FISHERY MANAGEMENT PLAN UPDATE
WEAKFISH
AUGUST 2020

STATUS OF THE FISHERY MANAGEMENT PLAN

Fishery Management Plan History

Original FMP Adoption:	ASMFC – October 1985
Amendments:	Amendment 1 – March 1992 Amendment 2 – October 1994 Amendment 3 – May 1996 Addendum I – October 2000 Amendment 4 – November 2002 Technical Addendum 1 – March 2003 Addendum I – December 2005 Addendum II – February 2007 Addendum III – May 2007 Addendum IV – November 2009
Revisions:	None
Supplements:	None
Information Updates:	None
Schedule Changes:	None
Next Benchmark Review:	TBD

Weakfish *(Cynoscion regalis)* are managed under Amendment 4 to the Interstate Fishery Management Plan (FMP) for Weakfish (Atlantic States Marine Fisheries Commission (ASMFC) 2002). The ASMFC adopted its first FMP for weakfish in 1985 (ASMFC 1985). Amendment 1 to the FMP (ASMFC 1992) unsuccessfully aimed to improve the status of weakfish. Amendment 2 (ASMFC 1994) resulted in some improvement to the stock, but several signs indicated that further improvement was necessary. Thus, Amendment 3 (ASMFC 1996) was implemented to increase the sustainability of the fishery. Addendum I to Amendment 3 was approved in 2000 in order to extend the existing management program until the Weakfish Management Board could approve Amendment 4.

Weakfish are currently managed under the management program contained in Amendment 4 (ASMFC 2002) and its subsequent addenda. The ASMFC adopted Addendum I to Amendment 4 (ASMFC 2005) to replace the biological sampling program. In response to a significant decline

in stock abundance and increasing total mortality since 1999, the Board approved Addendum II to Amendment 4 (ASMFC 2007a) to reduce the recreational creel limit and commercial bycatch limit, and set landings levels that, when met, will trigger the Board to re-evaluate management measures. Addendum III to Amendment 4 (ASMFC 2007b) altered the bycatch reduction device certification requirements of Amendment 4 for consistency with the South Atlantic Fishery Management Council's (SAFMC) Shrimp FMP.

The findings of the 2009 weakfish stock assessment indicated that weakfish are currently in a severely depleted state with natural mortality (M) rather than fishing mortality (F) believed to be the primary culprit in the decline (ASMFC 2016). In response to the continued decline in the weakfish population, the ASMFC Weakfish Management Board passed Addendum IV to Amendment 4 (2009). This Addendum required all states along the east coast to implement severe harvest restrictions on weakfish.

Harvest restrictions included a one fish daily recreational bag limit and a 100 pound daily commercial trip limit. North Carolina made a request that was approved by the Weakfish Management Board in August of 2010, to implement a 10 percent bycatch allowance for weakfish in lieu of the 100 pound daily trip limit. This request was considered to be conservationally equivalent to the 100 pound daily trip limit. The alternate management action allowed weakfish to be landed provided they make up less than 10 percent of the weight of all finfish landed up to 1,000 pounds per trip or day, whichever is larger. In November of 2012, based on the recommendation of the North Carolina Marine Fisheires Commission (NCMFC), the alternate management was halted and North Carolina reverted back to the 100 pound daily trip limit consistent with Addendum IV. The Weakfish Management Board, as part of Addendum IV, noted that reductions in harvest would not be adequate to rebuild the depleted weakfish stocks until other confounding factors (i.e. natural mortality) become more favorable for weakfish survival. The Board's actions were taken to reduce harvest and poise weakfish for a recovery.

A new benchmark stock assessment for weakfish was completed in 2016 (ASMFC 2016) and approved for management by the Weakfish Management Board at the 2016 Spring Meeting of the ASMFC. Results from the current assessment still indicate that weakfish are depleted and that continued high levels of natural mortality (M) are the cause of the decline. Fishing mortality (F) has decreased substantially since 2010 and overfishing on the stock is not occuring. The Board reviewed the results of the assessment at their May 2016 meeting and decided that no new management action was warranted.

An update to the peer-reviewed 2016 assessment was completed in 2019 (ASMFC 2019) and presented at the 2019 ASMFC Fall Meeting. Results of the assessment update show that the weakfish stock is depleted and has been since 2003. Estimates of recruitment, spawning stock biomass, and total abundance remain low in recent years. Estimates of fishing mortality were moderately high in recent years, although not as high as the time-series highs of the mid- to late-2000's or the earliest years, and natural mortality remained high. The Board reviewed the results of the assessment update at their October 2019 meeting and decided no new management action was warrented. The management program implemented under Addendum IV remains in effect.

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.

To ensure compliance with interstate requirements, North Carolina also manages this species under the North Carolina Fishery Management Plan for Interjurisdictional Fisheries (IJ FMP). The goal of the IJ FMP is to adopt fishery management plans, consistent with N.C. law, approved by the Mid-Atlantic Fishery Management Council, SAFMC, or the ASMFC by reference and implement corresponding fishery regulations in North Carolina to provide compliance or compatibility with approved fishery management plans and amendments, now and in the future. The goal of these plans, established under the Magnuson-Stevens Fishery Conservation and Management Act (federal council plans) and the Atlantic Coastal Fisheries Cooperative Management Act (ASMFC plans) are similar to the goals of the Fisheries Reform Act of 1997 to "ensure long-term viability" of these fisheries (NCDMF 2015).

Management Unit

Weakfish are managed under this plan as a single stock throughout their coastal range. All Atlantic coast states from Massachusetts through Florida and the Potomac River Fisheries Commission have a declared interest in weakfish. Responsibility for the FMP is assigned to the ASMFC Weakfish Management Board, Plan Review Team, Technical Committee, Stock Assessment Sub-Committee, and Advisory Panel..

Goal and Objectives

The goal of Amendment 4 of the ASMFC FMP is to utilize interstate management so that Atlantic coastal weakfish recover to healthy levels that will maintain commercial and recreational harvest consistent with a self-sustaining spawning stock and to provide for restoration and maintenance of essential habitat (ASMFC 2002). The management objectives are to:

1. Establish and maintain an overfishing definition that includes target and threshold fishing mortality rates and a threshold spawning stock biomass to prevent overfishing and maintain a sustainable weakfish population;
2. Restore the weakfish age and size structure to that necessary for the restoration of the fishery;
3. Return weakfish to their previous geographic range;
4. Achieve compatible and equitable management measures among jurisdictions throughout the fishery management unit, including states' waters and the federal EEZ;

5. Promote cooperative interstate research, monitoring and law enforcement necessary to support management of weakfish;
6. Promote identification and conservation of habitat essential for the long term stability in the population of weakfish; and
7. Establish standards and procedures for both the implementation of Amendment 4 and for determination of states' compliance with provisions of the management plan.

STATUS OF THE STOCK

Life History

Weakfish, also called gray trout, are known to inhabit waters of the Atlantic from southern Florida to Nova Scotia, Canada but are most prevalent from North Carolina to New York (Wilk 1979). They are members of the drum family and are closely related to spotted seatrout. Compared to spotted seatrout, weakfish occur in higher salinity areas of the estuary and are seasonally encountered around coastal inlets and in offshore waters. Weakfish migrate into more inshore environments and north along the U.S. Atlantic Coast in the spring and summer as water temperatures rise (Bigelow and Schroeder 1953; Wilk 1979). Spawning occurs during this time in higher salinity environments around the coastal inlets (Luczkovich et al. 1999; Luczkovich et al. 2008). Males drum to attract females and spawning activity usually occurs around dusk. Juvenile weakfish use the estuarine waters as a nursery area until the fall when water temperatures drop and they move into the offshore environment (Wilk 1979). Peak spawning in North Carolina is typically around April or May but females will spawn multiple times (batch spawners) throughout the spring and summer months (Lowerre-Barbieri et al. 1996; Merriner 1976). Most weakfish are sexually mature by age 1 and at 11 to 12 inches in length (Lowerre-Barbieri et al. 1996; Nye et al. 2008). Juvenile weakfish are opportunistic feeders, feeding on invertebrates and microscopic animals early in their life, then switching to mostly piscivorous feeding on small to moderately sized fish, depending on their size (Merriner 1975).

Stock Status

According to the 2019 stock assessment update, spawning stock biomass (SSB) in 2017 was 4.24 million pounds, well below the SSB threshold of 30% (13.6 million pounds), indicating the stock is depleted (Figure 1; ASMFC 2019). The weakfish Technical Committee recommended total mortality (Z) benchmarks, which includes fishing and natural mortality. Total mortality in 2017 was 1.45, which was above both the 20% target (1.03) and the 30% threshold (1.43), indicating total mortality was too high (Figure 2).

Stock Assessment

The assessment completed in 2016 and updated in 2019 employed a spatially structured forward projecting statistical catch at age model with time-varying natural mortality, with a terminal year of 2017. This model accounts for varying population spatial distribution and changing natural mortality through time. Results of the assessment show that the weakfish stock is depleted and has been for the past 15 years. Under conditions of time-varying natural mortality, there is no long-term stable equilibrium population size, so an SSB target is not informative for

management. After review of the assessment results, the Weakfish Technical Committee (TC) recommended an SSB threshold of 13.6 million pounds that is equivalent to 30 percent of the projected SSB under average natural mortality and no fishing (SSB30%). When SSB is below that threshold, the stock is considered depleted. Despite SSB showing a slight increasing trend in recent years, SSB was 4.24 million pounds in 2017 (Figure 1), which is well below the threshold. The model indicated natural mortality has been increasing since the mid-1990s, from approximately 0.17 at the beginning of the time-series to an average of 0.92 from 2007-2017 (Figure 2). The weakfish population has been experiencing very high levels of total mortality which has prevented the stock from recovering. Fishing mortality has increased in recent years, but was below the threshold in 2017.

STATUS OF THE FISHERY

Current Regulations

The NCDMF allows for the recreational harvest of weakfish year-round with a 12-inch total length minimum size and a one fish per day bag limit. The commercial harvest of weakfish is limited to a 100 pounds daily limit and 12-inches total length with the following exceptions: from April 1 through November 15, weakfish 10 inches total length or more may lawfully be taken in North Carolina internal waters by use of long haul seines or pound nets only and commercial flounder trawl and flynet operations are allowed to land a tolerance of no more than 100 undersized (less than 12 inch total length) weakfish per day or trip, whichever is longer and it is unlawful to sell undersized weakfish.

Commercial Landings

Commercial landings of weakfish peaked in 1988 at 15,091,878 pounds. Landings have since steadily dropped, and in 2009 Addendum IV reduced commercial harvest to 100 pounds per trip achieving an estimated reduction of 61 percent from the 2005-2008 harvest levels. Recent years have shown little increase due to low abundance and commercial harvest restrictions. Landings increased in 2019 to 115,638 pounds, the highest annual landings since 2013, but still well below harvest levels prior to 2007 (Table 1; Figure 3).

Recreational Landings

Recreational landings of weakfish are estimated from the Marine Recreational Information Program (MRIP). Recreational estimates across all years have been updated and are now based on the Marine Recreational Information Program (MRIP) new Fishing Effort Survey-based calibrated estimates. For more information on MRIP see https://www.fisheries.noaa.gov/topic/recreational-fishing-data.

Estimated recreational harvest has been variable since 1982 with a peak in 1987 at 3,442,746 pounds. Harvest since 2009 have decreased considerably due to the implementation of a one-fish bag limit in November 2009 as part of the harvest reductions from Addendum IV, which was estimated to reduce recreational harvest by 53 percent for North Carolina. Average harvest since 2010 is 77,020 pounds and has varied from a high of 157,269 pounds in 2015 to a low of 29,924 in 2018. Recreational harvest increased in 2019 to 43,252 pounds (or 39,061 fish), the second

lowest recreational landings in the time series (Table 1; Figure 3). Conversely, the number of weakfish released decreased in 2019, and has been decreasing since a peak in 2015 (Table 1).

The North Carolina Saltwater Fishing Tournament recognizes anglers for landing and/or releasing fish of exceptional size or rarity by issuing citations that document the capture for the angler. A total of eight citations (greater than 5 pounds landed) and 3 release citations (greater than 24 inches total length) were issued for weakfish in 2019 (Table 2; Figure 4).

MONITORING PROGRAM DATA

Fishery-Dependent Monitoring

Commercial fish houses are sampled monthly to provide length, weight, and age data to describe the commercial fisheries. The number of weakfish samples has been declining since 2000, following a similar trend to the commercial landings (Tables 1 and 3). Samples are collected from ocean fisheries as well as estuarine fisheries. The ocean sink net fishery and estuarine gill net fishery dominate the catches of weakfish accounting for 97 percent of the overall commercial catch in 2019.

Average and minimum lengths of fish harvested in the commercial fishery have remained relatively consistent throughout the time series (Table 3; Figure 6). Since 2012 the average length has been approximately 14 inches. However, since 2010, there has been a noticeable decline in maximum lengths, from an average of 32 inches (1982-2010) to an average of 26 inches (2011-2019).

Recreational lengths and weights are collected as part of the MRIP by recreational port agents. While the mean lengths of weakfish sampled from the recreational fishery are similar to those sampled from the commercial fishery, maximum observed lengths are smaller in the recreational fishery by approximately 6 inches (Table 3; Figure 7).

The commercial and recreational fisheries saw the same modal length of harvested fish (13 inches; Figure 5). In addition, in 2019, 93% of the commercial fishery harvest and 92% of the recreational fishery harvest was between 12 and 16 inches (Figure 5).

Fishery-Independent Monitoring

Fishery independent data are collected through both the Program 195 Pamlico Sound Survey and Program 915 Independent Gill Net Survey. The Program 195 survey provides an age-0 relative abundance index calculated from the September stations and an age-1+ index calculated from the June stations. Although the ASMFC stock assessment only uses the age-0 index, both are provided here to assess overall trends in both groups. The Program 195 indices show a variable trend over the years (Figures 8 and 9). The age-0 (24 fish per tow) and age-1+ (18.9 fish per tow) relative abundance indices from Program 195 in 2019 both increased from the previous year but remained below the time series averages (42.9 fish per tow and 39.0 fish per tow, respectively).

Program 915 collects size, age, and abundance data for commercially and recreationally important species in the Pamlico Sound, Pamlico, Pungo, and Neuse rivers, and the Cape Fear and New rivers using multi-mesh gill nets. The relative abundance index from the Pamlico Sound portion is used in the ASMFC stock assessment and had been showing a declining trend since the beginning of the time series, but it has remained relatively stable since 2015 (Figure 10). The data from the Pamlico, Pungo, and Neuse rivers and the Cape Fear and New rivers are not used in the assessment as these regions have minimal catches of weakfish.

Weakfish age samples (otoliths) are collected through both fishery dependent and independent sampling. Sampling for weakfish has been ongoing since 1995. Age samples are collected from all possible gears and during all months. Target sample numbers are set monthly and the number of samples collected yearly has ranged from 170 to 1,319, for a total of 14,080 otoliths aged to date. Ages have ranged from 0 to 15 years with an average modal age of two years (Table 4; Figure 11). Based on average age-at-lengths, weakfish growth does not plateau until age-10 (Figure 11). The maximum age of the weakfish sampled in 2019 (age 6) was the highest since 2009 (Table 4).

MANAGEMENT STRATEGY

Weakfish are currently managed under Addendum IV to Amendment 4 of the Weakfish FMP and requires all the Atlantic States to implement a one fish per person bag limit, a 100 pound commercial bycatch trip limit, and a 100 fish undersized trip limit allowance for the trawl fishery. Based off of results from the 2016 assessment, the Weakfish TC recommended a 30 percent SSB threshold be used as a reference point to determine if the stock is depleted. The TC also noted there is no long-term stable equilibrium population of weakfish due to time varying natural mortality, so they recommended managing the stock based using Z-based (total mortality) targets and thresholds of 20 percent and 30 percent. In addition, total mortality (Z) benchmarks are used to prevent an increase in fishing pressure when F is low but M is high. Although the total mortality of the stock in the terminal year of the assessment update (2017) was above both the Z target and threshold, the TC recommended and the board approved no new management measures at this time given how highly restrictive the weakfish management program already is.

RESEARCH NEEDS

Biological

High

- Collect catch and effort data including size and age composition of the catch, determine stock mortality throughout the range, and define gear characteristics. In particular, increase length-frequency sampling in fisheries from Maryland north.
- Derive estimates of discard mortality rates and the magnitude of discards for all commercial gear types from both directed and non-directed fisheries. In particular, quantify trawl bycatch, refine estimates of mortality for below minimum size fish, and focus on factors such as distance from shore and geographical differences.
- Conduct an age validation study.

- Identify stocks and determine coastal movements and the extent of stock mixing, including characterization of stocks in over-wintering grounds (e.g., tagging).
- Conduct spatial and temporal analysis of the fishery independent survey data. The analysis should assess the impact of the variability of the surveys in regards to gear, time of year, and geographic coverage on their (survey) use as stock indicators.
- Analyze the spawner recruit relationship and examine the relationships between parental stock size and environmental factors on year-class strength.

Medium
- Biological studies should be conducted to better understand migratory aspects and how this relates to observed trends in weight at age. Test for individual growth difference and the geospatial pattern, as well as the geospatial pattern of the catch rate surveys.
- Define reproductive biology of weakfish, including size at sexual maturity, maturity schedules, fecundity, and spawning periodicity. Continue research on female spawning patterns: what is the seasonal and geographical extent of "batch" spawning; do females exhibit spawning site fidelity?
- Continue studies on mesh-size selectivity, particularly for trawl fisheries.
- Continue studies on recreational hook-and-release mortality rates, including factors such as depth, warmer water temperatures, and fish size in the analysis. Studies are needed in deep and warm water conditions. Further consideration of release mortality in both the recreational and commercial fisheries is needed, and methods investigated to improve survival among released fish.

Low
- Develop a coastwide tagging database.

Social and Economic
- Assemble socio-demographic-economic data as it becomes available from ACCSP.
- Detailed information on production activities (e.g., fishing effort and labor used by gear, vessel characteristics, areas fished, etc.) and costs and earnings for the harvesting and processing sectors.
- Information on retail sales and demand for weakfish in order to estimate the demand and economic benefits of at-home and away-from home consumption of weakfish.
- Development of bio-economic models that link the underlying population dynamics to the economic aspects of the commercial and recreational fisheries.
- Distribution of weakfish to the various markets and across states.
- Information on the margins of various stages of processing and marketing also need to be obtained; this information is necessary to construct mathematical models that can be used to estimate the economic impacts of management and regulation.
- A directed data collection program for weakfish including the same variables presently collected by National Oceanic and Atmospheric Administration Fisheries in support of MRFSS and by the economic add-on. Data collected includes information on travel distance, mode of angling, expenditures, area fished, catch on previous trips, and other information.

- Development of commercial decision-making or behavioral models to explain how fishers might respond to various regulations.
- Estimation and assessment of consumer (net economic benefits to consumers) and producer (net economic benefits or profits to producers) surplus; the sum of consumer and producer surplus is a measure of the net economic value to society of a good or service.
- Development of input/output models for all states having commercial weakfish activity, or alternatively, full-blown economic impact models, which might consist of input/output models or General Equilibrium models.
- Determination of the economic value derived from recreational angling including the economic value of a catch and release fishery

Habitat

- Conduct hydrophonic studies to delineate weakfish spawning habitat locations and environmental preferences (temperature, depth, substrate, etc.) and enable quantification of spawning habitat.
- Compile existing data on larval and juvenile distribution from existing databases in order to obtain preliminary indications of spawning and nursery habitat location and extent.
- Document the impact of power plants and other water intakes on larval, post larval and juvenile weakfish mortality in spawning and nursery areas, and calculate the resulting impacts on adult stock size.
- Define restrictions necessary for implementation of projects in spawning and over-wintering areas and develop policies on limiting development projects seasonally or spatially.

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TABLES

Table 1. Recreational harvest (number and weight of fish landed in pounds) and releases (number of fish) and commercial harvest (weight in pounds) of weakfish from North Carolina, 1982-2019.

	Recreational				
	Numbers		Weight (lb)		
Year	Landed	# Released	Landed	Commercial Weight (lb)	Total Weight (lb)
1982	255,080	61,048	348,645	12,052,232	12,400,877
1983	596,354	16,387	749,910	10,233,734	10,983,644
1984	555,640	35,101	252,873	12,990,726	13,243,599
1985	1,010,772	2,638	796,974	9,797,734	10,594,708
1986	2,049,746	694,759	1,455,912	14,309,372	15,765,284
1987	2,403,361	250,581	3,442,746	11,508,389	14,951,135
1988	650,224	175,284	175,178	15,091,878	15,267,056
1989	456,191	65,500	331,840	10,115,747	10,447,587
1990	149,508	30,295	104,761	5,802,159	5,906,920
1991	358,273	32,083	286,349	5,308,574	5,594,923
1992	72,064	69,585	53,214	4,862,551	4,915,765

	Recreational				
	Numbers		Weight (lb)		
Year	Landed	# Released	Landed	Commercial Weight (lb)	Total Weight (lb)
1993	293,966	157,478	230,010	4,017,265	4,247,275
1994	336,188	477,521	276,435	3,489,929	3,766,364
1995	103,190	225,976	118,177	4,113,260	4,231,437
1996	138,577	361,153	121,291	3,977,633	4,098,924
1997	333,852	506,509	313,767	3,561,060	3,874,827
1998	450,645	669,125	487,884	3,354,008	3,841,892
1999	313,427	687,884	420,706	2,617,580	3,038,286
2000	147,397	852,262	179,599	1,869,042	2,048,641
2001	317,974	2,831,044	325,447	1,960,324	2,285,771
2002	214,040	917,803	215,402	1,828,150	2,043,552
2003	291,168	422,294	309,412	848,822	1,158,234
2004	395,268	614,762	428,627	685,463	1,114,090
2005	297,605	702,685	281,710	421,984	703,694
2006	343,092	1,047,135	302,775	363,086	665,861
2007	191,192	600,987	202,583	175,593	378,176
2008	203,779	470,805	209,470	162,516	371,986
2009	204,814	626,742	245,358	163,148	408,506
2010	110,770	914,004	103,903	106,328	210,231
2011	48,727	380,366	62,543	65,998	128,541
2012	96,947	396,620	95,952	91,384	187,336
2013	63,090	257,367	66,720	120,191	186,911
2014	71,912	1,067,344	70,988	105,247	176,235
2015	143,543	1,652,582	157,269	80,242	237,511
2016	77,341	1,097,615	83,702	79,667	163,369
2017	51,795	351,613	55,944	85,442	141,386
2018	30,935	300,195	29,924	35,133	65,057
2019	39,061	269,146	43,252	115,638	158,890
Average	204,720	614,725	353,612	1,954,296	2,154,780

Table 2. Total number of awarded citations for weakfish (>24-inches total length for release or > 5 pounds landed) from the North Carolina Saltwater Fishing Tournament from 1991-2019.

Year	Total Citations	Release Citations[+]	% Release
1991	1		0
1992	2		0
1993	10		0
1994	2		0
1995	3		0
1996	2		0
1997	0		0
1998	6		0
1999	6		0
2000	8		0
2001	8		0
2002	0		0
2003	124		0
2004	9		0
2005	3		0
2006	1		0
2007	2		0
2008	4	0	0
2009	3	0	0
2010	1	0	0
2011	1	0	0
2012	2	1	50
2013	4	0	0
2014	3	0	0
2015	2	0	0
2016	7	0	0
2017	16	16	100
2018	3	0	0
2019	8	3	38

[+] Weakfish release citations (fish released greater than 24 inches total length) began in 2008

Table 3. Mean, minimum, and maximum lengths (fork length, inches) of weakfish sampled from the commercial and recreational fisheries of North Carolina from 1982-2019. Commercial lengths include both marketable and scrap finfish.

	Commercial				Recreational			
Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured	Mean Length	Minimum Length	Maximum Length	Total Number Measured
1982	13.8	4.4	34.1	4,485	13.9	7.8	22.8	55
1983	13.8	4.6	33.7	10,357	13.9	7.7	25.6	29
1984	14.2	5.1	36.6	14,952	10.9	4.7	18.9	90
1985	12.9	4.7	34.4	15,310	12.0	7.7	22.4	34
1986	13.9	5.4	34.9	17,446	13.0	8.7	20.1	164
1987	12.9	4.4	34.2	22,943	15.1	7.9	22.4	253
1988	13.8	5.3	33.7	18,116	12.7	8.3	20.5	208
1989	14.8	4.8	35.2	14,853	12.0	7.5	23.2	182
1990	12.2	4.1	35.4	18,613	12.2	7.1	21.7	181
1991	11.1	4.2	26.1	24,772	12.0	7.3	18.6	136
1992	12.1	5.2	29.8	21,050	12.3	7.6	17.2	64
1993	11.9	4.0	29.2	23,679	12.6	8.6	16.0	196
1994	13.2	4.6	28.0	15,011	13.2	6.2	20.8	573
1995	12.7	4.4	29.5	18,526	15.2	10.0	20.2	231
1996	13.1	4.6	28.1	18,906	14.0	9.9	19.2	336
1997	13.1	4.1	29.7	20,583	13.7	8.3	20.7	602
1998	13.5	6.5	27.4	13,963	14.3	9.9	27.0	518
1999	13.2	5.1	29.1	16,490	15.4	10.6	26.0	258
2000	13.2	4.1	29.8	19,382	14.8	9.8	22.4	122
2001	14.0	6.5	31.5	15,182	14.1	10.6	19.9	180
2002	13.7	6.1	31.5	13,531	13.9	9.4	19.1	106
2003	12.7	4.2	33.3	9,721	14.1	8.6	27.5	131
2004	13.2	5.8	33.5	10,500	14.4	11.1	25.5	164
2005	13.2	5.6	34.4	9,893	14.0	11.7	19.8	104
2006	12.7	5.6	32.5	11,649	13.6	9.8	20.1	240
2007	12.3	4.8	26.1	6,817	14.2	10.5	20.7	76
2008	12.3	5.0	26.3	3,851	13.8	11.7	20.4	145
2009	12.8	6.3	33.7	3,318	14.8	9.7	21.9	132
2010	12.3	5.1	34.6	2,568	13.6	9.3	17.3	96
2011	12.7	7.8	25.1	2,044	14.6	11.6	30.7	41
2012	13.5	5.0	23.3	2,754	13.8	10.2	20.8	81
2013	14.0	8.0	28.3	3,466	14.2	7.6	22.8	74
2014	14.0	5.0	24.4	3,348	13.8	10.9	20.3	72
2015	14.0	5.4	27.7	2,212	14.0	12.2	19.0	34
2016	14.1	8.7	23.6	2,743	14.0	10.3	18.0	76
2017	14.3	8.5	28.2	1,240	14.2	8.7	17.0	51

	Commercial				Recreational			
Year	Mean Length	Minimum Length	Maximum Length	Total Number Measured	Mean Length	Minimum Length	Maximum Length	Total Number Measured
2018	13.7	7.0	26.9	770	13.4	8.6	18.5	34
2019	14.2	8.9	26.3	1,787	14.5	9.8	18.1	62

Table 4. Modal age, minimum age, maximum age, and number aged for weakfish collected through NCDMF sampling programs from 1995 through 2019.

Year	Modal Age	Minimum Age	Maximum Age	Total Number Aged
1995	1	0	5	494
1996	4	0	6	1,319
1997	3	0	7	1,027
1998	3	0	7	690
1999	3	0	8	648
2000	1	0	9	616
2001	2	0	10	630
2002	3	0	10	512
2003	4	0	8	491
2004	2	0	11	589
2005	2	0	12	561
2006	3	0	7	737
2007	2	0	6	560
2008	1	0	5	480
2009	1	0	15	263
2010	2	0	5	507
2011	2	0	4	376
2012	3	0	4	496
2013	2	0	5	515
2014	1	0	4	508
2015	3	0	4	425
2016	1	0	5	561
2017	1	0	5	353
2018	2	0	4	170
2019	2	0	6	552

FIGURES

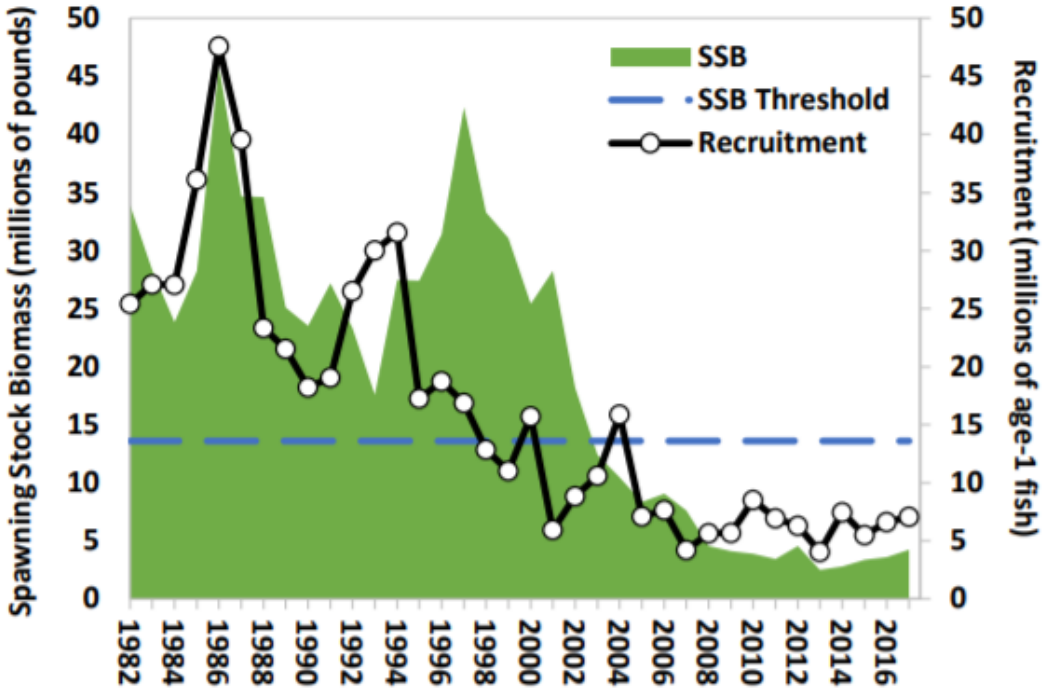

Figure 1. Spawning stock biomass (SSB) and recruitment of age-1 weakfish estimated along the U.S. Atlantic coast from 1982 to 2017 (ASMFC 2019). Dashed line represents the 30% spawning stock biomass (SSB) threshold of 13.6 million pounds.

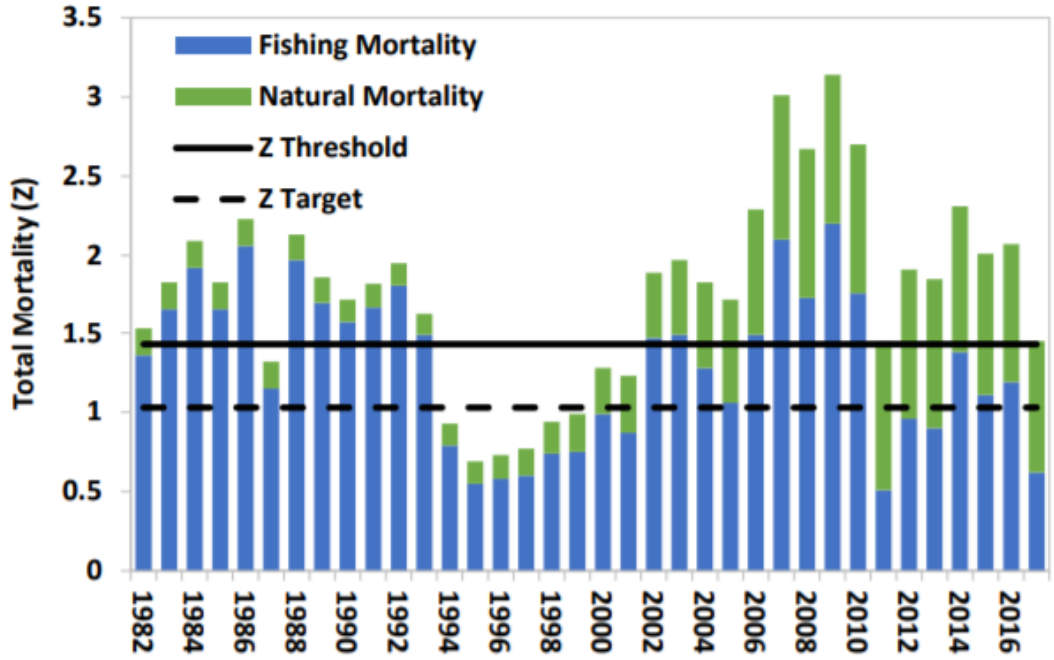

Figure 2. Natural mortality (M) and fishing mortality (F) estimated for all weakfish along the U.S. Atlantic east coast, 1982 to 2017 (ASMFC 2019). Solid and dashed lines represent total mortality targets (Z30% = 1.03) and thresholds (Z20% = 1.43) used to determine if the stock is being overfished.

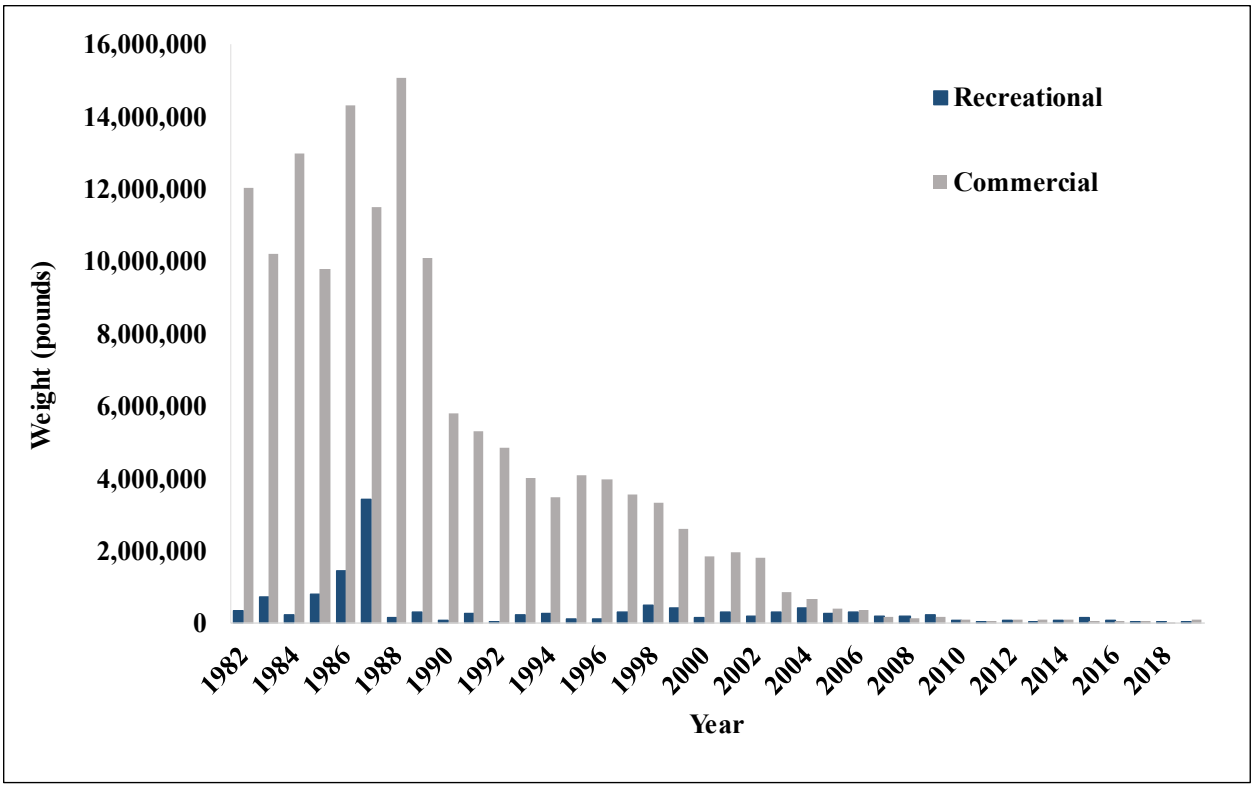

Figure 3. Annual commercial and recreational landings in pounds for weakfish in North Carolina from 1982 to 2019.

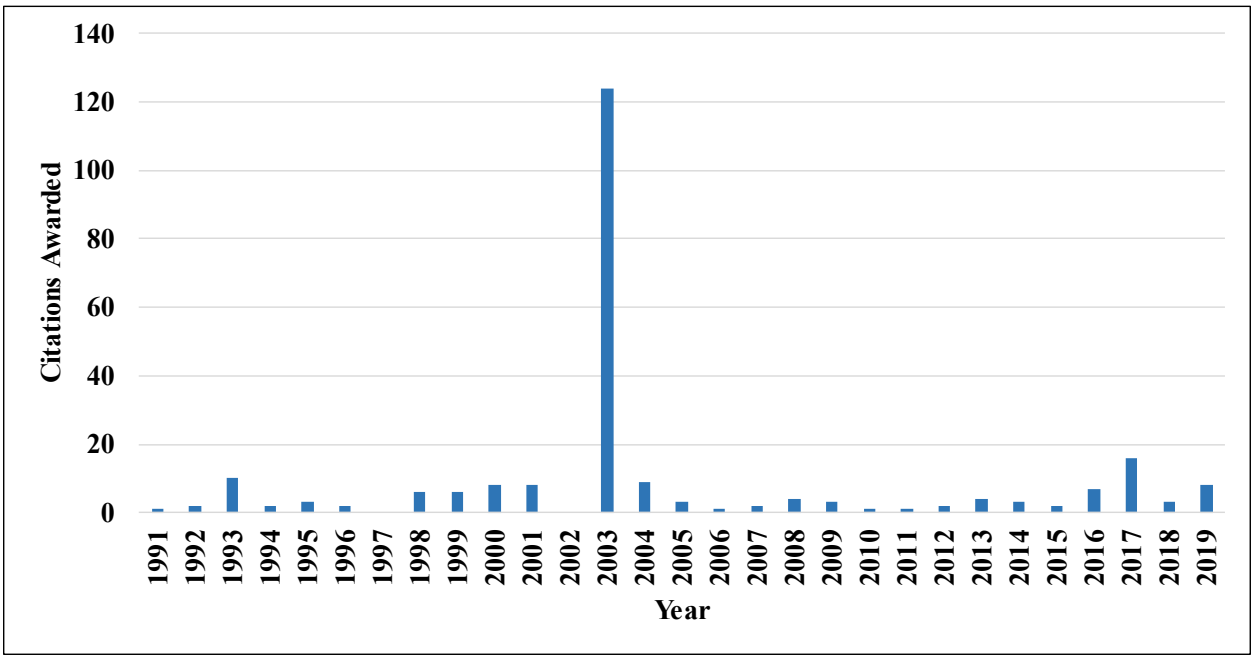

Figure 4. North Carolina Saltwater Fishing Tournament citations awarded for weakfish from 1991 to 2019. Citations are awarded for weakfish greater than 24 inches total length released or greater than 5 pounds landed.

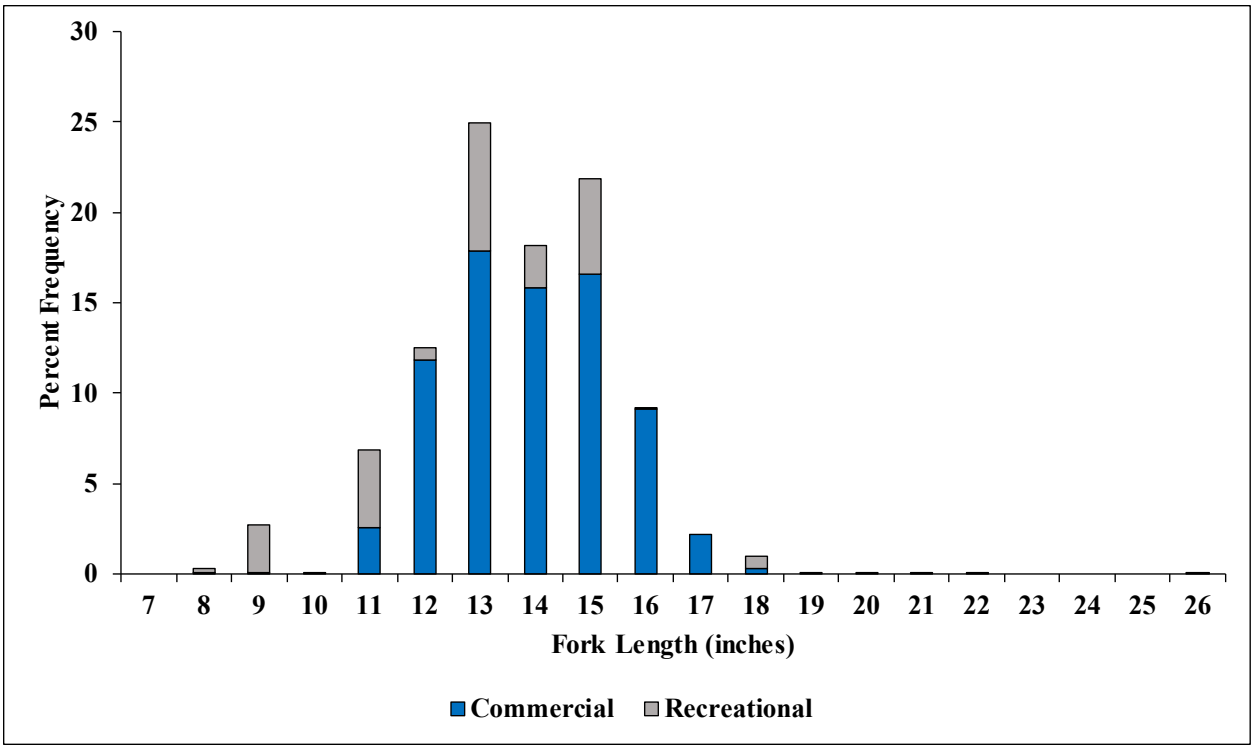

Figure 5. Commercial and recreational length frequency distribution from weakfish harvested in 2019.

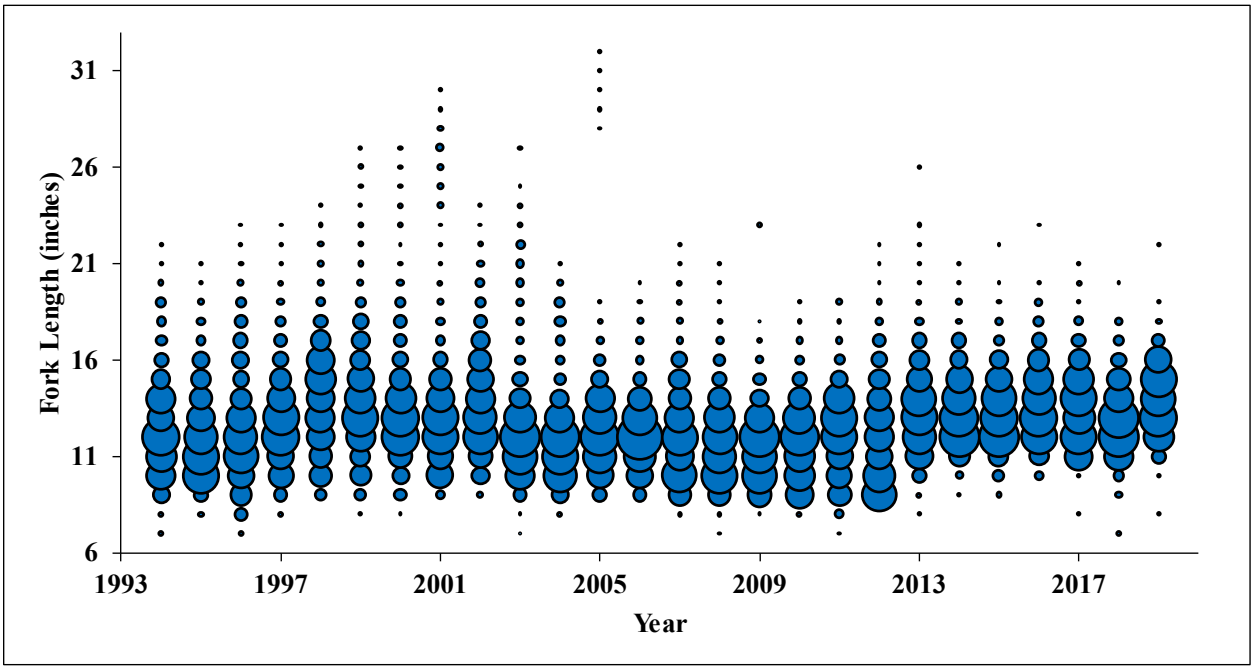

Figure 6. Commercial length frequency (fork length, inches) of weakfish harvested from 1994-2019. Bubbles represent fish harvested at length and the size of the bubble is equal to the proportion of fish at that length.

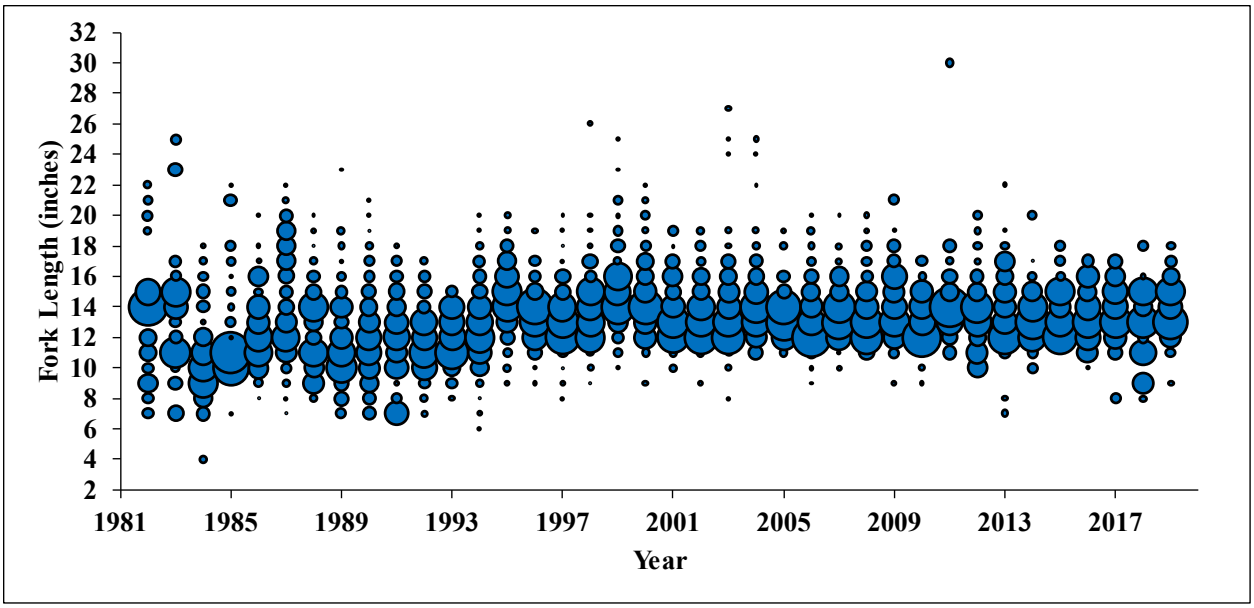

Figure 7. Recreational length frequency (fork length, inches) of weakfish harvested from 1982-2019. Bubbles represent fish harvested at length and the size of the bubble is equal to the proportion of fish at that length.

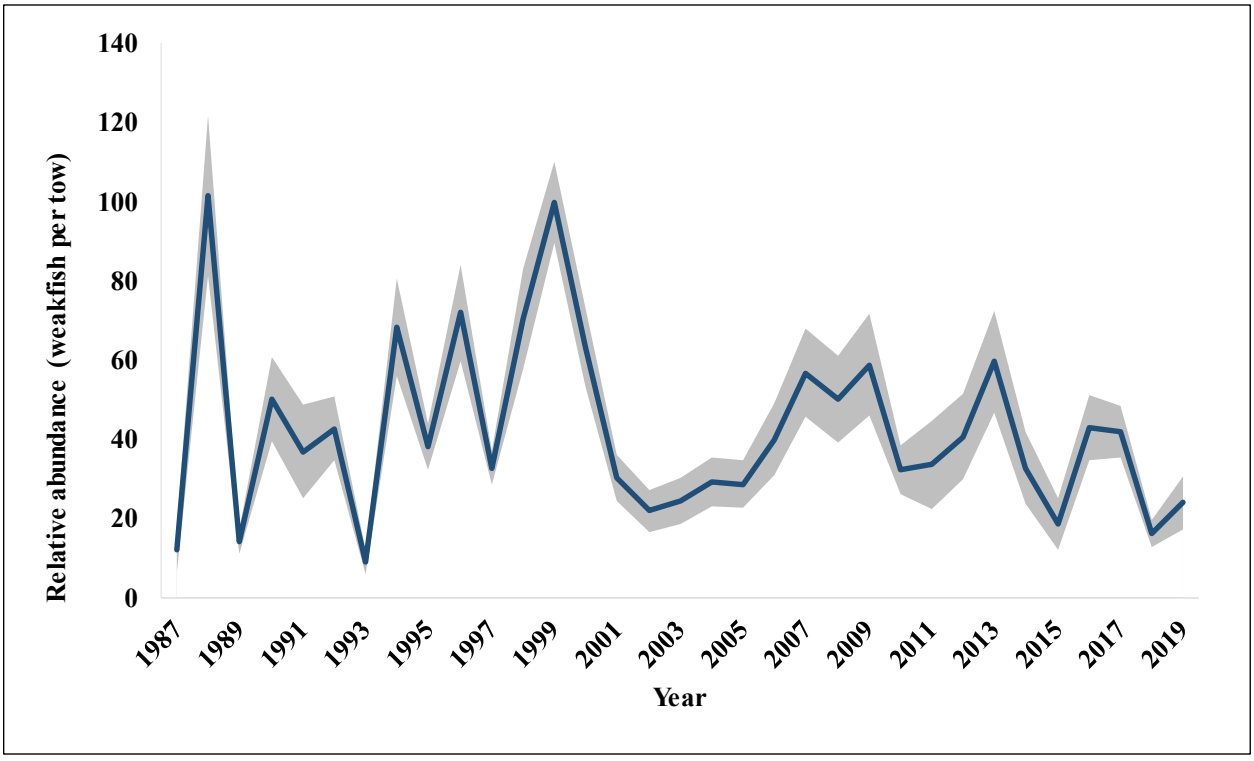

Figure 8. Relative abundance index (fish per tow) from the Pamlico Sound Survey (Program 195) in North Carolina of Age-0 weakfish collected during September with a total length less than 200 mm from 1987 through 2019. Error bars represent ± one standard error (SE).

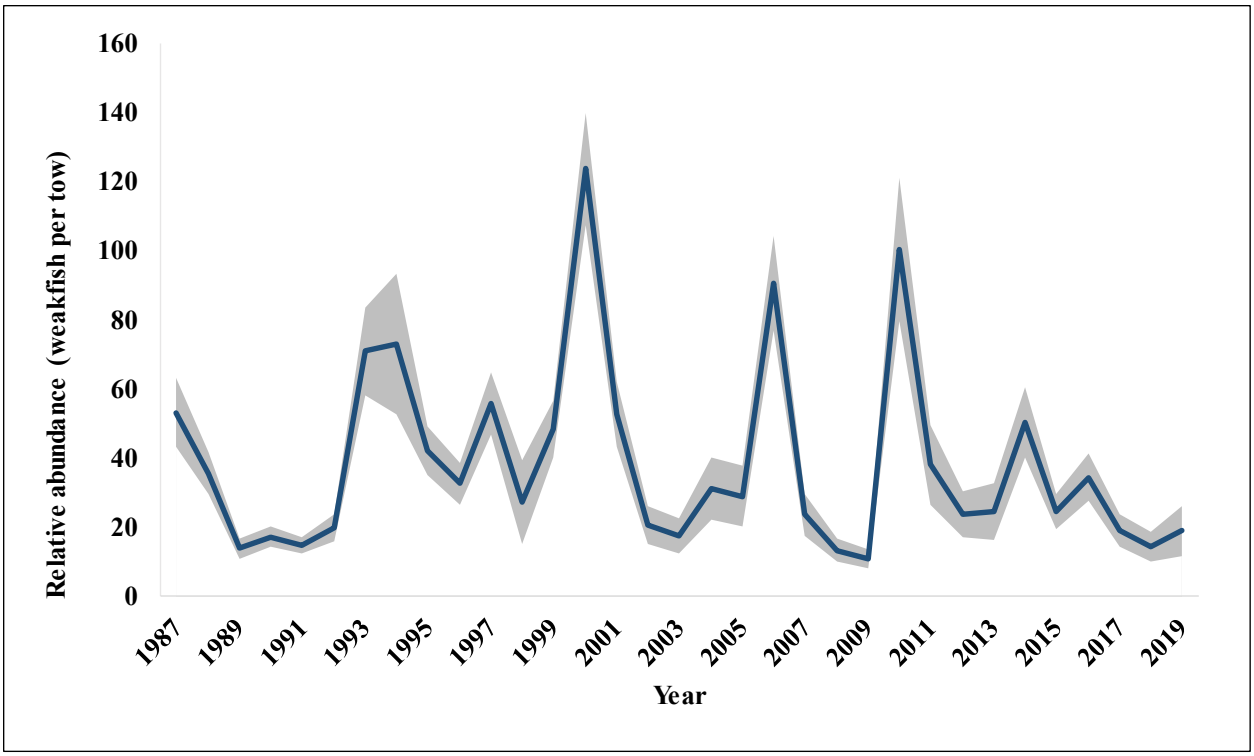

Figure 9. Relative abundance index (fish per tow) from the Pamlico Sound Survey (Program 195) in North Carolina of Age-1+ weakfish collected during June with a total length greater than 140 mm from 1987 through 2019. Error bars represent ± one standard error (SE).

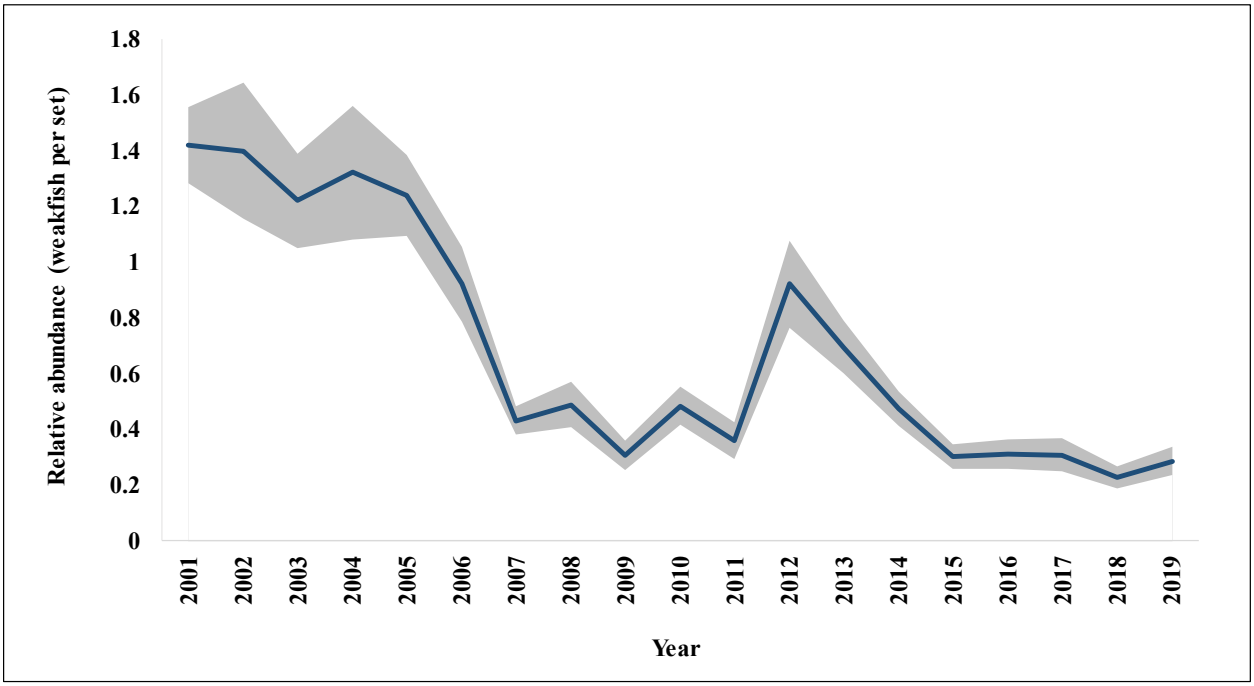

Figure 10. Relative abundance index (fish per station set) from the Pamlico Sound portion of the Independent Gill Net Survey (Program 915) in North Carolina, 2001 - 2019. Error bars represent ± one standard error (SE).

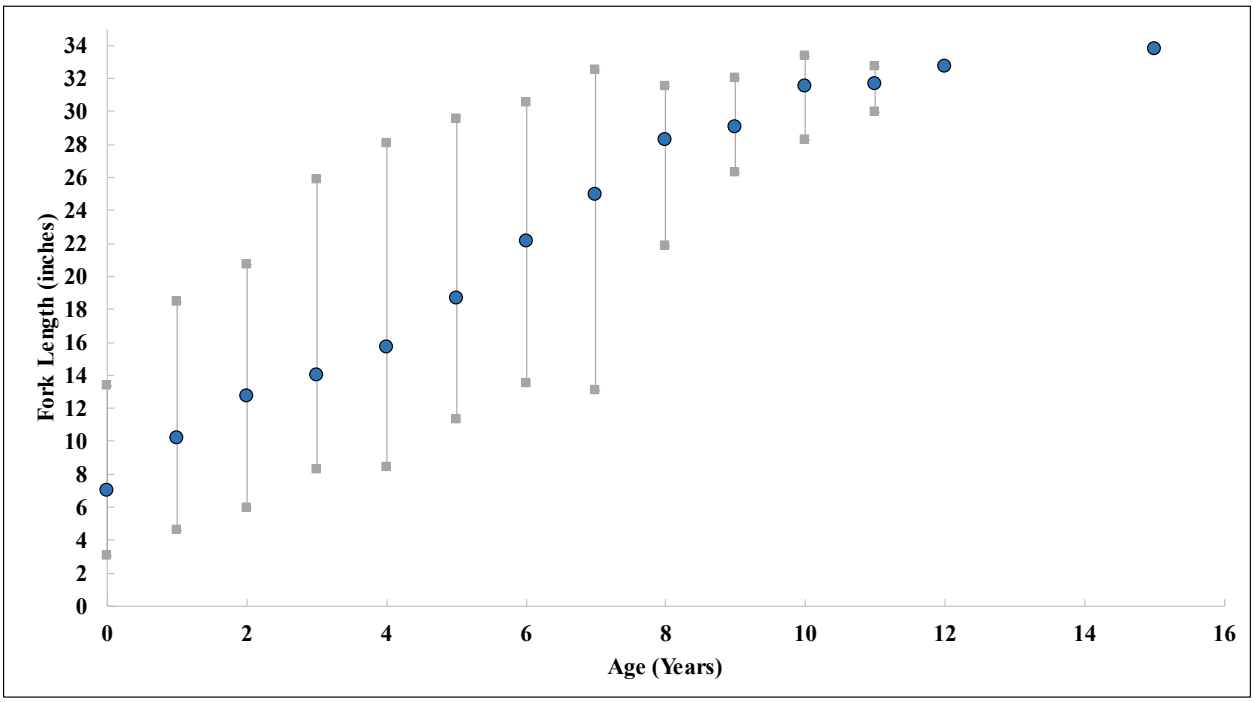

Figure 11. Weakfish length at age based on all age samples collected from 1995 to 2019. Blue circles represent the mean size at a given age while the grey squares represent the minimum and maximum observed size for each age.