Plan History

Original FMP Adoption:	April 2006
Amendments:	Amendment 1 – February 2015
Revisions:	Revision 1 to Amendment 1 – May 2018
Supplements:	None
Information Updates:	None
Recommended Schedule Change:	None
Next MFC Scheduled Review:	July 2019

The N.C. Shrimp Fishery Management Plan (FMP) was approved 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, allowed skimmer trawls as a Recreational Commercial Gear License (RCGL) gear and made recommendations on the minimum shrimp size at which some water bodies open to trawling. The plan also closed some areas in the state to protect habitats and juvenile finfish and 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 (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 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. 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 (>one and one half-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 presented to the NCMFC at its May 2018 business meeting. At this meeting the commission voted to require fishermen 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 will be 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); effective July 1, 2019. The commission also voted 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 Fishery Management Plan.

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 eight-inch minimum size limit for spot and a 10-inch minimum size limit for Atlantic croaker. At its February 2017 business meeting, the North Carolina Marine Fisheries Commission passed a motion to approve 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 are not available to implement the proposed rule changes without undue detriment to the agency's existing activities and the rules were never adopted.

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 of the N.C. Shrimp Fishery Management Plan is to utilize a management strategy that provides adequate resource protection, optimizes the long-term commercial harvest, maximizes social and economic value, provides sufficient opportunity for recreational shrimpers, and

considers the needs of all user groups. To achieve this goal, it is recommended that the following objectives be met:

1. Minimize waste and enhance economic value of the shrimp resource by promoting more effective harvesting practices.
2. Minimize harvest of non-target species of finfish and crustaceans and protected, threatened, and endangered species.
3. Promote the protection, restoration, and enhancement of habitats and environmental quality necessary for enhancing the shrimp resource.
4. Maintain a clear distinction between conservation goals and allocation issues.
5. Reduce conflicts among and within user groups, including non-shrimping user groups and activities.
6. Encourage research and education to improve the understanding and management of the shrimp resource.

STATUS OF THE STOCK

Life History

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 lifecycle of these three species are similar in that the adults spawn offshore and eggs are hatched into free-swimming larvae. These larvae develop through several stages into post-larvae. Once post-larval shrimp enter the estuaries, growth is rapid and is dependent on salinity and temperature. As the 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.

Stock Status

Population size is regulated by environmental conditions, and while fishing reduces the population size over the season, fishing is not believed to have any impact on subsequent year class strength unless the spawning stock has been reduced below a minimum threshold level by environmental conditions. Because of high fecundity and migratory behavior, the three species are all capable of rebounding from a very low population size in one year to a large population size in the next, provided environmental conditions are favorable.

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.

STATUS OF THE FISHERY

Current Regulations

General Rules

- Channel net is defined as a net used to take shrimp which is anchored or attached to the bottom at both ends or with one end anchored or attached to the bottom and the other end attached to a boat [15A NCAC 03I .0101(3)(b)].
- Headrope is defined as a support structure for the mesh or webbing of a trawl that is nearest to the water surface when in use [15A NCAC 03I .0101(3)(i)].
- Nursery areas are defined as areas in which for reasons such as food, cover, bottom type, salinity, temperature and other factors, young finfish and crustaceans spend the major portion of their initial growing season [15A NCAC 03I .0101(4)(f)].
- Military danger zones and restricted areas are designated in 15A NCAC 03R .0102 and are enforced by the appropriate federal agency [15A NCAC 03I .0110(a)].
- Maps or charts showing the boundaries of areas identified by rule or in proclamations are available for inspection [15A NCAC 03I .0121(a)].
- The NCDMF shall mark boundaries with signs insofar as may be practical. No removal or relocation of signs shall have the effect of changing the classification or affect the applicability of any rule pertaining to that body of water [15A NCAC 03I .0121(b)].

Rules Specific to Commercial Nets, Pots, Dredges, and Other Fishing Devices

- It is unlawful to use or set a fixed or stationary net in the Intracoastal Waterway where it may be a hazard to navigation, block more than two-thirds of any natural or manmade waterway, in the middle third of any marked navigation channel [15A NCAC 03J .0101(1), (2), and (3)].
- It is unlawful to possess aboard a vessel while using a trawl in internal waters more than 500 pounds of finfish from December 1 through February 28 and 1,000 pounds of finfish from March 1 through November 30 [15A NCAC 03J .0104(a)].
- It is unlawful to use trawls nets in internal coastal waters from 9:00 p.m. on Friday through 5:00 p.m. on Sunday, except for the areas described in the next bullet [15A NCAC 03J .0104(b)(1)].
- It is unlawful to use trawl nets from December 1 through February 28 from one hour after sunset to one hour before sunrise in portions of the Pungo, Pamlico, Bay, Neuse, and New rivers [15A NCAC 03J .0104(b)(5)(A), (B), (C), (D), and (E)].
- It is unlawful to use trawl nets in Albemarle Sound and its tributaries [15A NCAC 03J .0104(b)(3)].
- The Director may by proclamation, require bycatch reduction devices or codend modifications in trawl nets to reduce the catch of finfish that do not meet size limits or are unmarketable as individual foodfish by reason of size [15A NCAC 03J .0104(d)].
- It is unlawful to use trawl nets in designated pot areas opened to the use of pots by 15A NCAC 03J .0301(a)(2) within an area bound by the shoreline to the depth of six feet [15A NCAC 03J .0104(b)(6)].
- It is unlawful to use shrimp trawls for the taking of blue crabs in internal waters, except that it shall be permissible to take or possess blue crabs incidental to commercial shrimp trawling provided that the weight of the crabs shall not exceed 50% of the total weight of

the combined crab and shrimp catch; or 300 pounds, whichever is greater [15A NCAC 03J .0104(f)(2)].

- It is unlawful to use shrimp trawls for recreational purposes unless the trawl is marked with a pink buoy on the tailbag [15A NCAC 03J .0104(e)].
- The Fisheries Director may, by proclamation, close any area to trawling for specific time periods in order to secure compliance with this rule [15A NCAC 03J .0104(g)].
- It is unlawful to use a channel net until the Director specifies by proclamation when and where channel nets and other fixed nets for shrimping can be used [15A NCAC 03J .0106(a)(1)].
- It is unlawful to set a channel net without yellow light reflective tape on the staffs, stakes and buoys [15A NCAC 03J .0106(a)(2)].
- Channel nets cannot be set with any portion of the set within 50 feet of the center line of the Intracoastal Waterway (ICW) channel or in the middle third of any navigation channel marked by the Corps of Engineers or the Coast Guard. Fishermen must attend channel nets by being no more than 50 yards from the set at all times [15A NCAC 03J .0106(a)(3), (4), and (5)].
- The maximum corkline length of a channel net that can be used or possessed is 40 yards. 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 together with non-metal line when not attached to the net. Metallic floats or buoys to mark sets are unlawful [15A NCAC 03J .0106(b), (c), (d), and (e)].
- Channel nets must be properly marked with yellow light reflective tape and the owner's identification on each buoy. Identification includes one of the following: owner's N.C. motorboat registration number or the U.S. vessel documentation number or owner's last name and initials. Channel nets, anchor lines or buoys are not to be used in any way that constitutes a hazard to navigation [15A NCAC 03J .0106(f) and (g)].
- It is unlawful to use channel nets to take blue crabs in internal waters, except that it shall be permissible to take or possess blue crabs incidental to channel net operations provided that the weight of the crabs does not exceed 50% of the total weight of crab and shrimp or 300 pounds, whichever is greater [15A NCAC 03J .0106(h)(1)(A) and (B)].
- The Director may, by proclamation, close any area to channel net use for specific time periods in order to secure compliance with the above bullet [15A NCAC 03J .0106(h)(2)].
- It is unlawful to use nets from June 15 through August 15 in the waters of Masonboro Inlet or in the ocean within 300 yards of the beach between Masonboro Inlet and a line running 138° through the water tank on the northern end of Wrightsville Beach, a distance parallel with the beach of 4,400 yards. It is unlawful to use trawls within one-half mile of the beach between the Virginia line and Oregon Inlet [15A NCAC 03J. 0202(1) and (2)].
- It is unlawful to use a trawl with a mesh length less than four inches in the body and three inches in the extension and on and three-fourths inches in the cod end or tail bag from the west side of Beaufort Inlet Channel to the shore off Salter Path within a half mile of shore [15A NCAC 03J .0202(3)].
- 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 [15A NCAC 03J .0202(5)].

- It is unlawful to use shrimp trawls in all waters west of a line beginning at the southeastern tip of Baldhead Island at a point 33^0 50.4833'N – 77^0 57.4667 W; running southerly in the Atlantic Ocean to a point 33^0 46.2667'N – 77^0 56.4000 W from 9:00 p.m. through 5:00 a.m. [15A NCAC 03J .0202(8)].
- It is unlawful to use trawl nets upstream of the Highway 172 Bridge in New River from 9:00 p.m. through 5:00 a.m. when opened by proclamation from August 15 through November 30 (15A NCAC 03J .0208).
- It is unlawful to use any commercial fishing gear in the Southport Boat Harbor, Brunswick County and to use any commercial fishing gear in the Progress Energy Intake Canal between the fish diversion screen and the Brunswick nuclear power plant (15A NCAC 03J .0206 and .0207).
- It is unlawful to use shrimp pots with mesh lengths smaller than one and one-fourth inches stretch or five-eighths inch bar [15A NCAC 03J .0301(e)].
- It is unlawful to use pots with leads or leaders to take shrimp. Leads are defined as any fixed or stationary net or device used to direct fish into any gear [15A NCAC 03J .0301(l)].
- In Dare County, commercial fishing gear may not be used within 750 feet of licensed fishing piers when opened to the public. Commercial fishing gear may not be used in the Atlantic Ocean off of portions of Onslow, Pender, and New Hanover counties during specified time frames [15A NCAC 03J .0402(a)(1)(A)(ii), (a)(2)(A), (a)(2)(B)(i) and (ii), (a)(3)(A), (a)(3)(B)(i) and (iii), (a)(4)].
- Shrimp pound net set is defined as a pound net set 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(a)(6)].
- A permit is required to deploy a pound net set and must be operational for a minimum of 30 consecutive days during the permit period. Each pound required the permittee's identification on a sign attached to a stake at the permitted ends of each set at all times. They must have 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 and marked with yellow light reflective tape or yellow light reflective devices [15A NCAC 03J .0501(b) and (c)].
- It is unlawful to use a RCGL shrimp pound net unless it is marked by attaching to the offshore lead, one hot pink floating buoy. The owner shall be identified on the buoy by engraving the gear owner's current boat registration number or the owners U.S. vessel documentation name. Each shrimp pound must be set a minimum of 100 yards from a RCGL pound net set or 300 yards from an operational permitted shrimp pound net set [15A NCAC 03J .0501(d)(1) and (2)].
- It is unlawful within 30 days of abandonment of a permitted pound net set to fail to remove all stakes and associated gear from coastal fishing waters [15A NCAC 03J .0501(g)].
- Pound net permit applications, renewals and transfers are to comply with the permitting procedures and requirements for obtaining all NCDMF-issued permits. Application process, criteria for the granting of the permit, operational requirements and other elements of the shrimp pound net set permits are found in 15A NCAC 03J .0502, .0503, .0504, and .0505.

<u>Rules Specific to Shrimp</u>

- It is unlawful to take shrimp with nets until the Director opens the season in various waters by proclamation (15A NCAC 03L .0101).

Proclamations may specify any hours of day or night or both and any other conditions appropriate to manage the fishery. Some areas never open to shrimping, some areas are open year round, and some areas open and close throughout the year dependent upon shrimp movement and their size. Open areas to trawling are considered the shrimp open areas for all other gears including cast nets. All proclamations beginning with SH identify the open and closed areas and are found here throughout the year: http://portal.ncdenr.org/web/mf/proclamations-current.

- It is unlawful to take shrimp by any method from 9:00 p.m. on Friday through 5:00 p.m. on Sunday except in the Atlantic Ocean or with the use of fixed and channel nets, hand seines, shrimp pots and cast nets [15A NCAC 03L .0102].
- It is unlawful to take shrimp with mesh lengths less than one and one-half inches in trawls, one and one-fourth inches in fixed nets, channel nets, float nets, butterfly nets and hand seines [15A NCAC 03L .0103(a)(1) and (2)].
- It is unlawful to take shrimp with a net constructed in a manner as to contain an inner our outer liner of any mesh size. Net material used as chafing gear shall be no less than four inches mesh length [15A NCAC 03L .0103(b)].
- It is unlawful to take shrimp with trawls which have a combined headrope of greater than 90 feet in internal coastal waters except in Pamlico Sound, Pamlico River downstream of Pamlico Point/ Willow Point and Neuse River downstream of Winthrop Point/Windmill Point [15A NCAC 03L .0103(c)(1), (2), and (3)].
- It is unlawful to use a shrimp trawl in the Pungo River, upstream of Wades Point/Abel Bay, Pamlico River upstream of the entrance to Goose Creek/Wades Point and Neuse River upstream of Cherry Point/Wilkerson Point 15A [NCAC 03L .0103(d)].
- It is unlawful to possess more than 48 quarts, heads-on or 30 quarts heads-off of shrimp per person per day or per vessel per day for recreational purposes [15A NCAC 03L .0105(1)].
- It is unlawful to take or possess shrimp taken from any area closed to the taking of shrimp except for two quarts per person per day may be taken with a cast net in a closed area [15A NCAC 03L .0105(2)].
- It is unlawful to use trawls in the crab spawning sanctuaries from March 1 through August 31 [15A NCAC 03L .0205(a)].
- It is unlawful to use a trawl net in any primary or permanent secondary nursery area [15A NCAC 03N .0104, and .0105(a)].
- Special secondary nursery areas may be opened to shrimp and crab trawling from August 16 through May 14 [15A NCAC 03N .0105(b)].
  Special secondary nursery areas open by proclamation and vary in their open time periods within the August 16 through May 14 window. They are opened once the finfish amount has declined to reduce bycatch.

<u>Recreational Licenses and Limits</u>

- RCGL gear includes one shrimp trawl with a headrope not exceeding 26 feet in length per vessel, five shrimp pots, skimmer trawls, not exceeding 26 feet in total combined width and one shrimp pound net with each lead 10 feet or less in length and with a minimum lead net mesh of 1 ½ inches and enclosures constructed of net mesh of 1 ¼ inches or greater and with all dimensions being 36 inches or less. Attendance is required at all times for shrimp pounds [15A NCAC 03O .0302(a)(2), (3), (7), and (8)].
- It is unlawful for a RCGL holder to use pots, including shrimp pots unless each pot is

marked by attaching one hot pink floating buoy; the buoy should be engraved with the gear owners boat registration number or U.S. vessel documentation name [15A NCAC 03J .0302(a)(1) and (2)].

- It is unlawful to possess more than 48 quarts, heads-on, or 30 quarts, heads-off, of shrimp per person per day or per vessel per day [15A NCAC 03L .0105].
- It is unlawful to possess more than 48 quarts, heads-on, or 30 quarts, heads-off, of shrimp when only one person aboard a vessel possesses a valid RCGL and recreational commercial fishing equipment [15A NCAC 03O .0303(e)].
- It is unlawful to possess more than 96 quarts, heads on or 60 quarts, heads-off, of shrimp if more than one person aboard a vessel possesses a valid RCGL and recreational commercial fishing equipment [15A NCAC 03O .0303(f)].

Turtle Excluder Device Requirements

- It is unlawful to use a shrimp trawl that does not conform with the federal requirements for Turtle Excluder Devices (TEDs) [15A NCAC 03L .0103(g)].
- It is unlawful to trawl for shrimp in the Atlantic Ocean without TEDs within one nautical mile of shore from Browns Inlet to Rich's Inlet without a valid permit to waive the requirement to use TEDs in the Atlantic Ocean when allowed by proclamation from April 1 through November 30. It is unlawful to tow more than 55 minutes from April 1 through October 31 and 75 minutes from November 1 through November 30. It is unlawful to not fully empty the contents of each net after each tow. It is unlawful to refuse to take observers. It is unlawful to fail to report any sea turtle captured [15A NCAC 03O .0503(d)(1), (2), (3), (4), and (5)].

Federal Regulations

- 33 CFR 334.410 through 334.450
  These rules designate prohibited and restricted military areas, including locations within North Carolina coastal fishing waters, and specify activities allowed in these areas.
- 50 CFR 223.206 - Exceptions to prohibitions relating to sea turtles.
  The incidental taking of sea turtles in the shrimp trawl fishery is exempted from section 9 of the Endangered Species Act if conservation regulations are followed and include the installation of National Oceanic and Atmospheric Administration (NOAA) Fisheries approved TEDs and alternative tow times for skimmer trawls, pusher-head trawls and butterfly trawls.
- 50 CFR 223.207 – Approved TEDs
  This lists NOAA Fisheries approved TEDs such as the single-grid hard TEDs, hooped hard TEDs, special hard TEDs and soft TEDs, along with materials and gear specifications. Testing protocols for TEDs are also included in this rule.
- 50 CFR 229.7 – Monitoring of incidental mortalities
  This requires that fishermen who participate in a Category I or II fishery are required to accommodate an observer onboard your vessel(s) up on request
- 50 CFR 622, Appendix D – Approved Bycatch Reduction Devices (BRDs)
  This lists NOAA Fisheries approved BRDs and provides technical specifications for the construction and subsequent legal enforcement of these BRDs.

<u>Rules implemented in Amendment 1 to the N.C. Shrimp Fishery Management Plan on May 1, 2015</u>

- Modify the definition of mesh length to apply to diamond-mesh and square-mesh nets in support of a management strategy to require an additional bycatch reduction device in skimmer and otter trawls, which can include a square-mesh T-90 panel [15A NCAC 03I .0101(3)(n)].
- Codify an existing management strategy prohibiting the use of trawl nets, except skimmer trawls, upstream of the N.C. 172 Bridge over the New River in Onslow County to continue reducing bycatch [15A NCAC 03J .0208(a) and (b)].
- Clarify the Division of Marine Fisheries Director's proclamation authority for shrimp harvest restrictions [15A NCAC 03J .0104(g)].
- Establish a maximum combined headrope length of 220 feet in all internal coastal waters where there is no existing maximum combined headrope requirements, allowing for a phase-out period until Jan. 1, 2017 [15A NCAC 03L .0103(d)(1), (2), and (3)].
- Allow cast-netting of shrimp in all areas otherwise closed to shrimping and increasing the harvest limit in these areas to four quarts, heads-on, or 2 ½ quarts, heads-off [15A NCAC 03L .0105(2)].
- Prohibit shrimp trawling in the Intracoastal Waterway 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 [15A NCAC 03R .0114(4), (5), (6), and (7)].
- Establish a Permit for Weekend Trawling for Live Shrimp to allow live bait fishermen with a permit to fish until 12:00 p.m. (noon) on Saturdays [15A NCAC 03J .0104(b)(1)(B), 03L .0102(1), (2), and (3), and 03O .0503(k)(1), (2), and (3)].

Commercial Landings

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 Sound, North River, Newport River, Bogue Sound, and White Oak River. A variety of methods are used to catch shrimp including trawls, skimmer trawls, channel nets, shrimp pounds, and cast nets. Trawls are used on all three species in both the estuary and the ocean with two-seam trawls 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. Most trawling in the central portion of the state is conducted at night. Channel nets are popular around Harkers Island in the Straits and North River while skimmer trawling is very popular in Newport River and New River.

In the southern portion of the state, the fishery is characterized by a large number of small boats fishing internal waters (primarily the Intracoastal Waterway, 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, float, and butterfly nets 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. Channel nets are fished extensively in the areas around New River and Topsail inlets. 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. Skimmer trawls have become more popular around New River and Topsail Sound. These alternative gears are employed very little in areas south of Rich's Inlet, however tidal conditions seem favorable for their use. Cast nets and seines are also used to harvest shrimp to provide live shrimp for the commercial bait fishery.

Landings provided by the trip ticket program are combined for the three shrimp species (Figure 1). Total landings from 1994 to 2018 have averaged 7,345,451 pounds per year. In 2018, 9,729,526 pounds of shrimp were landed. Total landings decreased 30% from 2017 to 2018; likely a result of Hurricane Florence (9/17/18). In 2018, the majority (82%) of the harvest occurred in estuarine waters, with the remainder occurring in the Atlantic Ocean (less than 3 miles from shore). Landings in the ocean decreased 59% in 2018 and were below the times series average (Figure 3). Annual shrimping effort (number of trips) has fluctuated with shrimp abundance, but it appears to have gradually declined since 1994 (NCDMF 2015). This is due to a number of things including cheaper imported shrimp prices, increasing fuel prices, and fishermen retiring out of the industry. 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 breading operations in the Gulf shut down with only one operational in September and some North Carolina shrimpers could not sell their product (NCDMF 2015). The number of trips has increased slightly since 2014; however, decreased 2% from 2017 to 2018 (Figure 2).

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. Since July 1, 1999, 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 (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 are currently unknown since this survey was discontinued in 2008.

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 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 one fourth-inch mesh in the body and one eighth-inch mesh in the tailbag is used. A one-minute tow is conducted covering a distance of 75 yards. 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.

Trends in the annual brown shrimp catch per unit effort (CPUE) measured as the number of brown shrimp per station in Program 120 sampling shows fluctuations from year to year (Figure 4). The annual brown shrimp CPUE increased 77% from 2017 to 2018 (Table 2; Figure 4). The proportional standard error was below 20 in all but three years from 1988 to 2018 (Table 2). A PSE of "20" and less was established by the Atlantic Coast Cooperative Statistics Program (ACCSP) as a standard when considering the precision of a given metric. The margin of error for the annual brown shrimp CPUE is low, therefore providing greater confidence in the samples as an expression to the population (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 CPUE can also be used to determine year class strength. Trends in overall shrimp landings from June and July, months were brown shrimp predominately make up the harvest, show similar trends as the Program 120 data (Figure 5). Currently, there are no juvenile indices for white and pink shrimp in North Carolina.

MANAGEMENT STRATEGY

The management strategy 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.

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.

Amendment 1 was adopted in February 2015 and was limited in scope to bycatch issues in the commercial and recreational fisheries. The management strategy for this amendment recommended a wider range of certified bycatch reduction devices to choose from, the requirement of two bycatch reduction devices in shrimp trawls and skimmer trawls (beginning June 1, 2015), and 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 is 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 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. With the adoption of the Amendment 1, the Marine Fisheries Commission further directed the division to develop a live bait permit to allow permitted fishermen to fish until 12:00 p.m. (noon) on Saturdays.

An industry workgroup was formed as a management strategy through Amendment 1, to test gear modifications to reduce bycatch, to the extent practicable, with a 40% target reduction in the shrimp trawl fishery. At its May 2018 business meeting, the Marine Fisheries Commission voted to require fishermen to use one of four gear combinations tested by the workgroup that achieved at least 40% finfish bycatch. The new gear configurations will be 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); effective July 1, 2019. The commission also voted 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 Fishery Management Plan. The information paper titled "Shrimp Fishery Management Plan (FMP) Amendment 1: Consideration of Gear Modifications to Reduce Bycatch in the North Carolina Shrimp Trawl Fishery" serves as a Revision to Amendment 1 to the North Carolina Shrimp Fishery Management Plan to document the management strategy changes and rationale. All other management strategies contained in Amendment 1 will remain in place until another Revision, Supplement, or Amendment to the N.C. Shrimp Fishery Management Plan occurs.
See Table 3 for the specific management strategies implemented as part of Amendment 1.

RESEARCH NEEDS

The N.C. Marine Fisheries Commission selected research strategies and implementation status are provided in Table 3. Proposed research needs and status of need is provided in parenthesis from Amendment 1 include:

- Continue to conduct bycatch characterization work across all strata (for example: dominant species, season, areas, vessel type, number of nets/rigs, headrope length) - HIGH (ongoing through NCDMF)
- Initiate/increase state monitoring and reporting on the extent of unutilized bycatch and fishing mortality on fish less than age-1 in the shrimp trawl fishery - HIGH (needed)
- Continue to develop and test methods to reduce bycatch in the commercial and recreational shrimp trawl fisheries - HIGH (ongoing in commercial shrimp trawl fishery through NCDMF and the industry workgroup)
- Obtain mortality (immediate and post-harvest) estimates of culled (active and passive) bycatch from gears used in the recreational and commercial shrimp fisheries - HIGH (needed)
- Continue to develop standard protocol for bycatch estimations - HIGH (ongoing at NCDMF with collaborative efforts with other agencies and researchers)
- Continue to define and quantify the intensity, duration and spatial scale of trawling effort in N.C. estuaries - HIGH (ongoing through NCDMF)
- Determine species interactions and predator/prey relationships for prominent shrimp trawl bycatch - 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 - HIGH (needed)
- Determine the spatial and biological characteristics of submerged aquatic vegetation that maximize their ecological value to shrimp for restoration and conservation purposes - HIGH (ongoing through the Coastal Habitat Protection Plan)
- Effort data needs to be collected to provide estimates based on actual time fished (or number of tows), rather than number of trips - HIGH (needed)
- Improve accuracy of self-reported license gear survey data, or investigate other means of accurately obtaining shrimp fleet characteristic - HIGH (needed)
- Examine how sedimentation, hydrologic alterations, and environmental conditions affect the abundance of brown shrimp (Farfantepenaeus aztecus) in southeastern North Carolina - HIGH (needed)
- Conduct research to quantify the number of protected species interactions with the shrimp fishery - MEDIUM (ongoing through NCDMF)
- Continue to develop and test methods to reduce interactions with protected species in the commercial and recreational shrimp trawl fisheries – MEDIUM (ongoing work being conducted by NOAA)
- Initiate sampling to investigate if additional areas currently open to shrimping need changes to their habitat designations - MEDIUM (needed)
- Evaluate the effectiveness and efficiency of the current sampling protocol used to manage shrimp - MEDIUM (needed)

- Continue to map and quantify the habitat structure and sediment types in North Carolina estuaries - MEDIUM (ongoing through NCDMF)
- Continue to measure the effects of trawling on sediment size distribution and organic carbon content – MEDIUM (needed)
- Expand current social and economic surveys to specifically collect information on shrimp fishermen - MEDIUM (needed)
- Continue to determine the extent of recreational shrimp harvest that is occurring. This group primarily use cast nets to take shrimp either for bait or personal consumption - MEDIUM (needed)
- Continue to support research to determine the status of protected species along the N.C. coast to better anticipate and prevent interactions (for example: migration patterns and habitat utilization) - LOW (ongoing support continued to provide information as interactions with protected species occurs)
- Continue to investigate the impact of tiger shrimp in North Carolina. waters - LOW (research conducted through NOAA)
- Initiate research to determine the impacts of endocrine disrupting chemicals (EDCs) on the various life stages of shrimp - LOW (needed)

FISHERY MANAGEMENT PLAN SCHEDULE RECOMMENDATION

Recommend maintaining the current timing of the next MFC scheduled review. Amendment 1 of the N.C. Shrimp FMP was adopted in February 2015 with rule changes in effect May 1, 2015 and May 1, 2017.

LITERATURE CITED

Brown, K.B., B. Price, L. Lee, S. Baker, and S. Mirabilio. 2017. An evaluation of bycatch reduction technologies in the North Carolina shrimp trawl fishery. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, NC. 40 pp.

Brown, K.B., B. Price, L. Lee, S. Baker, and S. Mirabilio. 2018. Technical solutions to reduce bycatch in the North Carolina Shrimp Trawl Industry. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, NC. 50 pp.

NCDMF (North Carolina Division of Marine Fisheries). 2006. North Carolina Shrimp Fishery Management Plan. North Carolina department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 384 pp.

NCDMF (North Carolina Division of Marine Fisheries). 2015. North Carolina Shrimp Fishery Management Plan. Amendment 1. North Carolina department of Environment and Natural Resources. North Carolina Division of Marine Fisheries. Morehead City, NC. 519 pp.

TABLES

Table 1. Harvest (pounds) 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

Table 2. Program 120 annual sampling for brown shrimp from core stations in May and June combined. Number of samples (stations), brown shrimp arithmetic catch per unit effort (CPUE) as the number of shrimp 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), 1988-2018.

Year	Number of stations	CPUE (No. shrimp/tow)	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

Table 3. The N.C. Marine Fisheries Commission selected management strategies, and implementation status to reduce bycatch as mandated by 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 DMF 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.
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. • 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.	Stakeholder group convened in 2015 and industry testing completed in 2017. Results presented to MFC 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 Plans to continue shrimp industry workgroup and explore funding options for more studies.
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,

Management Strategy	Implementation Status
	http://portal.ncdenr.org/web/mf/proclamation-sh-02-2015
Status quo on effort management (no change in season, weekend, or night time 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

FIGURES

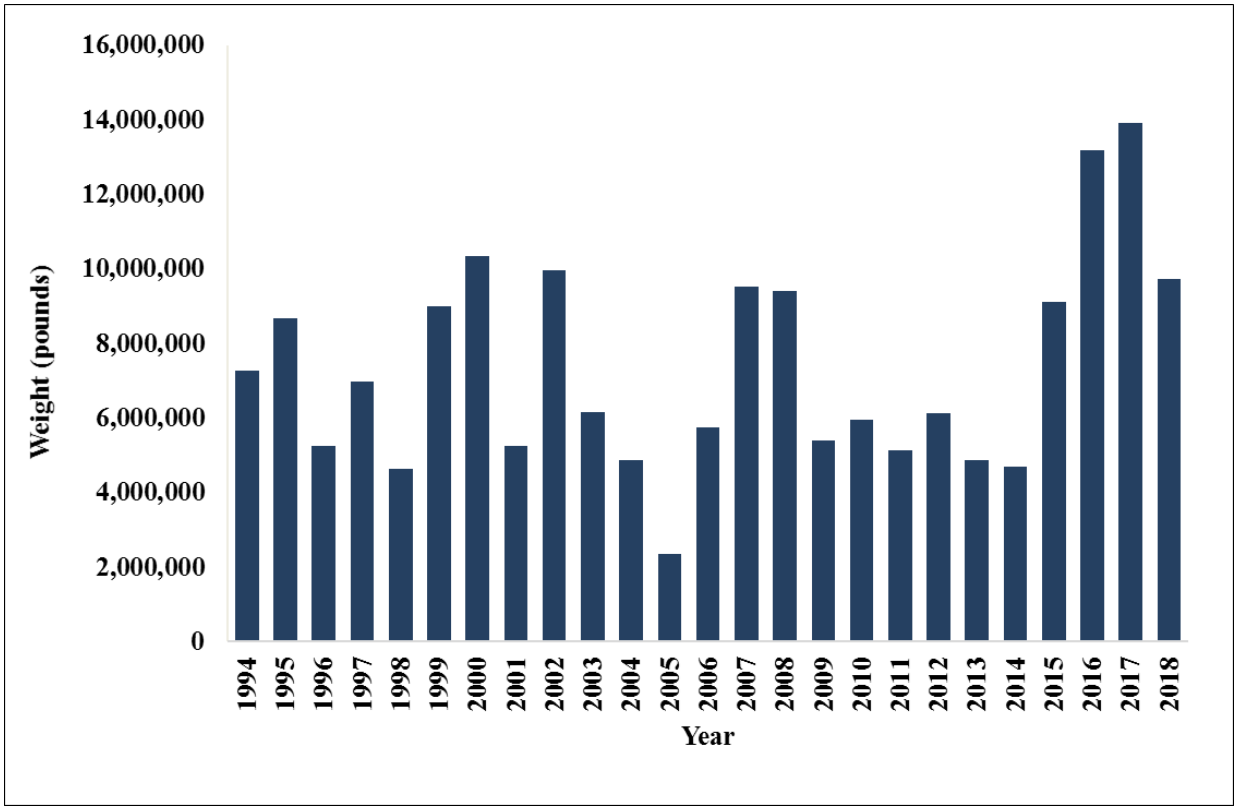

Figure 1. Annual commercial shrimp landings (pounds) from all three shrimp species combined in North Carolina, 1994-2018. Data from the NCDMF Trip Ticket Program.

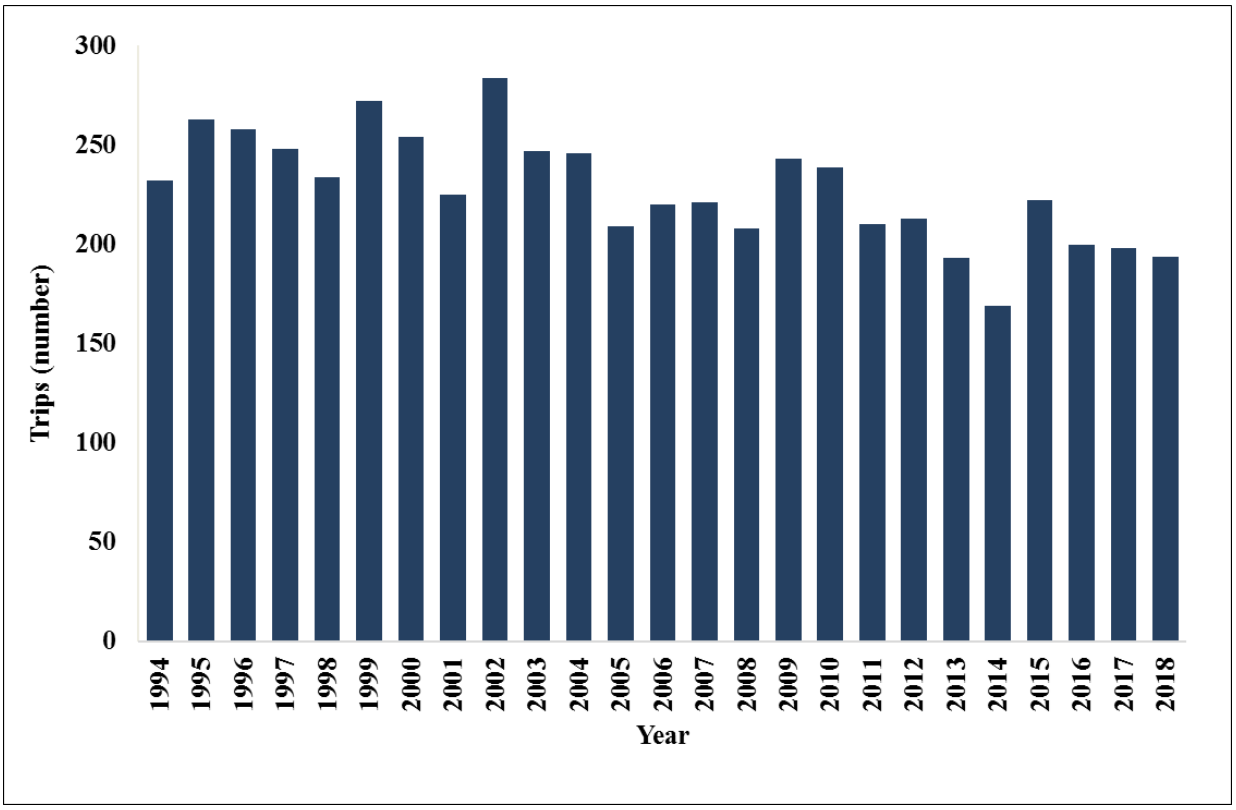

Figure 2. Annual number of commercial trips reported for all three species combined in inside and ocean waters, 1994-2018. Data from the NCDMF Trip Ticket Program.

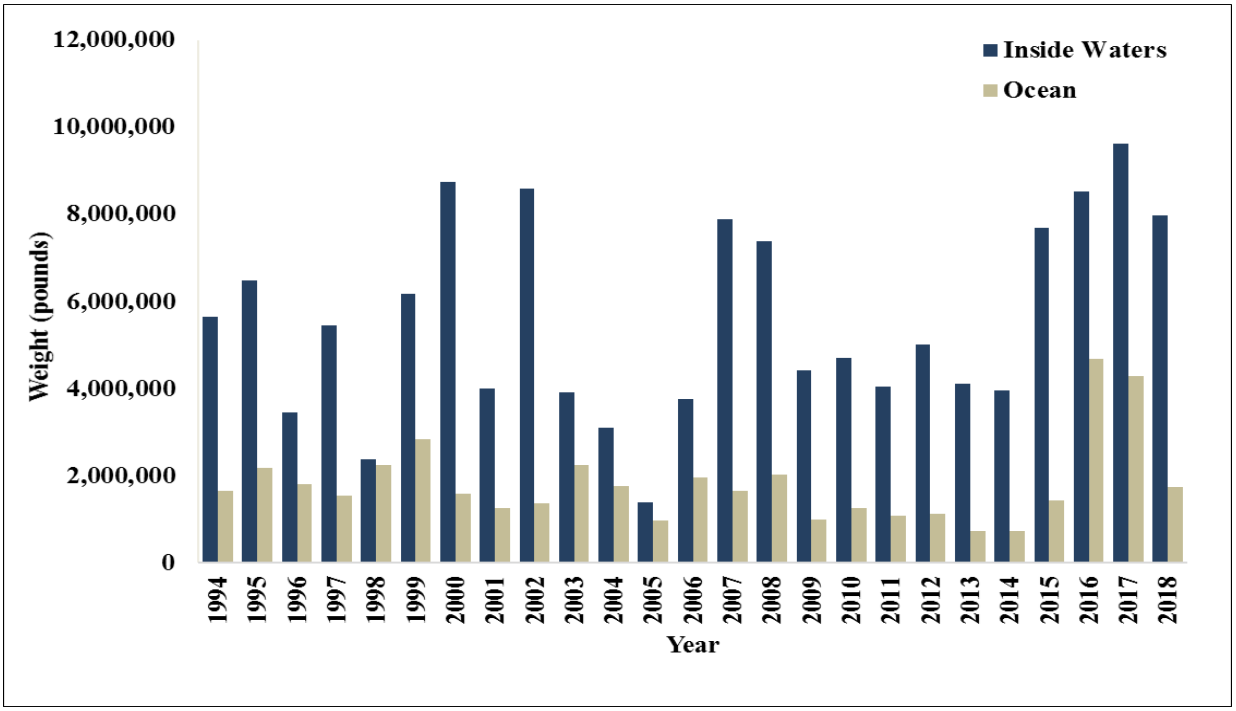

Figure 3. Annual commercial shrimp landings (pounds) by area from all three shrimp species combined in North Carolina, 1994-2018. Data from the NCDMF Trip Ticket Program.

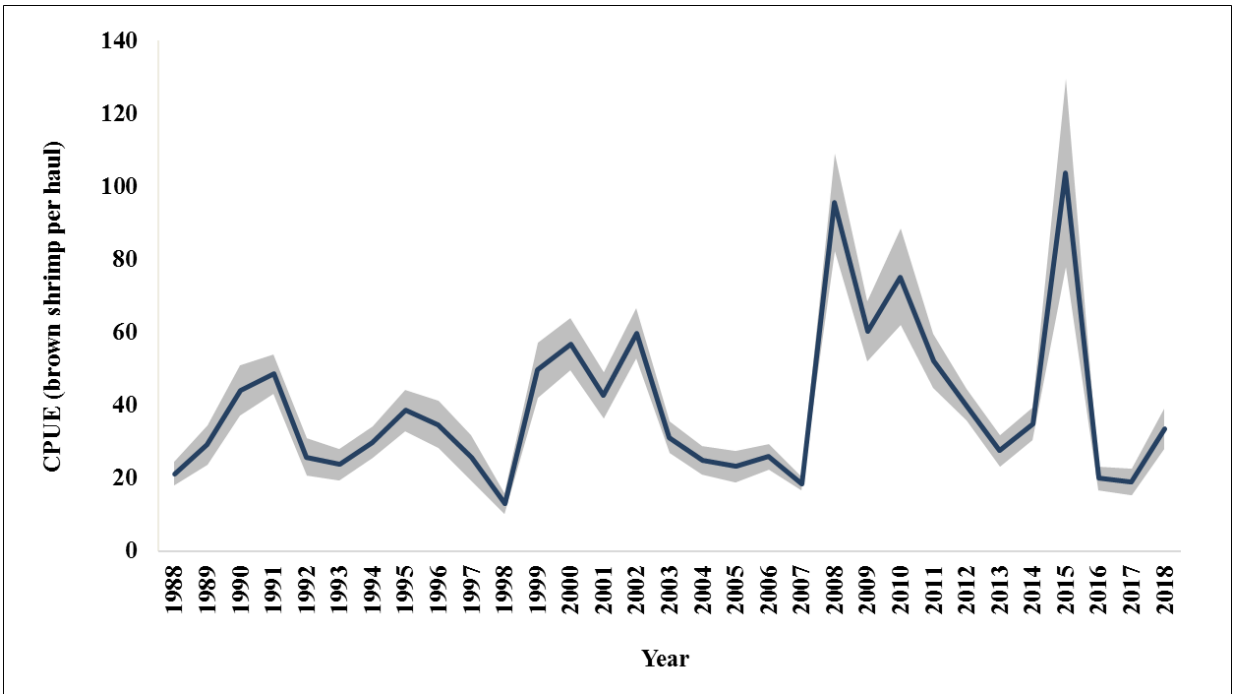

Figure 4. Annual catch per unit effort (CPUE; number of shrimp per station) of brown shrimp from Program 120 estuarine trawl survey, 1988-2018. Shaded area represents standard error.

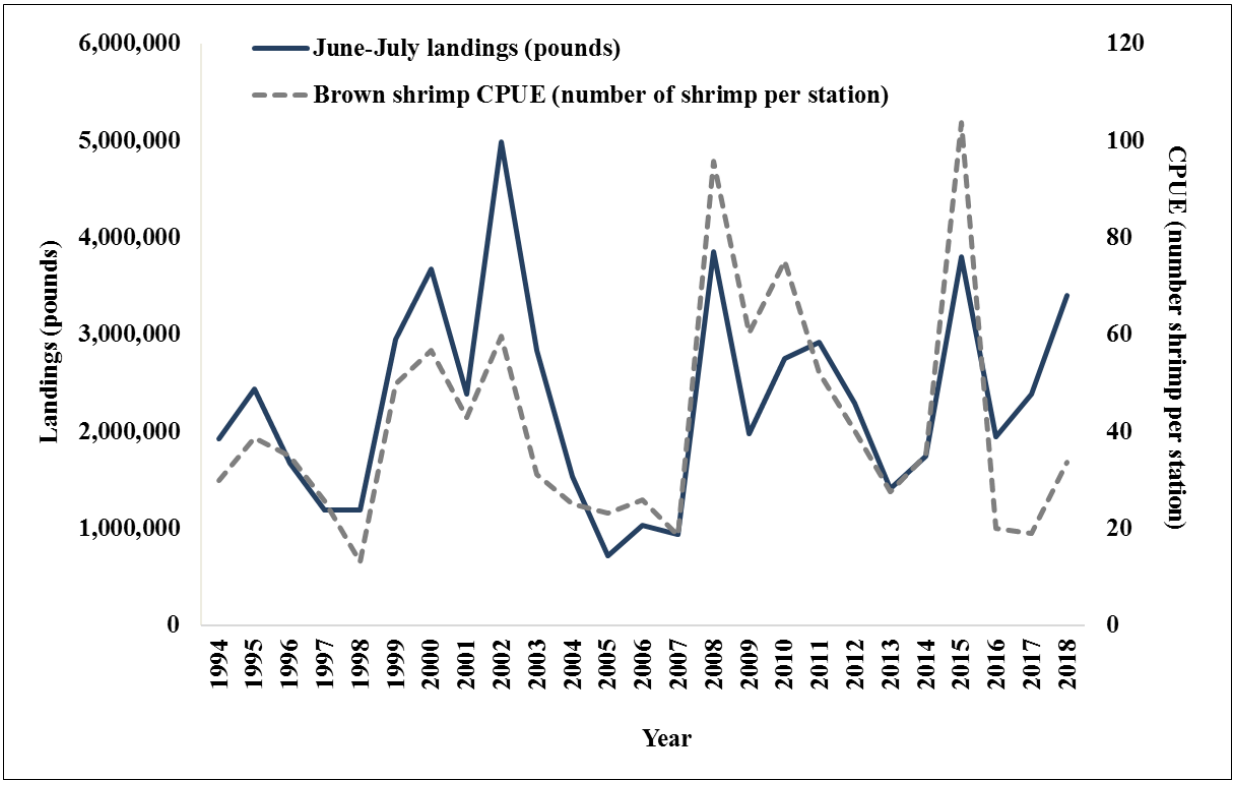

Figure 5. Comparison of shrimp commercial shrimp landings in the months of June and July to the brown shrimp Program 120 catch per unit effort (number of shrimp per station), 1994-2018.