FISHERY MANAGEMENT PLAN UPDATE
SOUTHERN FLOUNDER
AUGUST 2019

STATUS OF THE FISHERY MANAGEMENT PLAN

Fishery Management Plan History

Original FMP Adoption:	February 2005
Amendments:	Amendment 1 – February 2013
Revisions:	None
Supplements:	Supplement A to the 2005 FMP – February 2011 Supplement A to Amendment 1 – November 2015
Information Updates:	None
Recommended Schedule Change:	None
MFC Scheduled Review:	Review started in 2017

A five-year review of the N.C. Southern Flounder Fishery Management Plan (FMP) began January 2018, immediately following a peer review workshop evaluating the 2018 stock assessment. At the end of the peer review workshop, the Southern Flounder Review Panel accepted the pooled-sex run of the ASAP model presented at the Review Workshop as a valid basis of management for at least the next five years, with the expectation that the model will be updated with data through 2017 to provide the best, most up to date estimate of stock status for management. The reviewers also noted that management advice based on the 2015 terminal year would be out of date by the time it could be implemented and that expected changes to recreational catch estimates (MRIP) should be incorporated into the assessment model and management response.

During 2018, the southern flounder stock assessment sub-committee updated all necessary data inputs for the ASAP model. The pooled-sex model was updated with data through 2017 including incorporating the new MRIP estimates that were available, Results indicate the stock was overfished and overfishing was still occurring. Analyses that provided projections of reductions to fishing mortality necessary to end overfishing and to determine what reductions would be necessary to rebuild the spawning stock biomass and end the overfished status were completed. The plan development team continues to work through the development of Amendment 2 to the Southern Flounder FMP in conjunction with the Southern Flounder FMP Advisory Committee.

Until Amendment 2 is approved by the MFC, management of southern flounder falls under Amendment 1 and Supplement A to Amendment 1. Actions to achieve sustainable harvest in Amendment 1 include: 1) accept management measures to reduce protected species interactions as the management strategy for achieving sustainable harvest in the commercial southern flounder fishery; 2) increase the recreational minimum size limit to 15 inches and decrease the creel limit to six fish. Amendment 1 also set new sustainability benchmarks at 25% Spawning Potential Ratio (SPR) (threshold) and 35% SPR (target).

Supplement A to Amendment 1 was approved at the November 2015 NCMFC meeting. Management actions approved include: increasing the minimum commercial size limit to 15 inches, increasing the minimum mesh size for gill nets to six-inch stretched mesh (ISM), closing the commercial gill net and recreational fisheries on October 15, closing the commercial gig fishery once the pound net fishery closes, a 38% reduction to the pound net fishery based on the 2011-2015 average landings, and to increase the escape panels in flounder pound nets to five and three-quarters inch. All management actions were effective January 1, 2016. However, an injunction was granted in October 2016 stopping the Division from enacting some of the management actions. The recreational closure on October 15, the commercial closure of the gig fishery, and the 38% reduction in pound net landings based on the 2011-2015 average did not occur.

Management Unit

The Amendment 1 and Supplement A to Amendment 1 to the North Carolina Fishery Management Plan management unit was defined as North Carolina coastal and joint waters. However, due to increased information relative to genetic identification and tagging studies the unit stock for the 2018 stock assessment was changed to include all waters from North Carolina through the East coast of Florida.

Goal and Objectives

Until the goals and objectives of Amendment 2 are approved by the MFC, the goals and objectives of Amendment 1 remain. The goal of Amendment 1 to the North Carolina Southern Flounder FMP is to end overfishing and rebuild the spawning stock for long-term sustainable harvest and maintain the integrity of the stock. To achieve this goal, the following objectives must be met:

1. Ensure that the spawning stock biomass of southern flounder is adequate to produce recruitment levels necessary to increase spawning stock biomass and expand age distribution.
2. Implement management measures that will achieve sustainable harvest.
3. Promote harvesting practices that minimize bycatch.
4. Continue to develop an information program to educate the public and elevate their awareness of the causes and nature of problems in the southern flounder stock, its habitat and fisheries, and explain the rationale for management efforts to sustain the stock.
5. Address social and economic concerns of all user groups, including issues such as user conflicts.

6. Promote the protection, restoration, and enhancement of habitats and environmental quality for the conservation of the southern flounder population.
7. Initiate, enhance, and/or continue studies to improve the understanding of southern flounder population ecology and dynamics.
8. Initiate, enhance, and/or continue studies to collect and analyze the socio-economic data needed to properly monitor and manage the southern flounder fishery.

STATUS OF THE STOCK

Life History

Southern flounder *(Paralichthys lethostigma)* are a bottom dwelling species of the left eyed flounder family found in the Atlantic Ocean and estuaries from northern Mexico to Virginia. This species is one of three commonly caught left eyed flounder in North Carolina; Southern flounder, Gulf flounder (*Paralichthys albigutta*), and summer flounder (*Paralichthys dentatus*). This species supports important commercial and recreational fisheries along the U.S. South Atlantic and Gulf coasts and are particularly important to fisheries in North Carolina. The biological unit stock for southern flounder inhabiting North Carolina waters may include fish from other southern states based on evidence from tagging and genetic studies, as well as differences in aging structures, which indicate one single unit stock of southern flounder from North Carolina to Florida. Evidence also suggests some adult southern flounder return to the estuaries after spawning in the ocean, while others remain in the ocean. Tagged fish are typically recaptured south of original tagging locations and often in other states once in the ocean. Limited data from South Carolina and Georgia tagging programs suggest a low probability of adult movement from South Carolina or Georgia to North Carolina waters.

Data collected from fall fisheries by the North Carolina Division of Marine Fisheries suggests that with the onset of maturity, fish of both sexes migrate out of inlets to ocean waters in the fall. Southern flounder can produce approximately 3 million eggs per female in multiple spawning events in a season, and spawning is thought to take place between November and April. Larval southern flounder pass through inlets within 30 to 45 days of hatching and settle throughout the sounds and rivers in the winter and early spring. Nearly half of female flounder are thought to be mature by ages 1 and 2 (at approximately 16 inches). Fish collected in the ocean tend to be larger and older with females attaining larger sizes. The largest southern flounder observed in North Carolina was a 33 inch long female and a 20 inch long male. The maximum observed age was 9 for a female and 9 for a male; southern flounder captured in North Carolina represent the oldest ages observed throughout the species' range.

Juvenile and adult southern flounder are bottom dwelling and typically feed by camouflaging themselves and ambushing their prey with a quick upward lunge. Southern flounder diets switch to fish when they are between 3 and 4 inches long. Adult southern flounder feed almost exclusively on other fish, but will consume shrimp as well.

Stock Status

Following the recommendation of the peer review panel, the southern flounder working group recommended that the stock size threshold and target be defined in terms of Spawning Stock Biomass (SSB) associated with the fishing mortality target and threshold. Based on the results of

the January 2018 stock assessment, the probability that fishing mortality in 2015 is above the threshold value of 0.46 is 53%, whereas there is a 95% chance the fishing mortality in 2015 is above the target value of 0.31. The probability that the SSB in 2015 is below the threshold or target value (3,984 and 5,411 mt, respectively) is 100%. Therefore, the current status of the southern flounder stock is overfished and overfishing is occurring.

Stock Assessment

The 2009 stock assessment used a statistical catch-at-age model run using the Age Structured Assessment Program (Takade 2009). Results showed the stock to be overfished with overfishing occurring throughout the time series. These were the most recent assessment results included in Amendment 1. The 2014 Southern Flounder Stock Assessment used a statistical catch-at-age model run using Stock Synthesis (NCDMF 2015). Upon review of the assessment, external peer reviewers and the NCDMF determined the model could not fully account for stock mixing during spawning, nor quantify migration of southern flounder to and from North Carolina waters. Consequently, the assessment was not accepted for determining stock status. As a result, a multistate southern flounder stock assessment was developed and included data and expertise of state agency staff from North Carolina. South Carolina, Georgia, and Florida, as well as researchers from the University of North Carolina at Wilmington and Louisiana State University. The multistate assessment was an attempt to further address the geographical distribution of the unit stock and was peer reviewed in December 2017. This assessment used a statistical catch-at-age model run using the Age Structured Assessment Program (Lee et. al. 2018). The Southern Flounder Review Panel accepted the pooled-sex run of the ASAP model presented at the Review Workshop and was approved as a valid basis of management for at least the next five years, with the expectation that the model will be updated with data through 2017 to provide the best, most up to date estimate of stock status for management. The reviewers also noted that management advice based on the 2015 terminal year would be out of date by the time it could be implemented and that expected changes to recreational catch estimates (MRIP) should be incorporated into the assessment model and management response. During 2018, the southern flounder stock assessment sub-committee updated all necessary data inputs for the ASAP model. The pooled-sex model was updated with data through 2017 including incorporating the new MRIP estimates that were available, results indicate the stock was overfished and overfishing was still occurring. Analyses that provided projections of reductions to fishing mortality necessary to end overfishing and to determine what reductions would be necessary to rebuild the spawning stock biomass and end the overfished status were completed.

STATUS OF THE FISHERY

Current Regulations

Commercial: 15-inches total length (TL) minimum size limit from internal waters and 14-inches TL minimum size limit from ocean waters, 6 ISM minimum mesh size for gill nets, closed season in internal waters from December 1-31; no trip limits in internal waters and a 100 pound trip limit in ocean waters unless the individual has a License to Land Flounder from the Atlantic Ocean.

Recreational: 15-inches TL minimum size limit, four-fish creel limit from all joint and coastal waters, and year-round season.

At the NCMFC's November 2015 business meeting they adopted a supplement to the FMP which instituted several new rule changes effective January 1, 2016. Please check the NCDMF's website for a summary of the actions http://portal.ncdenr.org/web/mf/nr-50-2015-mfc-flounder.

Commercial Landings

All landings reported as caught in inshore waters are considered to be southern flounder by the NCDMF Trip Ticket Program. Most southern flounder landings are from gill nets and pound nets, although gigs and other inshore gears (e.g., trawls) catch flounder in smaller numbers. Historically, pound nets were the dominant gear but landings from gill nets were higher in 1994-2013 (Figure 1). Peak commercial landings occurred in 1994 (Table 1). Since 1994, pound net landings decreased greatly, while gill net landings remained relatively high until 2010. Decreases in gill net landings from 2010 to 2012 were mainly due to lower landings in the Albemarle Sound. The Sea Turtle Settlement Agreement (2010) added regulations to gill nets in portions of the state, resulting in lower effort in many areas, however, the Albemarle Sound was mostly unaffected by these regulations. The Albemarle Sound is typically where the majority of southern flounder gill net harvest occurs. In 2013, gill net harvest increased greatly in the Albemarle Sound, but decreased in Pamlico Sound and Core Sound; pound net landings also increased greatly in 2013. Since 2014, gill net harvest has decreased in all areas of the state, especially in the Albemarle Sound due to widespread gill net closures to avoid catches of red drum and closures due to protected species interactions. Pound net harvest surpassed gill net harvest 2014 through 2018 (Figure 1). Gig harvest of southern flounder has generally increased, especially since 2010. Harvest by other commercial gears has generally decreased to its lowest point in 2018 and currently makes up a small portion of commercial harvest. Commercial harvest is the highest in fall months.

Trends in commercial trips have generally followed landings trends (Figure 2). Trips include the number of trip ticket records with landings reported; some trips may represent more than one day of fishing. The majority of trips that harvest flounder are from gill nets. Gill net trips have been variable around a decreasing trend since 2010. Pound net trips were decreasing until 2002, since they have been variable on a lower level. Gigging trips have been variable around an increasing trend since 2010.

Recreational Landings

Recreational fishing activity is monitored through the Marine Recreational Information Program. In this report, estimates across all years have been updated and are now based on the MRIP new Fishing Effort Survey-based calibrated estimates. For more information on MRIP methodology changes see https://www.fisheries.noaa.gov/topic/recreational-fishing-data.

Recreational harvest of southern flounder is mainly by hook and line and gigs, with a small amount of harvest by spearfishing or Recreational Commercial Gear License (RCGL) gears. NCDMF does not have information on long-term trends of the gig fishery. This is because the

Marine Recreational Information Program (MRIP) rarely encounters gig fishermen. A DMF mail-based survey of gigging that began in 2010 indicates the gig harvest from 2010-2018 averaged 10% of the recreational harvest (with hook and line harvest making up the remainder). Hook and line harvest can be split into ocean and inshore harvest, with most southern flounder harvested inshore (Figure 3). Hook and line harvest peaked in 2010 (Table 1). Recreational harvest is highest during summer months.

Trends in recreational trips are somewhat difficult to interpret because they represent all *paralichthid* flounder species commonly caught in North Carolina (southern, summer and Gulf). This is because anglers simply report targeting 'flounder' rather than a particular species of flounder. Trips can be defined in several ways, but in this document all trips that harvested or released any *paralichthid* flounder species were included. Trends in trips and harvest are roughly similar throughout most of the time-series, but trips have been declining since 2013 while harvest has been variable. (Figure 4).

MONITORING PROGRAM DATA

Fishery-Dependent Monitoring

Commercial fishing activity is monitored through fishery-dependent sampling conducted by the division since 1982. Data collected in this program allow the size and age distribution of southern flounder to be characterized by gear and fishery. Several NCDMF sampling programs collect biological data on commercial and recreational fisheries that catch southern flounder. The primary programs that collect length and age data for harvested southern flounder include: 461 (gill net and seine), 476 (gig and spear), 432 (pound net) and 437 (long haul seine). Programs 466 and 570 collect length data on harvested and discarded flounder. Other commercial sampling programs focusing on fisheries that do not target southern flounder rarely collect biological data. The NCDMF sampling of the recreational fishery through the MRIP collects length data on southern flounder. The NCDMF mail-based gigging survey collects harvest data for the recreational gig fishery, but does not collect length or age data. Age data from the recreational fishery are collected mainly via voluntary angler donations through the NCDMF Carcass Collection Program.

There were no clear trends in commercial length and age data from 2005 to 2018 (Table 2). In 2018, 49% of southern flounder were harvest by pound nets, followed by gill nets (40%), gigs (10%), and other gear accounted for 1% (Figure 5). Commercial age data for 2018 are not available at this time. Annual mean lengths were fairly consistent; however, an increase in mean length was observed due to the changes in minimum commercial size regulation, increasing to 15-inches (Table 1; Figure 6).

There were no clear trends in recreational length and age data from 2005 to 2018 (Table 3). Recreational age data for 2018 are not available at this time. Annual mean lengths collected through age sampling programs were consistent and 2017 was similar to previous years where 17 inches was the mean length as seen 12 of the last 14 years. MRIP length requency data show harvest of smaller fish has declined as changes to minimum size limits has occurred (Table 3; Figure 7).

Fishery-Independent Monitoring

Several NCDMF independent sampling programs collect biological data on southern flounder. The primary surveys that collect length data for southern flounder and that were evaluated as indices of abundance in recent stock assessments were: 120 (Estuarine Trawl Survey), 195 (Pamlico Sound Survey), 135 (Albemarle Sound Independent Gill Net Survey and 915 (Pamlico Sound and Rivers Independent Gill Net Surveys). Age data primarily is collected in Program 915, although the other three surveys do collect age data. Methodology for analyzing trends in catch-per-unit-effort (CPUE) for each survey changed with the 2018 stock assessment when generalized linear models (GLMs) were used to calculate relative yearly abundance index values. These indices were not updated for this report, as an update to the stock assessment is under way and final GLM values have not been finalized. As a result, nominal CPUE values have been include in this report.

There were no clear trends in fishery-independent length and age data from 2005 to 2018 (Table 4). Independent age data for 2018 are not available at this time. Annual mean lengths were fairly consistent and 2016 had the second largest mean length in the time-series. However, the number of fish measured in 2016 was the lowest of any year from 2005 to 2017.

Data collected by Program 915 were used for an index of general (juvenile and adult) abundance in the January 2018 stock assessment. The survey is designed to characterize the size and age distribution for key estuarine species in Pamlico Sound and its major river tributaries. Sampling began in Pamlico Sound in 2001 and was expanded to the current sampling area (including tributaries) in 2003. Each array of nets consists of floating gill nets in 30-yard segments of 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, and 6.5-inch stretched mesh, for a total of 240 yards of nets. Catches from an array of gill nets comprise a single sample; two samples (one shallow, one deep) totaling 480 yards of gill net are completed each trip. Gill nets are typically deployed within an hour of sunset and fished the following morning. Efforts are made to keep all soak times within 12 hours. All gill nets are constructed with a hanging ratio of 2:1. Gill net sets are determined using a random stratified survey design, based on area and water depth. Each region is overlaid with a one-minute by one-minute grid system (equivalent to one square nautical mile) and delineated into shallow (less than six feet) and deep (greater than six feet) strata. Deep strata were not included in data analysis for this report. Sampling in Pamlico Sound is divided into two regions: Region 1, which includes areas of eastern Pamlico Sound adjacent to the Outer Banks from southern Roanoke Island to the northern end of Portsmouth Island; and Region 2, which includes Hyde County bays from Stumpy Point Bay to Abel's Bay and adjacent areas of western Pamlico Sound. Each of the two regions is further stratified into four similar sized areas, denoted by either Hyde or Dare and numbers one through four. The rivers are divided into four areas in the Neuse River, three areas in the Pamlico River, and one area for the Pungo River. Although the survey is conducted in all months except January, only July-September data were used to analyze CPUE trends because these months had the peak catches of southern flounder. The survey was expanded to include areas in the southern portion of the state in 2008, but these data were not analyzed for the index due to the short time-series. The abundance index for Program 915 peaked in 2010 and the low point was in 2016 for the time-series analyzed (2003-2018) and has a decreasing trend (Table 5; Figure 8) with the last four years all below the time series average.

Data collected by Program 135 was not used as an index of general (juvenile and adult) abundance in the January 2018 stock assessment but continues to provide an additional data source to monitor trends in the population. Beginning in 1990, Program 135 has conducted gill net sets in waters of Albemarle Sound. The survey was designed to monitor the striped bass population. The survey follows a random stratified design, stratified by geographic area. This survey divides the Albemarle region into six sample zones that are further subdivided into one-mile square quadrants with an average of 22 quadrants per zone. Four arrays of twelve meshes (2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 8.0, 10.0-inch stretch) of gill nets are set in each quadrant by the fishing crew, two arrays are sinking gill nets and two are floating. One unit of effort is defined as each 40-yard net fished for 24 hours. The abundance index for Program 135 peaked in 1992 and the low points were in 2011, 2016, 2017, and 2018 for the time-series analyzed (1991-2018; Table 5; Figure 9). The CPUE for each of the last five years have all been below the servies average.

Data collected by Program 120 were used for a Juvenile Abundance Index (JAI) in the January 2018 stock assessment. 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 one sample for each station each month during the months of May and June. This survey targets juvenile finfish, blue crabs, and Penaeid shrimp. A two-seam 10 and one-half 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 collected 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 is collected, including salinity, dissolved oxygen, temperature, wind speed and direction. Data from this survey were used to produce a southern flounder JAI from 1991 to 2018. The JAI for Program 120 peaked in 1996 and the low point was in 2016 for the time-series analyzed (1991-2018) and shows a variable trend (Table 5; Figure 10) with each of the last 5 years being below the time series average.

Data collected by Program 195 were not used as a JAI in the January 2018 stock assessment but continues to provide an additional data source to monitor trends in the population. Program 195 conducts trawls using a random-stratified survey design in waters of Pamlico Sound and major river tributaries in June and September. Only data from September were used for the JAI in the 2014 stock assessment. Stations are randomly selected from strata based upon depth and geographic location. Randomly selected stations are optimally allocated among the strata based upon all previous sampling in order to provide the most accurate abundance estimates (PSE <20). Tow duration is 20 minutes; using double rigged demersal mongoose trawls (9.1m headrope, 1.0m X 0.6m doors, 2.2-cm bar mesh body, 1.9-cm bar mesh cod end and a 100-mesh tailbag extension. Data from this survey were used to produce a southern flounder JAI from 1991 to 2018. The JAI for Program 195 peaked in 1996 and the low point was in 1998 for the time-series analyzed (1991-2018; Table 5; Figure 11). However, annual CPUE for three of the last four years has been above the time series average.

In order to describe the age structure of harvest and indices, southern flounder age structures are collected from various fishery independent (scientific surveys) and dependent (fisheries) sources throughout the year. In 2017, 1,178 southern flounder were aged ranging in age from 0 to 7 years (Tables 2-4). Growth in length is rapid for the first year of life and then slows. The relationship of length and age for southern flounder is unpredictable with much overlap in age for a given length (Figure 12).

MANAGEMENT STRATEGY

Until Amendment 2 is approved for management by the MFC, Southern flounder are managed under Amendment 1 and Supplement A to Amendment 1 to the Southern Flounder FMP, adopted in February 2013. Amendment 1 established the threshold SPR of 25% and the target SPR of 35% and implemented management measures for the commercial and recreational fisheries (Table 6). Actions to achieve sustainable harvest in Amendment 1 include: 1) accept management measures to reduce protected species interactions as the management strategy for achieving sustainable harvest in the commercial southern flounder fishery; 2) increase the recreational minimum size limit to 15 inches and decrease the creel limit to six-fish. Since the adoption of Amendment 1, the 2014 Southern Flounder Stock Assessment was completed. Upon review of the assessment, external peer reviewers and the NCDMF determined the model could not fully account for stock mixing during spawning and quantify migration of southern flounder to and from North Carolina waters. Consequently, the assessment was not accepted for determining stock status. Due to concerns for the health of the stock based on abundance trends and the percentage of immature fish in the harvest, in February 2015 the NCMFC requested a supplement be developed for reducing harvest in the southern flounder fishery.

Supplement A to Amendment 1 was approved at the November 2015 MFC business meeting. Management actions approved included: 1) increasing the minimum commercial size limit to 15 inches; 2) increasing the minimum mesh size for gill nets to 6 ISM; 3) closing the commercial gill net and recreational fisheries on October 15; 4) closing the commercial gig fishery once the pound net fishery closes, a 38% reduction to the pound net fishery based on the 2011-2015 average landings; and 5) an increase to five and three-quarter inch escape panels. All management actions were effective January 1, 2016. However, an injunction was granted in October 2016, preventing the NCDMF from enacting some of the management actions. The commercial gill net and recreational closure on October 15, the commercial closure of the gig fishery, and monitoring the 38% reduction in pound net landings based on the 2011-2015 average did not occur.

RESEARCH NEEDS

The management strategies and implementation status from Amendment 1 and Supplement A of the N.C. Southern Flounder FMP can be found in Table 6. The following research recommendations were included in Amendment 1; status of need is provided in parentheses:

- Investigate the feasibility of a quota as a management tool for the commercial southern flounder fishery (underway).

- Annual survey of the recreational gig fishery (mail-based survey underway, dockside survey still needed).
- Further research on southern flounder that remain in the ocean after the spawning season (tagging studies underway, but other studies may be needed).
- Determine the exact locations of spawning aggregations of southern flounder in the ocean (tagging studies underway, but other studies may be needed).
- Continued otolith microchemistry research to gain a better understanding of ocean residency of southern flounder (more research needed).
- Tagging study of southern flounder in the ocean to gain a better understanding of migration patterns into the estuaries (underway).
- Update the southern flounder maturity schedule (completed).
- Fishery dependent sampling of the commercial spear fishery for flounder in the ocean (some sampling done under NCDMF sampling, but more may be needed).
- Harvest estimates and fishery dependent sampling of the recreational spear fishery for flounder in the ocean (not done except what MRIP encounters).
- Increased fish house sampling of the Currituck Sound flounder gill net and pound net fisheries (sampling has increased, more may be needed).
- Increased at-sea observer trips with gill netters and pound netters in Currituck Sound (underway for gill nets, pound net observing needed).
- Reestablish a RCGL survey to obtain harvest, discard, and effort information (needed).
- Establish an at-sea observer program of the RCGL fishery (needed).
- Formulate a bycatch estimate of southern flounder from crab pots (more research needed).
- Further research on degradable materials to determine which material works best in a given water body and how other parameters, such as microbial activities and the effects of light penetration impact degradation rates and performance of the crab pot (progress unknown).
- Further research on flatfish escapement devices that minimize undersized flounder bycatch and maximize the retention of marketable blue crabs (needed).
- Further research on factors that impact release mortality of southern flounder in the recreational hook and line fishery (more research needed).
- Research on deep hooking events of different hook types and sizes on southern flounder (needed)
- Population dynamics research for all Atlantic protected species (some research completed, more is needed).
- Continued gear research in the design of gill nets and pound nets to minimize protected species interactions (some research completed, more may be needed).
- Development of alternative gears to catch southern flounder (some research completed, more may be needed).
- Further research on the size distribution of southern flounder retained in pound nets with 5.75-inch and 6-inch escape panels (some research completed, more is needed).
- Research on the species composition and size distribution of fish and crustaceans that escape pound nets through 5.75-inch and 6-inch escape panels (some research completed, more is needed).
- Coast-wide at-sea observations of the flounder pound net fishery (needed).
- Discard mortality estimates of southern flounder from pound nets (needed).

- Continue at-sea observations of the large mesh gill net fishery, especially outside of the PSGNRA, including acquiring biological data on harvest and discards (underway).
- Increase the number of large mesh gill net catches sampled in areas such as Albemarle Sound and the Newport River (sampling has increased, more may be needed).

Research recommendations from the January 2018 stock assessment:

- Develop a survey that will provide estimates of harvest and discards for the recreational gig fisheries in North Carolina, South Carolina, Georgia, and Florida
- Conduct sampling of the commercial and recreational ocean spear fishery harvest and discards
- Develop a survey that will estimate harvest and discards from commercial gears used for recreational purposes
- Develop a survey that will provide estimates of harvest and discards from gears used to capture southern flounder for personal consumption
- Improve estimates of the B2 component (catches, lengths, and ages) for southern flounder from the MRIP
- Collect additional discard data (ages, species ratio, lengths, fates) from other gears (in addition to gill nets) targeting southern flounder (pound net, gigs, hook-and-line, trawls)
- Develop and implement consistent strategies for collecting age and sex samples from commercial and recreational fisheries and fisheries-independent surveys to achieve desired precision for stock assessment
- Complete an age validation study using known age fish
- Implement a tagging study to estimate emigration, movement rates, and mortality rates throughout the stock's range
- Expand, improve, or add inshore and offshore surveys of southern flounder to develop indices for future stock assessments
- Expand, improve, or add fisheries-independent surveys of the ocean component of the stock
- Collect age and maturity data from the fisheries-independent SEAMAP Trawl Survey given its broad spatial scale and potential to characterize offshore fish
- Conduct studies to better understand ocean residency of southern flounder
- Determine locations of spawning aggregations of southern flounder
- Develop protocol for archiving and sharing data on gonads for microscopic observation of maturity stage of southern flounder for North Carolina, South Carolina, Georgia, and Florida
- Examine the variability of southern flounder maturity across its range and the effects this may have on the assessment model
- Investigate how environmental factors (wind, salinity, temperatures, or oscillations) may be driving the stock-recruitment dynamics for southern flounder
- Promote data sharing and research cooperation across the South Atlantic southern flounder range (North Carolina, South Carolina, Georgia, and Florida)
- Consider the application of areas-as-fleets models in future stock assessments given the potential spatial variation (among states) in fishery selectivity and fleet behavior in the southern flounder fishery
- Consider the application of a spatial model to account for inshore and ocean components of the stock as well as movements among states

The peer review panel concluded that the working group's research recommendations were appropriate and endorsed all of them. In addition to identifying some research needs as high priority, the peer review panel offered the following additional research recommendations:

- Conduct studies to quantify fecundity and fecundity-size/age relationships in Atlantic southern flounder
- Work to reconcile different state-level/regional surveys to better explain differences in trends
- Develop a recreational CPUE (e.g., from MRIP intercepts or the Southeast Regional Headboat Survey if sufficient catches are available using a species guild approach to identify trips, from headboat logbooks, etc.) as a complement to the more localized fishery independent indices
- Explore reconstructing historical catch and catch-at-length data prior to 1989 to provide more contrast in the removals data
- Study potential species interactions among *Paralichthid* flounders to explain differences in population trends where they overlap

FISHERY MANAGEMENT PLAN SCHEDULE RECOMMENDATION

At its August 2015 business meeting the NCMFC approved the FMP schedule that maintained the timeline for a scheduled review of the southern flounder FMP to begin in 2018.
At its Aug. 18, 2016 business meeting, the NCMFC approved a motion to begin the review of the FMP as soon as a valid stock assessment is available. A coast-wide stock assessment for southern flounder, including data from North Carolina, South Carolina, Georgia, and Florida, was completed in January 2018 with an update completed in January 2019. This update was a necessary result of an external peer review of the January 2018 stock assessment conducted in December 2017.

LITERATURE CITED

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TABLES

Table 1. Southern flounder recreational harvest and number released (Marine Recreational Information Program) and commercial harvest (North Carolina Trip Ticket Program) for 1989-2018. All weights are in pounds.

	Recreational				
	Numbers		Weight (lb)		
Year	Landed	Released	Landed	Commercial Weight (lb)	Total Weight (lb)
1989	119,047	125,192	199,850	3,225,955	3,425,805
1990	138,106	152,895	216,960	2,560,459	2,777,419
1991	257,319	791,778	489,865	4,163,374	4,653,239
1992	115,329	433,576	219,720	3,145,020	3,364,740
1993	83,811	370,372	127,860	4,272,368	4,400,228
1994	168,237	562,915	323,869	4,878,609	5,202,478
1995	127,106	459,800	271,703	4,166,966	4,438,669
1996	173,400	449,876	339,228	3,807,009	4,146,237
1997	209,038	873,901	560,323	4,076,793	4,637,116
1998	96,124	411,939	205,569	3,952,729	4,158,298
1999	78,321	209,956	184,969	2,933,331	3,118,300
2000	326,712	942,560	607,053	3,205,792	3,812,845
2001	304,791	990,335	567,568	3,522,136	4,089,704
2002	366,671	1,415,247	789,539	3,436,753	4,226,292
2003	293,793	860,052	621,985	2,198,503	2,820,488
2004	347,492	1,537,924	827,593	2,454,577	3,282,170
2005	298,307	997,132	675,856	1,870,754	2,546,610
2006	352,942	1,287,601	761,069	2,287,823	3,048,892
2007	279,916	1,075,735	572,064	2,083,043	2,655,107
2008	349,860	2,532,079	807,867	2,602,390	3,410,257
2009	329,117	1,889,921	692,704	2,396,240	3,088,944
2010	556,812	2,835,142	1,149,899	1,689,557	2,839,456
2011	388,647	2,087,604	942,373	1,247,450	2,189,823
2012	290,035	2,434,621	701,698	1,646,137	2,347,835
2013	374,215	2,357,529	869,223	2,186,391	3,055,614
2014	209,228	1,856,280	447,337	1,673,511	2,120,848
2015	249,166	1,709,189	558,303	1,202,952	1,761,255
2016	299,273	2,178,145	695,713	899,932	1,595,645
2017	221,321	1,988,000	451,126	1,394,906	1,846,032
2018	217,805	1,002,753	495,289	903,055	1,398,344

Table 2. Southern flounder total length (inches) and age data for NCDMF commercial fishery sampling programs (includes harvest and some discard information).

Year	Mean Length	Minimum Length	Maximum Length	Total Measured	Modal Age	Minimum Age	Maximum Age	Total Aged
2005	16	2	31	28,972	2	0	7	83
2006	16	5	31	39,572	3	0	6	80
2007	16	4	29	23,768	2	0	5	94
2008	16	1	28	39,302	2	0	7	212
2009	16	4	28	33,403	2	1	6	34
2010	16	5	29	27,176	2	1	5	33
2011	16	5	30	32,000	3	1	6	90
2012	16	4	30	29,865	2	0	6	38
2013	16	1	32	33,776	1	1	5	245
2014	16	1	28	26,354	2	0	4	408
2015	16	2	30	19,717	1	0	5	330
2016	17	6	27	14,712	0	0	4	246
2017	17	3	30	14,775	0	0	5	418
2018	17	2	27	8,962	NA	NA	NA	NA

Table 3. Southern flounder total length (inches) and age data for NCDMF recreational fishery sampling.

Year	Mean Length	Minimum Length	Maximum Length	Total Measured	Modal Age	Minimum Age	Maximum Age	Total Aged
2005	17	13	26	202	3	1	6	112
2006	16	10	31	343	3	1	6	188
2007	17	14	24	220	2	1	8	137
2008	17	13	27	311	3	1	6	79
2009	17	12	26	306	2	1	4	45
2010	17	11	28	754	2	1	7	127
2011	17	14	26	478	2	1	6	91
2012	18	14	30	400	2	1	6	57
2013	17	13	27	390	3	1	5	47
2014	17	14	26	199	2	1	7	42
2015	17	14	24	177	3	1	6	36
2016	17	14	25	225	2	0	5	123
2017	17	14	26	215	2	0	7	140
2018	17	13	27	276	NA	NA	NA	NA

Table 4. Southern flounder total length (inches) and age data for NCDMF fishery-independent sampling programs.

Year	Mean Length	Minimum Length	Maximum Length	Total Measured	Modal Age	Minimum Age	Maximum Age	Total Aged
2005	8	0	25	3,769	2	0	4	516
2006	9	0	23	3,560	3	0	4	539
2007	7	0	22	3,812	1	0	5	513
2008	10	0	27	4,270	1	0	5	816
2009	10	1	27	3,230	1	0	5	414
2010	9	1	23	4,168	1	0	5	1,072
2011	12	1	28	2,604	1	0	6	720
2012	10	1	26	4,878	1	0	3	1,112
2013	9	1	27	3,534	1	0	6	678
2014	9	1	25	2,339	1	0	3	802
2015	9	1	24	2,133	1	0	3	463
2016	11	2	30	1,426	1	0	3	404
2017	9	1	22	2,238	1	0	3	620
2018	9	0	24	2,123	NA	NA	NA	NA

Table 5. Annual nominal abundance index values for southern flounder as catch per unit effort and standard error (SE) in N.C. Division of Marine Fisheries independent surveys (programs 120, 195, 135 and 915). Indices for programs 120 and 195 are considered juvenile (young-of-year) abundance indices.

Year	P915 Index	P915 SE	P135 Index	P135 SE	P195 Index	P195 SE	P120 Index	P120 SE
1991			0.17	0.01	0.6	0.2	1.13	0.17
1992			0.18	0.02	4.83	1.3	2.49	0.30
1993			0.15	0.01	3.81	1.1	2.93	0.38
1994			0.08	0.01	3.33	1.2	1.79	0.24
1995			0.11	0.01	2.83	0.7	1.69	0.24
1996			0.03	0	9.65	2.0	7.82	0.95
1997			0.1	0.01	3.1	0.8	2.74	0.29
1998			0.08	0.01	0.37	0.1	0.90	0.15
1999			0.04	0	1.91	0.5	2.49	0.30
2000			0.05	0.01	0.77	0.2	3.74	0.43
2001			0.1	0.01	0.82	0.3	4.38	0.46
2002			0.14	0.01	3.28	1.5	4.49	0.56
2003	3.41	0.35	0.03	0	2.94	0.8	6.31	1.01
2004	3.11	0.34	0.09	0.01	1.28	0.2	3.89	0.46
2005	2.64	0.25	0.08	0.01	3.25	1.0	3.05	0.38
2006	1.84	0.29	0.13	0.01	1	0.3	2.63	0.33
2007	1.44	0.17	0.16	0.01	1.07	0.3	3.64	0.39
2008	2.97	0.35	0.17	0.01	0.94	0.5	2.40	0.33
2009	2.04	0.27	0.12	0.01	1.28	0.3	1.93	0.26
2010	3.57	0.46	0.05	0.01	1.14	0.3	5.03	0.66
2011	2.33	0.35	0.02	0	0.6	0.2	1.09	0.19
2012	2.22	0.22	0.08	0.01	4.44	1.9	3.07	0.39
2013	2.57	0.24	0.1	0.01	1.05	0.3	2.64	0.33
2014	1.81	0.19	0.05	0	0.64	0.2	1.86	0.30
2015	1.32	0.23	0.04	0	2.46	0.4	1.67	0.27
2016	1.14	0.15	0.02	0	0.73	0.3	0.53	0.11
2017	1.34	0.15	0.02	0	6.02	2.2	1.03	0.16
2018	1.51	0.18	0.02	0	2.94	1.0	1.34	0.18

Table 6. Management action taken as a result of Amendment 1 and Supplement A to the Southern Flounder FMP.

MANAGEMENT STRATEGY	OUTCOME
Commercial: Accept management measures to reduce protected species interactions as the management strategy for achieving sustainable harvest in the commercial southern flounder fishery. Specific minimum measures for the flounder gill net fishery are provided in Issue Paper 10.1.1 (page 129). Recreational: Increase the minimum size limit to 15 inches and decrease the creel limit to six fish-20.2% harvest reduction	Commercial: No Action Required Recreational: Proclamation FF-29-2011 (refer to Supplement A to the 2005 FMP)
Status quo and address research recommendations	No Action Required
Status quo (implement mediation and proclamation authority to address user conflicts with large mesh gill nets)	No Action Required
Status quo (200-yard minimum distance between pound nets and gill nets)	No Action Required
Status quo and address research recommendations	No Action Required
Status quo and expand research on flatfish escape devices and degradable panels under commercial conditions to other parts of the state	No Action Required
Status quo and expand research on factors impacting the release mortality of southern flounder and on deep hooking events of different hook types and sizes	No Action Required
• Request funding for state observer program • Apply for Incidental Take Permit for large mesh gill net fishery • Continue gear development research to minimize protected species interactions	No Action Required
Status quo minimum mesh size for escape panels (5.5-inch stretched mesh) and recommend further research on 5.75-inch stretched mesh escape panels	No Action Required
Status quo minimum mesh size (5.5 inches stretched mesh)	No Action Required
Increase minimum mesh size to harvest southern flounder to 6.0-inch stretched mesh Increase minimum size limit for commercial fisheries to 15 inches	Proclamation FF-3-2016 (refer to Supplement A to Amendment 1 of the 2005 FMP)
Increase minimum mesh size for escape panels to 5.75-inch stretched mesh	Proclamation M-34-2015 (refer to Supplement A to Amendment 1 of the 2005 FMP)
Reduce daily bag limit for recreational harvest of southern flounder from 6 fish to 4 fish	Proclamation FF-4-2017 (refer to Addendum XXVIII to ASMFC Summer Flounder, Scup, Black seabass FMP)

FIGURES

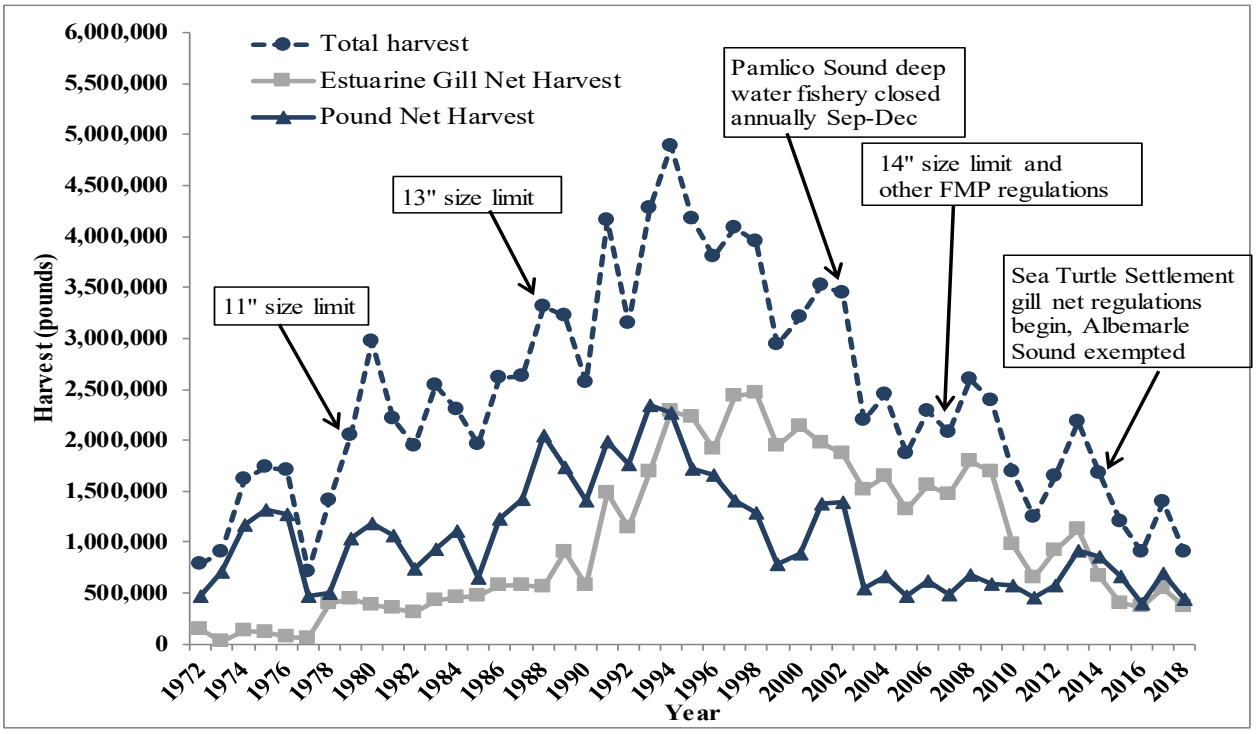

Figure 1. Southern flounder harvest (pounds) for total commercial fishery and top two gears (gill nets and pound nets) from N.C. Trip Ticket Program 1972-2018 with major fishery regulation changes.

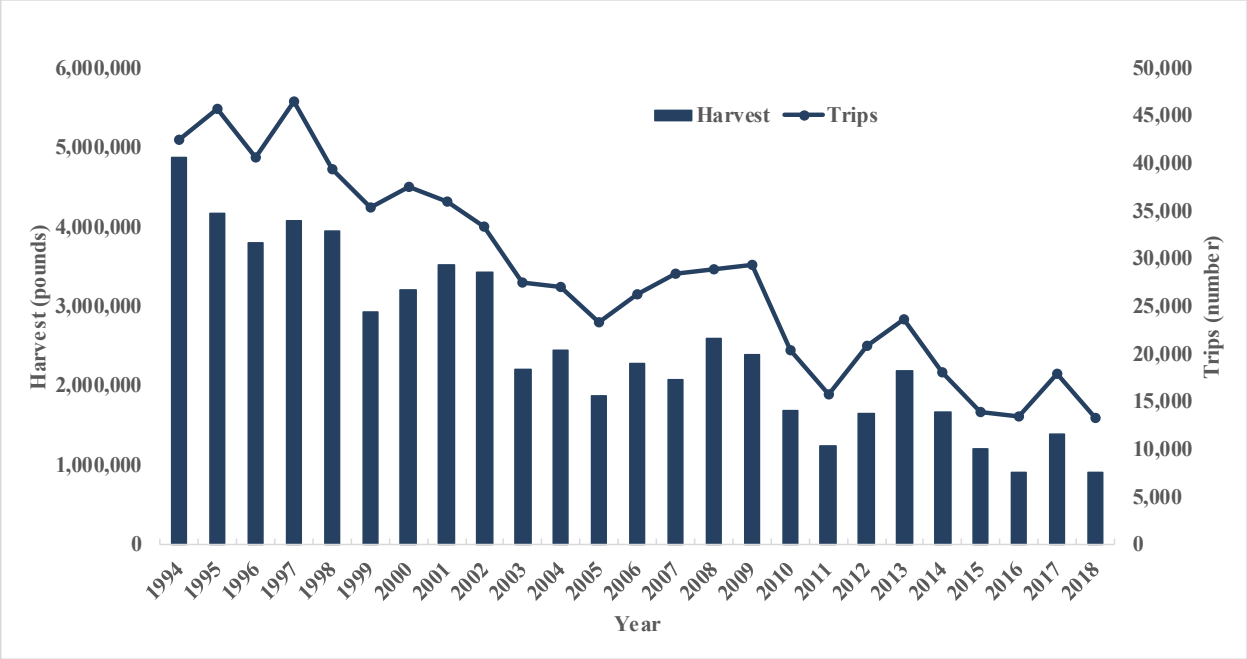

Figure 2. Southern flounder commercial trips (numbers) and harvest (pounds) from N.C. Trip Ticket Program, 1994-2018.

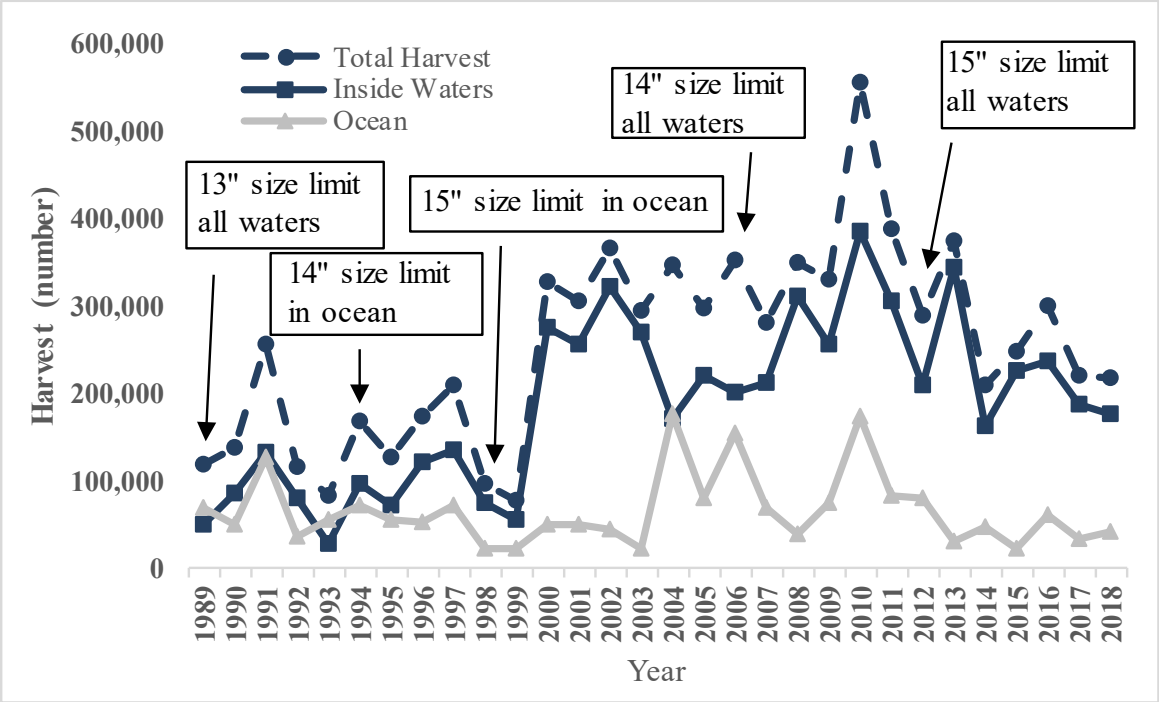

Figure 3. Southern flounder recreational hook and line harvest in numbers of fish from MRIP data 1989-2018 and major fishery regulation changes.

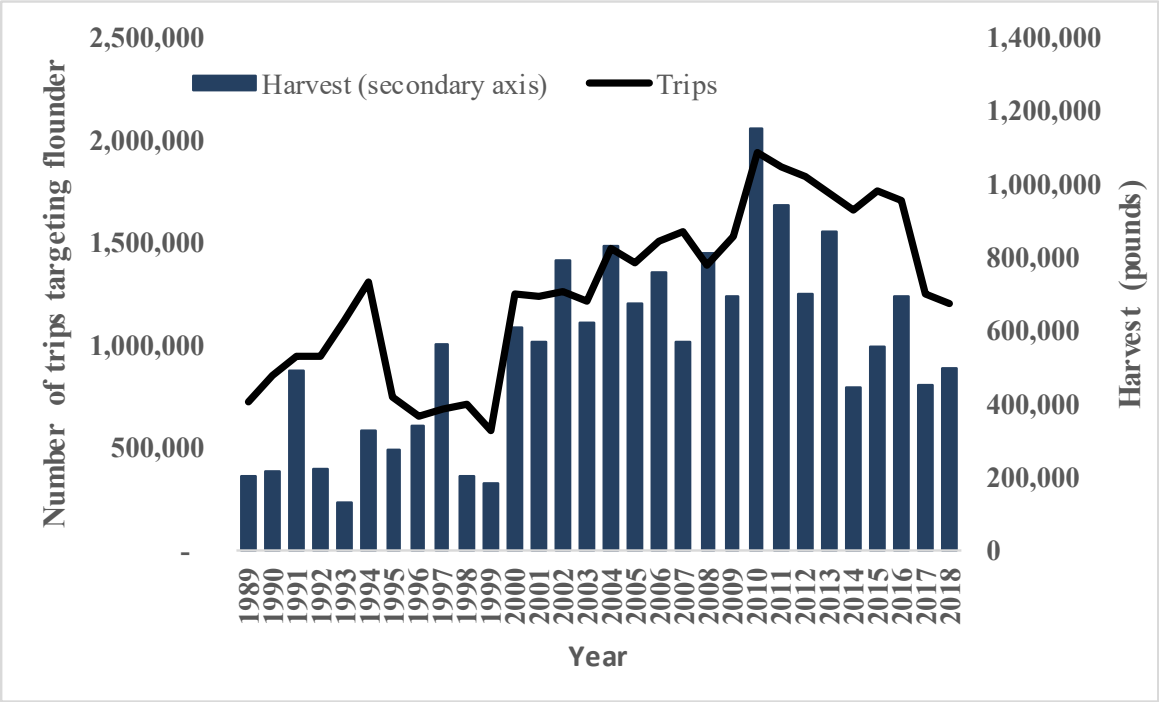

Figure 4. Recreational hook and line harvest (in numbers of fish) and all trips that harvested or released paralichthid flounder species, from MRIP data 1992-2018. Data from prior to 2004 were calibrated to align with MRIP estimates post-2004.

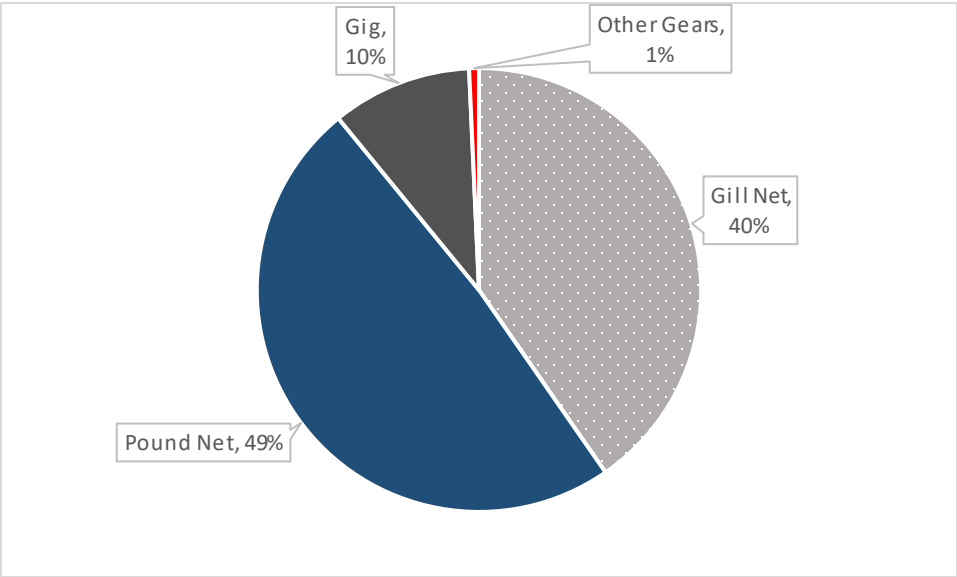

Figure 5. Commercial harvest of southern flounder in 2018 by gear type.

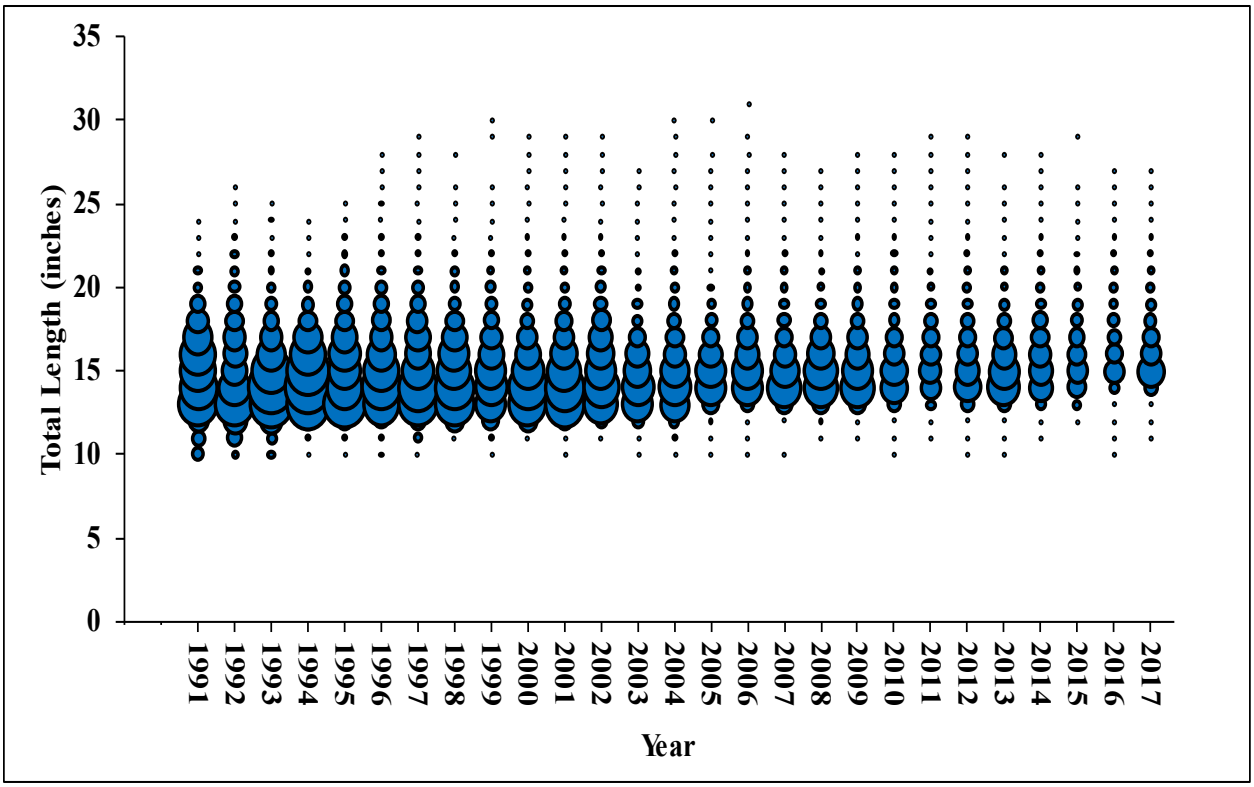

Figure 6. Commercial length frequency (total length, inches) of southern flounder harvested from 1991 through 2017. Bubbles represent fish harvested at length and the size of the bubble is equal to the proportion of fish at that length.

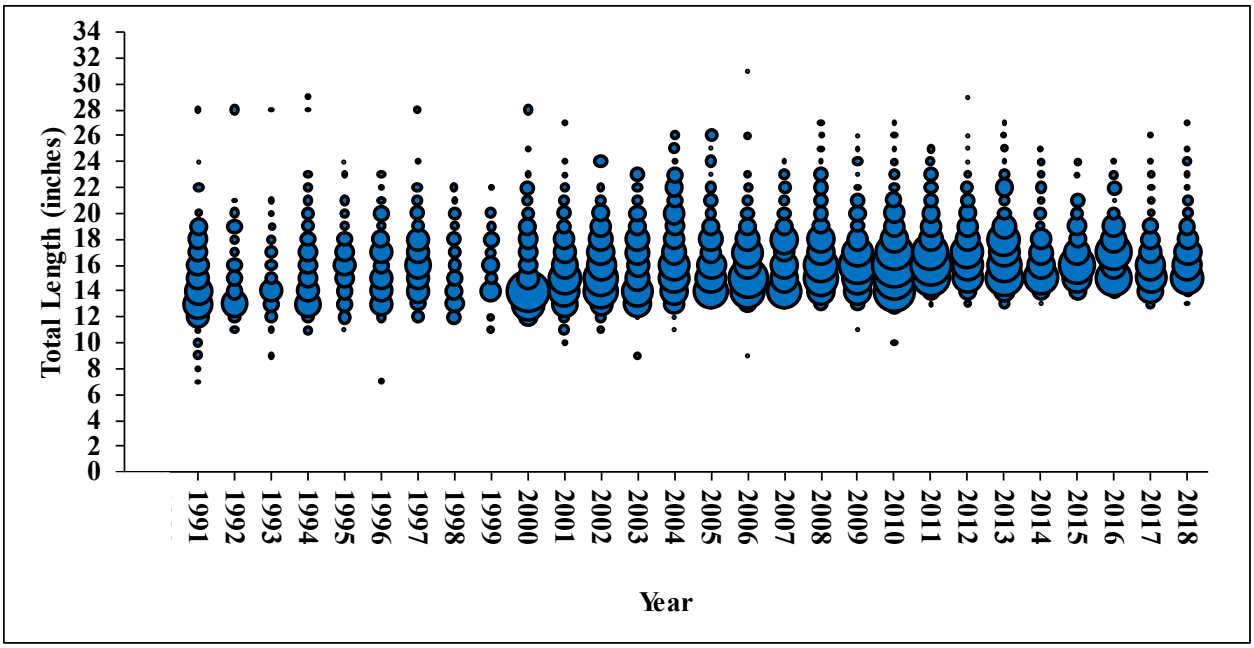

Figure 7. Recreational length frequency (total length, inches) of southern flounder harvested in North Carolina from MRIP, 1991 through 2018. Bubbles represent fish harvested at length and the size of the bubble is equal to the proportion of fish at that length.

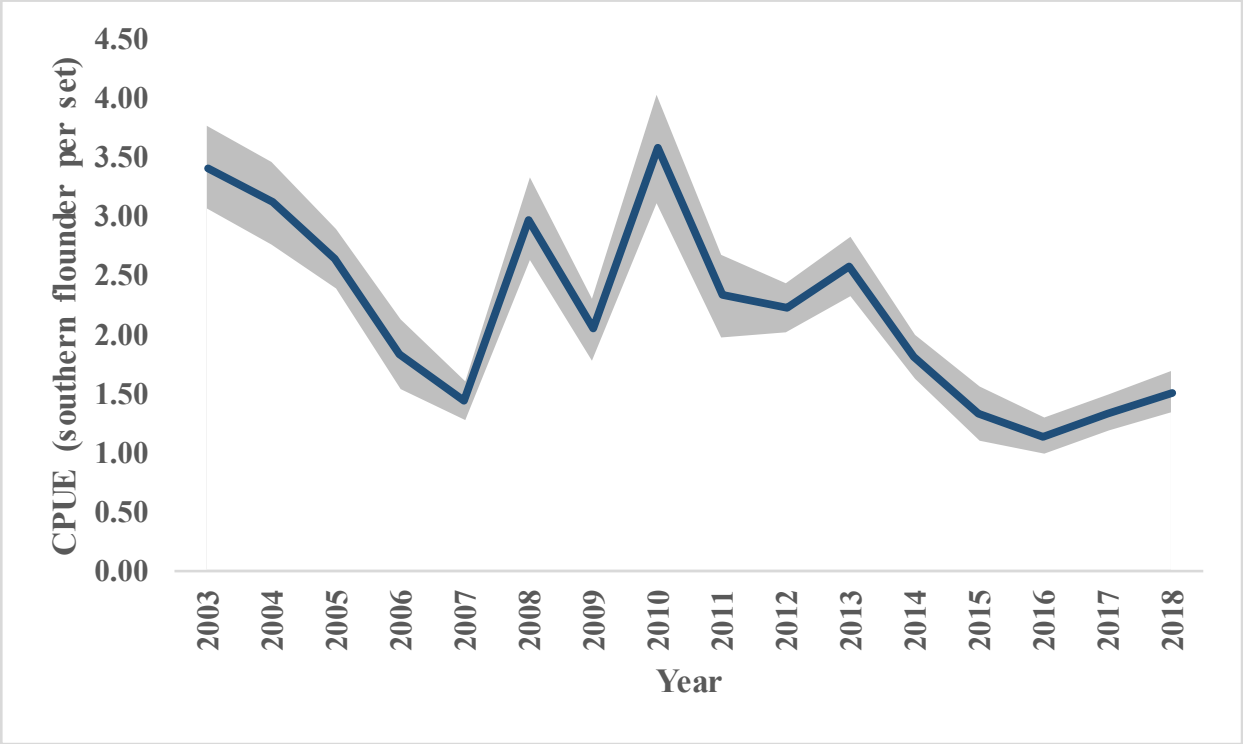

Figure 8. Annual nominal abundance index values for southern flounder (juveniles and adults) caught in the Pamlico Sound Independent Gill Net Survey (P915).

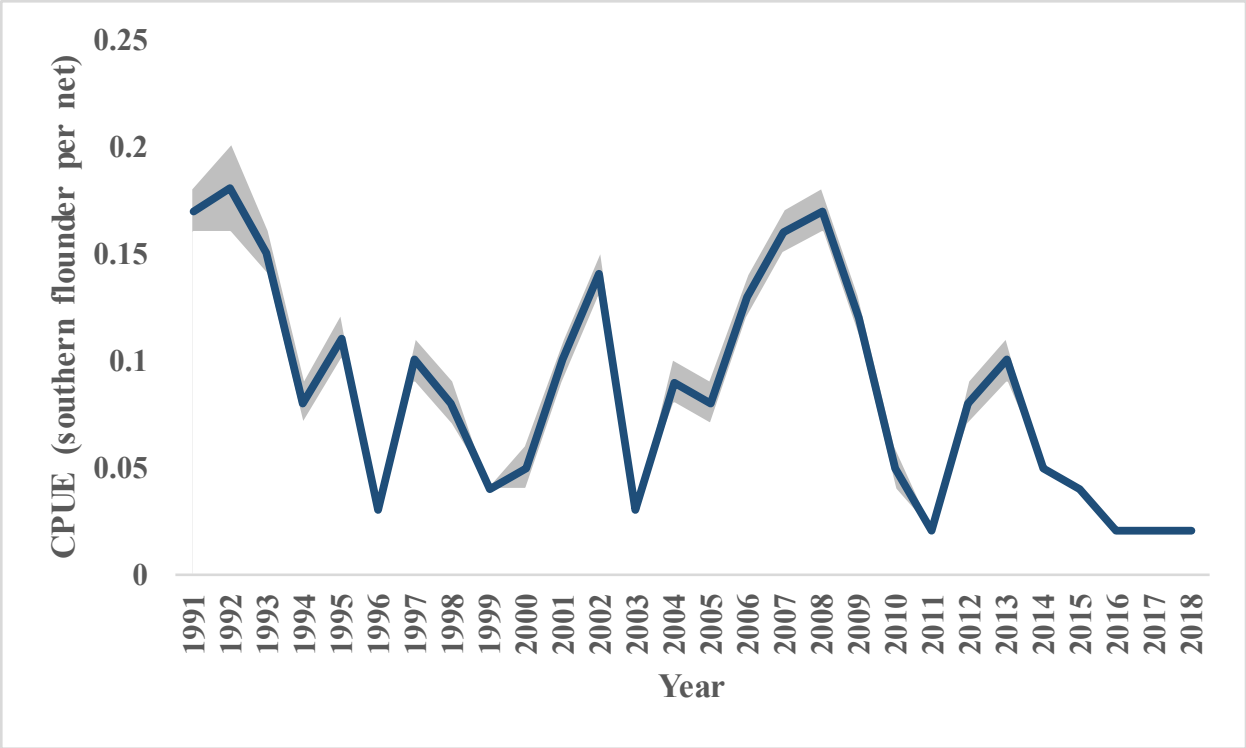

Figure 9. Annual nominal abundance index values for southern flounder (juveniles and adults) caught in the Striped Bass Independent Gill Net Survey (P135).

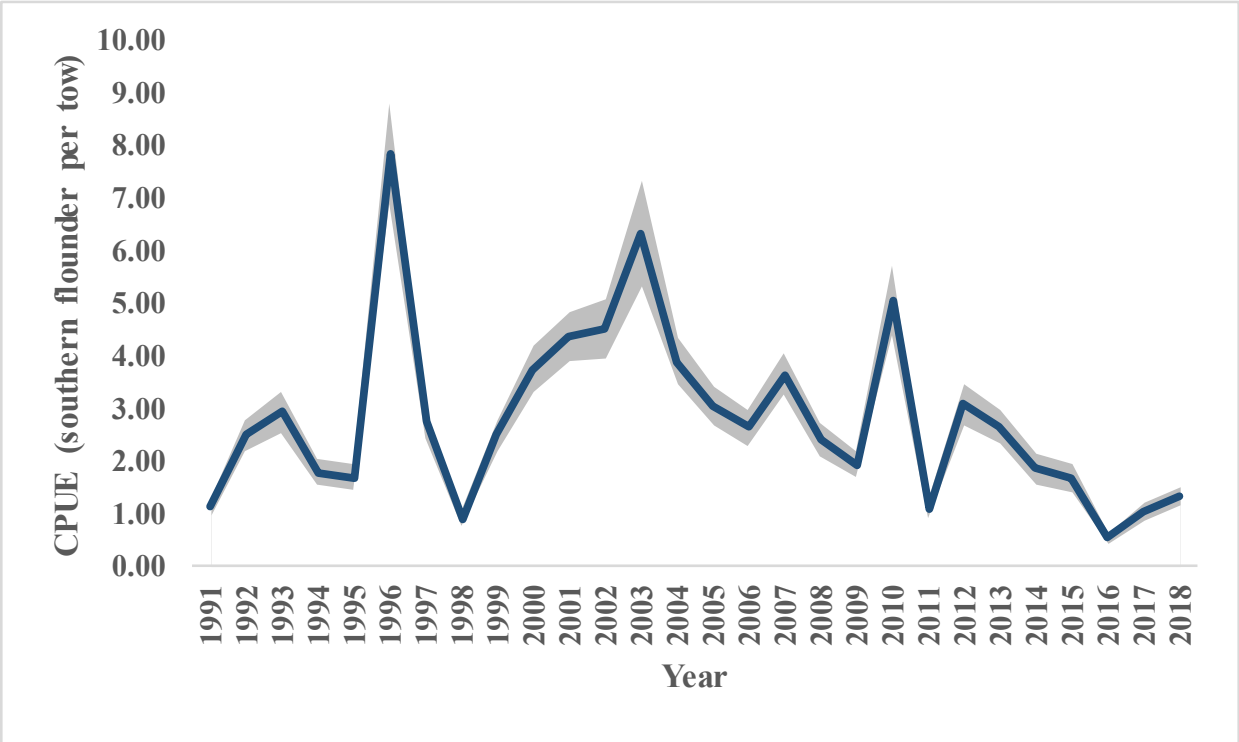

Figure 10. Annual nominal abundance index values for southern flounder (juveniles and adults) caught in the Estuarine Trawl Survey (P120).

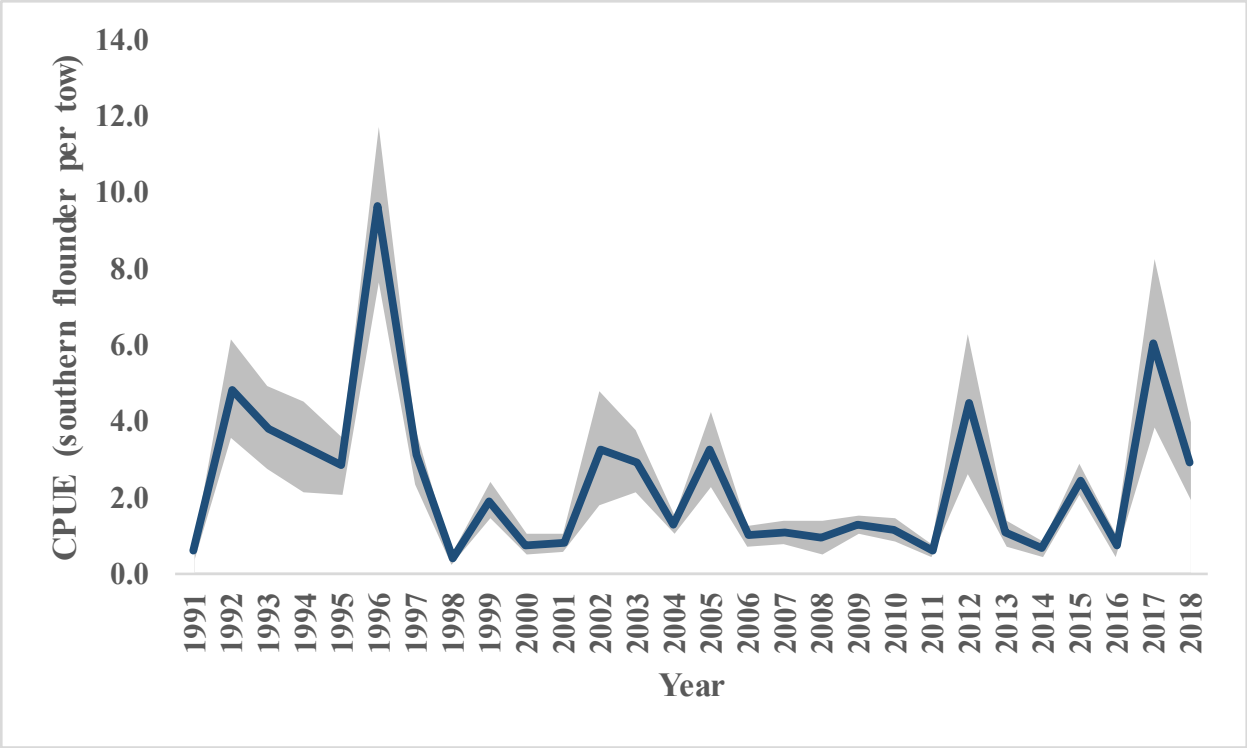

Figure 11. Annual nominal abundance index values for southern flounder (juveniles and adults) caught in the Pamlico Sound Survey (P195).

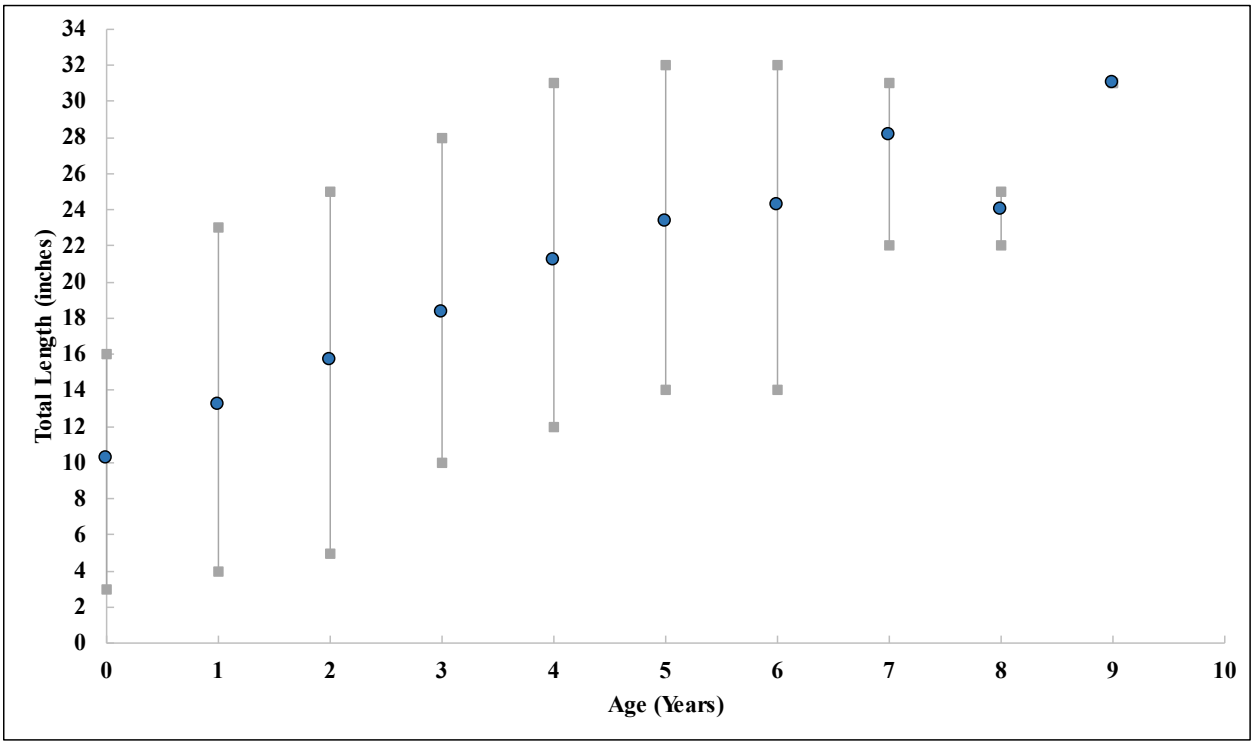

Figure 12. Southern flounder length at age based on all age samples collected from 1991 through 2017. Blue circles represent the mean size at a given age while the grey squares represent the minimum and maximum observed size for each age.