FISHERY MANAGEMENT PLAN UPDATE
ATLANTIC CROAKER
AUGUST 2022

STATUS OF THE FISHERY MANAGEMENT PLAN

Fishery Management Plan History

FMP Documentation:	October 1987	
	Amendment 1	November 2005
	Addendum I	March 2011
	Addendum II	March 2014
	Addendum III	February 2020
Comprehensive Review:	2024	

The original Fishery Management Plan (FMP) for Atlantic croaker was adopted in 1987 and included states from Maryland through Florida (ASMFC 1987). Upon review of the FMP, the South Atlantic State/Federal Fisheries Management Board (here after referred to as the Board) determined the management recommendations were vague and that an amendment was needed to better define the management measures necessary to achieve the FMP goals. The Interstate Fisheries Management Program Policy Board adopted the finding that the original FMP did not contain any management measures that states were required to implement (ASMFC 2014).

In 2002, the Board directed the Atlantic Croaker Technical Committee to conduct the first coast wide stock assessment in preparation for an amendment. The stock assessment was developed in 2003 and approved by a Southeast Data Assessment Review panel for management use in June 2004. Amendment 1 was approved in November 2005 and fully implemented by January 1, 2006 (ASMFC 2005).

Amendment 1 expanded the original management area to include the states of Delaware and New Jersey and defined two management regions: the mid-Atlantic region which included states from New Jersey through North Carolina and the south-Atlantic region, which included states from South Carolina through the east coast of Florida (ASMFC 2005).

Amendment 1 established biological reference points to define the overfished and overfishing stock statuses for the mid-Atlantic region only. Amendment 1 did not require specific measures to restrict recreational or commercial harvest, though states with more conservative measures in place were encouraged to maintain those regulations. Amendment 1 also specified that, through adaptive management, the Board may revise Amendment 1. Regulatory and/or monitoring requirements could be included in the resulting addendum along with procedures for determining de minimis status and implementing alternative management programs via conservation equivalency.

Amendment 1 specified triggers for assessment of the stock in non-assessment years. However, if the technical committee felt there was sufficient evidence of changes in the stock, a stock assessment could be initiated in the absence of hitting the triggers. The triggers considered by the technical committee included relative percent change in landings, biological data monitoring,

effort vs. landings, Marine Recreational Information Program catch per unit effort (CPUE), along with state and regional surveys.

Addendum I to Amendment 1 was initiated in August 2010 to modify the management area and biological reference points for Atlantic croaker, based on results from the 2010 stock assessment. The assessment evaluated the Atlantic croaker population as a single coast wide stock, whereas Amendment 1 divided the coast into two management regions. To fully utilize the stock assessment in managing the population, Addendum I consolidated the stock into one management unit and established a procedure by which the Board could approve peer-reviewed biological reference points without a full administrative process such as an amendment or addendum (ASMFC 2011).

Addendum II to Amendment 1 was initiated in February 2014 and approved in August 2014. Addendum II establishes the use of the Traffic Light Approach (TLA) as a precautionary management framework (Caddy and Mahon 1995; Caddy 1998, 1999; Caddy 2002). The TLA is preferred for fast-growing, early maturing species like Atlantic croaker because it is more important to respond to multi-year trends rather than annual changes. The TLA more effectively illustrates long term trends than the triggers established by Addendum I. The management framework utilizing the TLA replaced the management triggers stipulated in Addendum I (ASMFC 2014). The harvest component of the TLA is a composite of commercial and recreational harvest data. The population, or adult abundance, component is a composite of fishery independent survey indices (e.g., Northeast Fishery Science Center (NEFSC) and Southeast Area Monitoring and Assessment Program (SEAMAP)). If thresholds for both population characteristics meet or exceed thresholds for a three-year period, management measures are triggered.

In February 2020, the Board approved Addendum III to Amendment 1, which revised the TLA's trigger mechanism and management response for the recreational and commercial fisheries (ASMFC 2020a). Addendum III incorporated the use of a regional approach (Mid-Atlantic NJ-VA and South Atlantic NC-FL) to better reflect localized fishery trends and changed the TLA to trigger management action if three of the four terminal years exceed threshold levels. State-specific management action is initiated when the proportion of red exceeds specified thresholds (30% or 60%) for both harvest and abundance. If management action is triggered, the coastwide response includes recreational bag limits and quantifiable measures to achieve percent reductions in commercial harvest. Response requirements vary depending on which threshold is exceeded. Addendum III also defines the mechanism by which triggered management actions may be removed, after abundance characteristics are no longer triggering management action. The TLA is reviewed annually in September. For additional information and links to the above-mentioned FMP, amendment, and addendums please refer to the ASMFC webpage for Atlantic croaker (http://www.asmfc.org/species/atlantic-croaker).

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 Atlantic croaker under the North Carolina Fishery Management Plan for Interjurisdictional Fisheries. The goals of the North Carolina FMP for Interjurisdictional Fisheries is to adopt FMPs, consistent with North Carolina Law, approved by the Mid-Atlantic Fishery Management Council (MAFMC), South Atlantic Fishery Management Council (SAFMC), or the Atlantic States Marine Fisheries Commission (ASMFC) by reference and implement corresponding fishery regulations in North Carolina to provide compliance or compatibility with approved FMPs and amendments, now and in the future. The goal of the councils and ASMFC plans, established under the Magnuson-Stevens Fishery Conservation Management Act (federal councils) and the Atlantic Coastal Fisheries Cooperative Management Act (ASMFC) are similar to the goals of the N.C Fisheries Reform Act of 1997 to "ensure long-term viability" of the fisheries (NCDMF 2015).

Management Unit

New Jersey through the east coast of Florida.

Goal and Objectives

The goal of Amendment 1 is to utilize interstate management to perpetuate the self-sustaining Atlantic croaker resource throughout its range and generate the greatest economic and social benefits from its commercial and recreational harvest and utilization over time. The four objectives of Amendment 1 are to:

- Manage the fishing mortality rate to provide adequate spawning potential to sustain long-term abundance of the population.
- Manage the stock to maintain the spawning stock biomass above the target biomass levels and restrict fishing mortality to rates below the threshold.
- Develop a management program for restoring and maintaining essential habitat.
- Develop research priorities that will further refine the management program to maximize the biological, social, and economic benefits derived from the population.

DESCRIPTION OF THE STOCK

Biological Profile

Atlantic croaker (*Micropogonias undulatus*) inhabit marsh, submerged aquatic vegetation, mud, and sand-bottom areas (Odell et al. 2017) from the Gulf of Maine to Argentina, but are most abundant from the Chesapeake Bay to northern Florida. However, the center of Atlantic croaker distribution is forecast to shift northward due to climate change (Hare et al. 2010). Atlantic croaker feed on shrimp, crabs, worms, shellfish, and small fishes (Powers et al. 2005; Nye et al. 2011). Atlantic croaker has a protracted spawning season beginning in the early fall and extending through December with a peak during September and October (White and Chittenden 1977;

Barbieri et al. 1994). Eggs and recently hatched larvae spawned in ocean waters drift toward land and the advanced larval stages and juveniles continue their migration inshore by actively swimming into estuarine nursery areas (Odell et al. 2017). Maximum recruitment (the number of fish entering the population) of juveniles is usually in the spring, with movement to offshore waters in the fall (Haven 1959; Norcross and Austin 1988). Higher overwinter survival of juvenile Atlantic croaker has been linked to increased winter water temperatures (Hare and Able 2007; Morley et al. 2016).

Atlantic croaker grow quickly, and can reach sizes over 20 inches (Ross 1988). Most Atlantic croaker are mature by the end of their first year (White and Chittenden 1977; Barbieri et al. 1994; ASMFC 2010), with length at 50 percent maturity generally falling between seven- and nine-inches total length (Barbieri et al. 1994; ASMFC 2010; NCDMF 2021a). While it is uncommon to see Atlantic croaker over age 10 (NCDMF 1999; Bobko et al. 2003), the oldest observed specimen, caught in the Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP), was 17 years.

Stock Status

Because there is no currently approved stock assessment, the stock status for spot with relation to overfishing or overfished is unknown.

To evaluate the status of the stock between stock assessments, the TLA established under Addendum II and revised under Addendum III, is reviewed annually in years when an assessment is not already being conducted.

Results from the 2020 TLA (2019 terminal year) indicated harvest indices for both regions and abundance indices for the Mid-Atlantic were above 30% in three of the last four years and thus the TLA for Atlantic croaker triggered at the 30% threshold or moderate concern and management action as outlined in Addendum III was enacted in March 2021 (ASMFC 2020b).

Results of the 2021 TLA (2020 terminal year) indicated harvest indices for both regions and abundance indices for the Mid-Atlantic remained above 30% in three of the last four years. The harvest composite index triggered for the seventh year in a row in the Mid-Atlantic region and the sixth year in a row in the South Atlantic region (Figure 1; ASMFC 2021). The adult abundance (age 2+) composite characteristic has exceeded the 30% threshold since 2010 in the Mid-Atlantic region (no 2019 or 2020 data points as ChesMMAP indices were not available) but has not exceeded the 30% threshold in the South Atlantic region since 2010 (no 2020 data points; Figure 2; ASMFC 2021). The adult composite index in the South Atlantic has indicated an increasing or stable trend. While not used for management decisions, the composite juvenile abundance index consisting of North Carolina Pamlico Sound Survey is reviewed annually. The index has been variable since 2002 with some indication of increases in abundance since 2010 except for 2018 with a usually high red portion indicating low abundance (Figure 3; ASMFC 2021).

Stock Assessment

The next Atlantic croaker Benchmark Stock Assessment is scheduled for 2024. The most recent benchmark stock assessment, completed in 2017, did not pass peer review and will not be used for management. The assessment was not recommended for management because of concern over

uncertainty in biomass estimates due to conflicting signals among abundance indices and catch time series as well as sensitivity of model results to assumptions and model inputs (ASMFC 2017, 2019). The review panel noted that discard estimates from the shrimp trawl fishery was an improvement from the last assessment and recommended shrimp trawl discard estimates be incorporated into annual monitoring using the TLA.

For reference, the most recent stock assessment accepted for use in management was completed in 2010 (ASMFC 2010). Results of the 2010 stock assessment indicated the population was not experiencing overfishing and was likely not overfished. The assessment indicated biomass had been increasing and the age-structure of the population had been expanding since the late 1980s. Biological reference points in the 2010 stock assessment are ratio based. Overfishing is occurring if F/FMSY is greater than 1 and the stock is considered overfished if SSB/(SSBMSY(1-M)) is less than 1.

DESCRIPTION OF THE FISHERY

Current Regulations

The 2020 TLA update (2019 terminal year) for Atlantic croaker triggered at the 30% threshold and coastwide management action as outlined in Addendum III was enacted in March 2021. The management response outlined in Addendum III specifies, non de minimis states are required to implement a 50 fish bag limit for their recreational fishery and must reduce commercial harvest by 1% of the average state commercial harvest from the previous 10 years.

In North Carolina, the 50 fish per person per day recreational bag limit became effective April 15th, 2021 (FF-24-2021) and remains in place for the 2022 season. The commercial Atlantic croaker fishery closed December 16th, 2021 through December 31st, 2021 to meet the required 1% reduction (FF-65-2021). The same commercial closure period will occur in December 2022. Management measures will remain in place for at least three years (until 2023) and future TLA updates will determine future management action after this time.

Commercial Fishery

Data collected from the North Carolina Trip Ticket program indicates commercial harvest was at its greatest in the late 1990's to early 2000s' peaking at 14,429,197 pounds in 2003 (Table 1; Figure 4a). Landings in the past five years have been the lowest in the time series dropping to a time series minimum of 540,622 pounds harvested in 2021. Commercial harvest averaged 6,164,385 pounds from 1991 through 2021 and has generally been declining since 2003 with significant landings declines beginning in 2010. Commercial landings are currently supported almost entirely (99%) by the gill net fishery with 88% of landings reported from ocean gill nets and 11% of landings from estuarine gill nets (Figure 5). Atlantic croaker are a component of the scrap or bait fishery in North Carolina, but this component generally makes up a small percentage of landings.

Recreational Fishery

Atlantic croaker are targeted recreationally by shore-based anglers and those fishing from private vessels during the summer and fall. Harvest data from the Recreational Commercial Gear License (RCGL) were collected from 2002 to 2008. The program was discontinued in 2009 due to lack of funding. From 2002 to 2008, an average of 14,534 pounds were harvested per year (NCDMF 2021b). Recreational estimates across all years have been updated and are now based on the Marine Recreational Information Program (MRIP) Fishing Effort Survey-based calibrated estimates. For more information on MRIP see https://www.fisheries.noaa.gov/topic/recreational-fishing-data.

From 1991 through 2021 recreational harvest of Atlantic croaker in North Carolina ranged from 164,644 to 758,751 pounds or between 472,917 and 1,935,961 fish (Table 1, Figures 4b and 6). Harvest by weight has generally declined since 2014 with the three lowest reported values occurring consecutively from 2018 to 2020, while the number of individuals harvested has increased since a time series low in 2018. In 2021, 1,066,533 fish and 376,121 pounds of Atlantic croaker were harvested, a 58% increase in number of fish and a 68% in weight from 2020.

The number of recreational releases has been variable over the time series with a noticeable peak in 2014 (Figure 6). The percentage of releases has steadily increased over the time series from 55% to 90%. In 2021, anglers released 9,539,047 fish, a 72% increase from 2020. This spike in discard percentage may be the result of the 50 fish bag limit enacted in 2021.

The number of Atlantic croaker measured during MRIP sampling has generally declined, with 122 individuals measured in 2021 (Table 2). Mean total length (TL) in 2021 was the same as 2020 at 8.9 inches and has fluctuated little since 1991 ranging from 8.4 to 10.4. Similarly, minimum and maximum TL have fluctuated little since 1991. Most of the recreational catch consists of fish from 6.0 to 10.0 inches TL (Figure 7). There was a wider range of lengths harvested during the 1990's and early 2000's. Length distribution from the 2021 recreational harvest ranged from 6.0 to 12.0 inches and when compared to commercial catches had greater representation of smaller size classes (Figure 8).

MONITORING PROGRAM DATA

Fishery-Dependent Monitoring

In 2021, 4,208 Atlantic croaker lengths were obtained from commercial fish house sampling with a mean TL of 9.6 inches, and lengths ranging from 5.9 to 13.7 inches (Table 3). Mean TL has varied little ranging from 9.3 inches to 12.1 inches and has generally declined since 2005. Minimum TL ranged from 3.9 inches to 7.4 inches and maximum TL ranged from 24.8 to 13.3 inches. Bait samples are included in calculations of mean, minimum and maximum length.

Modal length generally increased from 1994 to the early 2000's (Figure 9). There is a noticeable decline and contraction in size classes beginning in 2015, with most fish falling between 7.0 and 11.0 inches.

Size trends in 2021 commercial samples indicate a dominance of 9.0-inch fish with few over 11.0 inches or under 8.0 inches (Figure 8). When compared to the recreational fishery, the commercial fishery harvested a narrower range of sizes.

Fishery-Independent Monitoring

The number of Atlantic croaker aged in North Carolina's comprehensive life history program (P930) from 1996 through 2021 has ranged from 237 in 2011 to 1,071 in 1998 (Table 4). Modal age was one or two in most years but has been zero in recent years including 2008, 2016, 2017, 2020. Minimum age was zero in every year while maximum age ranged from six to 15 years. Maximum age was between 11 and 15 years from 2001-2010 and between six and ten from 2011-2021. A total of 488 fish were aged in 2021 with a modal age of one and a maximum age of nine. There is significant overlap in length at age, though mean length tends to plateau at age seven and length does not exceed 22 inches in any age class (Figure 10).

The Pamlico Sound Survey (P195) samples 54 stations (grids) annually in June and September. Stations are randomly selected from strata based upon depth and geographic location. Tow duration is 20 minutes, using double rigged demersal mongoose trawls (9.1 m headrope, 1.0 X 0.6 m doors, 2.2-cm bar mesh body, 1.9-cm bar mesh cod end and a 100-mesh tailbag extension). Data from this survey is used to produce juvenile abundance indices (JAI) that are incorporated into ASMFC stock assessments and reported annually to ASMFC as part of compliance reports and for incorporation into the juvenile composite TLA. Length cutoffs for juvenile Atlantic croaker were updated in 2022 after analyzing length distribution of age-0 and age-1 Atlantic croaker in P930. Juvenile Atlantic croaker are defined as fish <160 mm TL (6.3 inches) in June, and fish <210 mm TL (8.3 inches) in September.

The COVID pandemic impacted sampling in 2020 and 2021. Executive Order (EO) 116, issued on March 10, 2020, declared North Carolina under a State of Emergency and was soon followed by EO 120 which implemented a statewide Stay at Home Order for all non-essential State employees. In 2020, sampling was limited to 28 stations sampled in June and 35 stations sampled in September. A total of 35 stations were sampled in June 2021 and 32 stations were sampled in September 2021. Limited sampling likely impacted abundance indices calculated from Sound Survey data. An initial analysis of this impact was conducted for the 2020 Atlantic croaker abundance indices and concluded the magnitude of abundance may be overestimated slightly but limited sampling was likely able to capture the general abundance trends.

The Atlantic croaker weighted JAI from the Pamlico Sound Survey from 1987 through 2021 has been variable in both June and September. Annual fluctuations in the June JAI are most notable after 2009 when steep increases in abundance are followed by steep declines (Figure 11). The June JAI has ranged from 69 individuals per tow in 1996 to 1,297 individuals per tow in 2010 with a time series average of 420 individuals per tow. The time series average in September is slightly greater at 500 individuals per tow ranging from 96 individuals per tow in 1987 to 1,376 individuals per tow in 2020. The September JAI fluctuates around the time series average but the past ten years indicated a slightly increasing trend. The 2021 JAI contradicts the increasing abundance trend showing a steep decline in September 2021 of 299.7 individuals per tow. The June JAI in 2021 at 515 individuals per tow shows the continuation of the decline from June 2020.

Most Atlantic croaker captured in the Pamlico Sound Survey are juveniles (age 0), but because of the protracted spawning and recruitment period, the length composition of Atlantic croaker captured in the survey can be variable. There is more variability in length compositions of Atlantic croaker caught in the June portion of the survey compared to the September portion of the survey (Figure 12). Modal length in June is generally 3.0 to 5.0 inches while modal length in September is around 5.0 inches with little fluctuation between years. Interestingly, the length composition from both June and September 2021 shows a wider range than previous years.

RESEARCH NEEDS

There is no research or monitoring programs required of the states except for the submission of an annual compliance report. However, several coastwide and state specific research recommendations have been identified and ranked through the ASMFC FMP and stock assessment process. The high priority research recommendations are reported below. Additional research and monitoring recommendations can be found in the 2016 Atlantic Croaker Stock Assessment Peer Review Report here under Term of Reference 8 (ASMFC 2017). Increase observer coverage for commercial discards, particularly the shrimp trawl fishery. Develop a standardized, representative sampling protocol for observers to use to increase the collection of individual lengths and ages of discarded finfish.

- Describe the coast-wide distribution, behavior, and movement of croaker by age, length, and season, with emphasis on collecting larger, older fish.
- Continue state and multi-state fisheries-independent surveys throughout the species range and subsample for individual lengths and ages. Ensure NEFSC trawl survey continues to take lengths and ages. Examine potential factors affecting catchability in long-term fishery independent surveys.
- Quantify effects of BRDs and TEDs implementation in the shrimp trawl fishery by examining their relative catch reduction rates on Atlantic croaker.
- Continue to develop estimates of length-at-maturity and year-round reproductive dynamics throughout the species range. Assess whether temporal and/or density- dependent shifts in reproductive dynamics have occurred.
- Re-examine historical ichthyoplankton studies for an indication of the magnitude of estuarine and coastal spawning, as well as for potential inclusion as indices of spawning stock biomass in future assessments. Pursue specific estuarine data sets from the states (NJ, VA, NC, SC, DE, ME) and coastal data sets (MARMAP, EcoMon).

MANAGEMENT STRATEGY

The TLA established under Addendum II and revised under Addendum III (approved February 2020) to Amendment 1 is used as a precautionary management framework for Atlantic croaker. The TLA provides guidance in lieu of a current stock assessment. Addendum III incorporated the use of a regional approach (Mid-Atlantic NJ-VA and South Atlantic NC-FL) to better reflect localized fishery trends. Under this management program, if the amount of red in the Traffic Light

for both population characteristics (adult abundance and harvest) meet or exceed the threshold for any three of the four most recent years, then management action is required. The harvest composite index triggered at the 30% threshold in both regions in 2019. The adult abundance characteristics for the Mid-Atlantic exceeded the threshold in 2019 while the South Atlantic abundance composite characteristic did not exceed the trigger in 2019. Since both population characteristics were above the 30 percent threshold in at least three years from 2016-2019, management actions were implemented in March 2021.

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TABLES

Table 1. Atlantic croaker recreational harvest and number released (Marine Recreational Information Program) and commercial harvest (North Carolina Trip Ticket Program), 1991–2021. All weights are in pounds.

	Recreational			Commercial	
Year	Number Landed	Number Released	Weight Landed (lb)	Weight Landed (lb)	Total Weight (lb)
1991	1,335,923	2,031,277	488,193	3,436,960	3,925,153
1992	1,836,941	2,565,212	556,026	2,796,612	3,352,638
1993	1,590,195	2,594,149	590,338	3,267,652	3,857,990
1994	1,921,848	4,302,429	557,403	4,615,754	5,173,157
1995	1,632,366	2,024,031	602,628	6,021,284	6,623,912
1996	1,224,357	2,051,175	564,016	9,961,834	10,525,850
1997	1,142,169	2,367,265	550,949	10,711,667	11,262,616
1998	865,487	2,038,932	376,255	10,865,897	11,242,152
1999	1,042,224	2,848,626	525,970	10,185,507	10,711,477
2000	860,246	3,475,554	394,037	10,122,627	10,516,664
2001	1,285,029	2,387,491	647,119	12,017,424	12,664,543
2002	1,265,031	2,218,039	651,611	10,189,153	10,840,764
2003	1,127,298	2,765,303	708,487	14,429,197	15,137,684
2004	1,218,206	3,407,280	683,113	11,993,003	12,676,116
2005	672,437	3,038,472	323,380	11,903,292	12,226,672
2006	1,376,403	6,381,434	498,741	10,396,554	10,895,295
2,007	1,058,663	3,933,603	336,486	7,271,162	7,607,648
2008	678,638	3,274,873	275,052	5,791,766	6,066,818
2009	958,128	5,623,278	359,703	6,135,437	6,495,140
2010	1,280,446	4,571,287	638,817	7,312,159	7,950,976
2011	873,659	7,005,152	360,390	5,054,186	5,414,576
2012	848,495	3,878,710	307,338	3,106,616	3,413,954
2013	1,300,804	6,729,556	453,881	1,927,938	2,381,819
2014	1,935,961	10,347,332	758,751	2,629,908	3,388,659
2015	1,437,019	9,632,560	557,735	1,819,020	2,376,755
2016	1,109,570	7,254,382	443,728	2,092,287	2,536,015
2017	666,930	4,631,445	237,160	1,008,015	1,245,175
2018	472,917	4,311,368	164,644	1,643,646	1,808,290
2019	651,268	3,634,211	224,337	1,278,340	1,502,677
2020	673,377	5,560,605	223,685	570,423	794,108
2021	1,066,533	9,539,047	376,121	540,622	916,743
Mean	1,142,212	4,400,777	465,680	6,164,385	6,630,066

Table 2. Mean, minimum, maximum total length (inches), and total number of Atlantic croaker measured by Marine Recreational Information Program sampling in North Carolina, 1991–2021.

Year	Mean Total Length	Minimum Total Length	Maximum Total Length	Total Number Measured
1991	8.5	5.1	39.3	627
1992	8.5	4.6	13.2	535
1993	8.7	5.0	21.2	861
1994	8.6	4.8	15.6	2,065
1995	9.2	4.3	15.6	1,268
1996	10.0	5.3	16.7	1,169
1997	9.6	5.0	16.5	937
1998	9.3	6.0	16.7	599
1999	9.7	6.3	17.2	681
2000	9.6	6.7	17.6	360
2001	10.0	6.5	15.8	529
2002	9.7	6.0	15.0	255
2003	10.4	7.3	18.4	289
2004	10.1	7.0	17.4	263
2005	9.6	6.7	17.2	140
2006	8.8	4.8	14.9	198
2007	8.4	4.1	13.9	113
2008	9.4	4.3	15.4	188
2009	8.9	5.7	15.8	210
2010	9.8	6.2	16.8	330
2011	9.6	4.9	14.3	255
2012	9.2	4.9	14.1	230
2013	9.1	5.9	15.4	267
2014	9.1	4.1	14.1	215
2015	9.2	5.8	13.9	142
2016	9.3	6.3	13.2	219
2017	9.0	6.7	12.5	169
2018	8.9	6.5	19.1	119
2019	9.0	5.9	19.1	147
2020	8.9	5.9	19.1	127
2021	8.9	6.6	12.8	122

Table 3. Mean, minimum, maximum total length (inches), and total number of Atlantic croaker measured from North Carolina commercial fish house samples, 1994–2021. Bait samples are included in calculations of mean, minimum and maximum length.

Year	Mean Total Length	Minimum Total Length	Maximum Total Length	Total Number Measured
1994	9.3	4.6	15.2	20,282
1995	9.9	4.6	18.0	21,286
1996	11.0	4.3	18.3	32,339
1997	11.1	4.3	17.9	26,341
1998	11.7	3.9	19.7	22,818
1999	11.8	3.9	19.1	20983
2000	11.6	4.0	19.8	29,022
2001	12.0	4.5	19.7	30,506
2002	12.0	5.1	19.7	21,985
2003	12.1	4.9	18.6	25,881
2004	12.0	3.9	20.0	23,335
2005	12.0	4.9	19.7	21,719
2006	11.4	4.7	24.8	20,541
2007	11.3	4.6	19.4	15,011
2008	11.1	4.6	19.5	15,032
2009	11.2	4.8	19.1	20,448
2010	11.3	5.0	17.8	21,511
2011	11.5	4.6	16.6	15,947
2012	11.2	5.5	17.9	10,930
2013	11.2	5.6	17.2	9,062
2014	10.3	4.4	16.7	11,523
2015	10.6	5.4	15.5	9,593
2016	10.7	7.4	15.2	6,959
2017	10.0	6.6	15.2	6,022
2018	10.3	6.2	15.2	3,771
2019	9.9	6.1	15.2	4,775
2020	9.4	5.4	13.3	1,807
2021	9.6	5.9	13.7	4,208

Table 4. Modal, minimum, maximum age, and total number of Atlantic croaker aged in North Carolina from fishery dependent and fishery independent sampling, 1996–2021. Includes otolith ages only. Age data from 2021 is preliminary.

Year	Modal Age	Minimum Age	Maximum Age	Total Number Aged
1996	2	0	6	836
1997	1	0	9	428
1998	1	0	9	1,071
1999	1	0	9	671
2000	1	0	9	815
2001	2	0	12	793
2002	1	0	11	605
2003	1	0	12	516
2004	2	0	13	681
2005	3	0	14	597
2006	1	0	13	658
2007	5	0	15	321
2008	0	0	15	739
2009	1	0	14	709
2010	4	0	13	703
2011	1	0	8	237
2012	2	0	7	349
2013	1	0	8	577
2014	2	0	8	1,070
2015	1	0	9	993
2016	0	0	6	474
2017	0	0	7	451
2018	1	0	8	544
2019	2	0	10	537
2020	0	0	7	380
2021	1	0	9	488

FIGURES

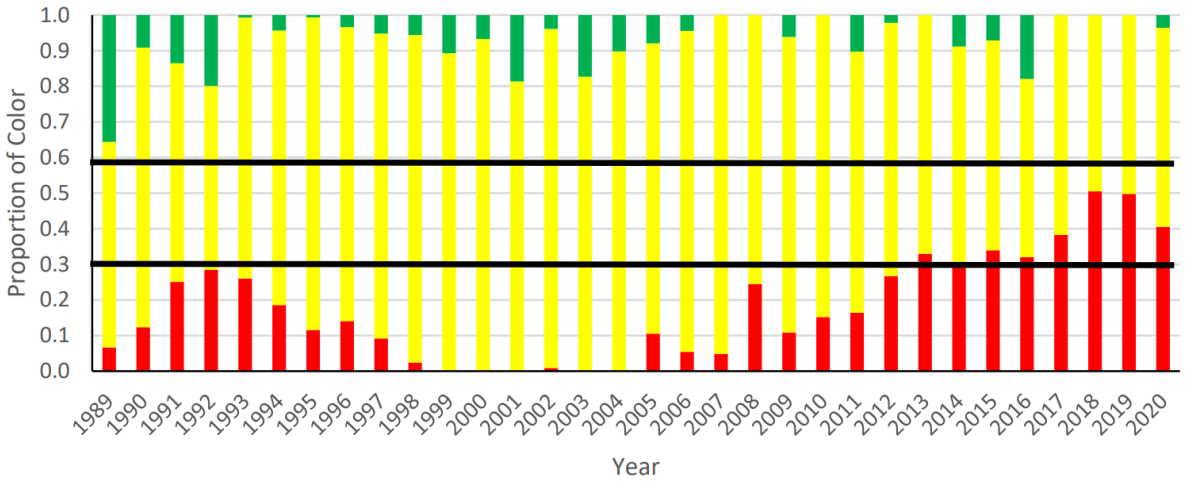

Figure 1. Annual color proportions for the harvest composite TLA of South Atlantic region (NC-FL) Atlantic croaker recreational and commercial landings, 1989–2020 (ASMFC 2021). The reference period is 2002–2012.

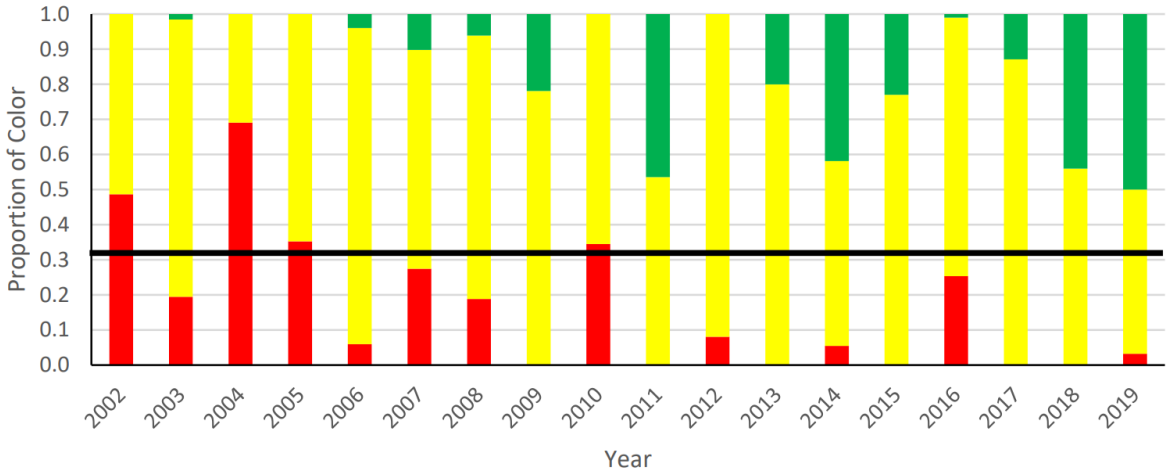

Figure 2. Annual color proportions for the abundance composite TLA of South Atlantic region (NC-FL) for adult (age 2+) Atlantic croaker fishery independent indices (SEAMAP and SCDNR trammel survey), 2002–2019 (no 2020 data point due to limited sampling; ASMFC 2021). The reference period is 2002–2012.

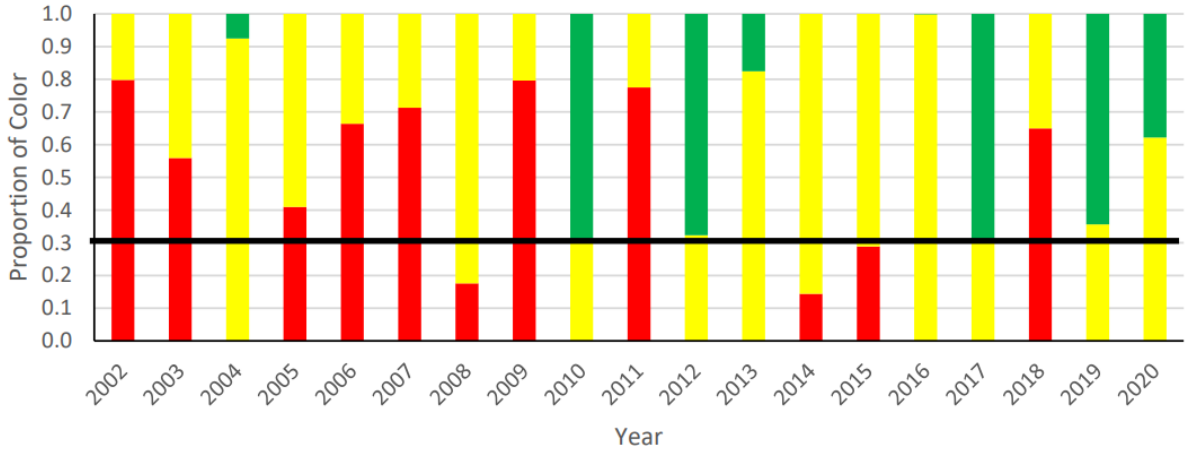

Figure 3. Annual color proportions for the abundance composite TLA of South Atlantic region (NC-FL) for juvenile (age 0) Atlantic croaker from the NCDMF Pamlico Sound Survey, 2002–2020 (ASMFC 2021). Reference period is 2002–2012. Juvenile index does not trigger management action

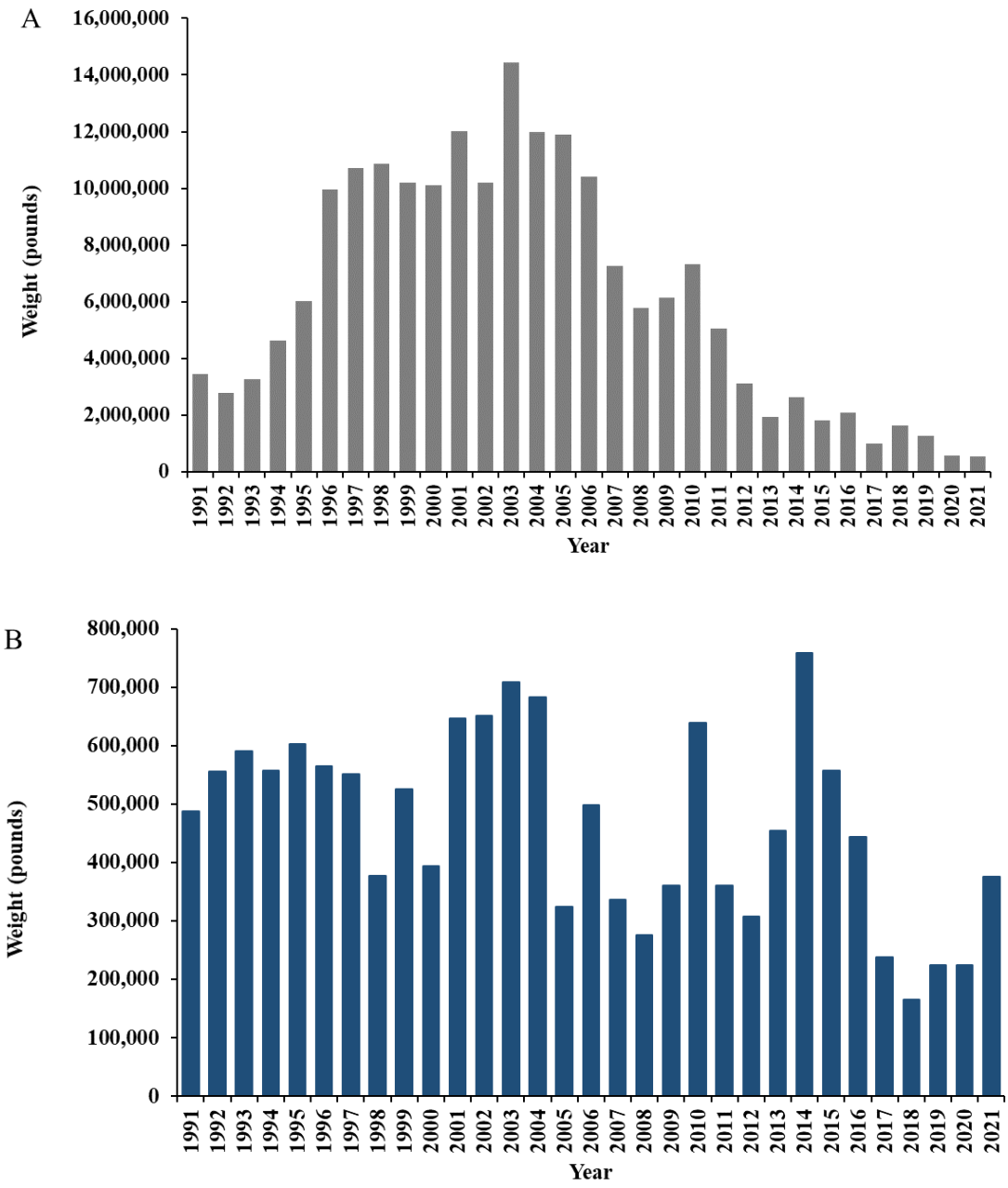

Figure 4. Annual A) commercial landings (North Carolina Trip Ticket Program) and B) recreational harvest (Marine Recreational Information Program) in pounds for Atlantic croaker in North Carolina, 1991–2021.

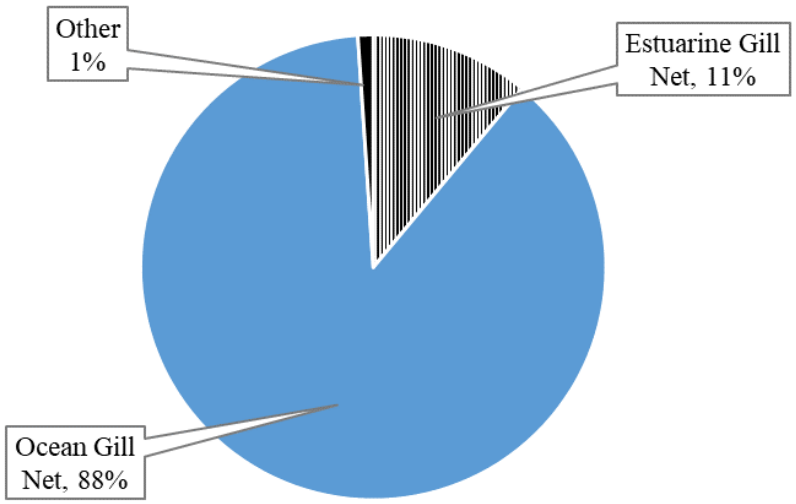

Figure 5. Commercial harvest of Atlantic croaker by gear, 2021. Other gears include swipe net, beach seine, crab pots, haul seines and pound nets.

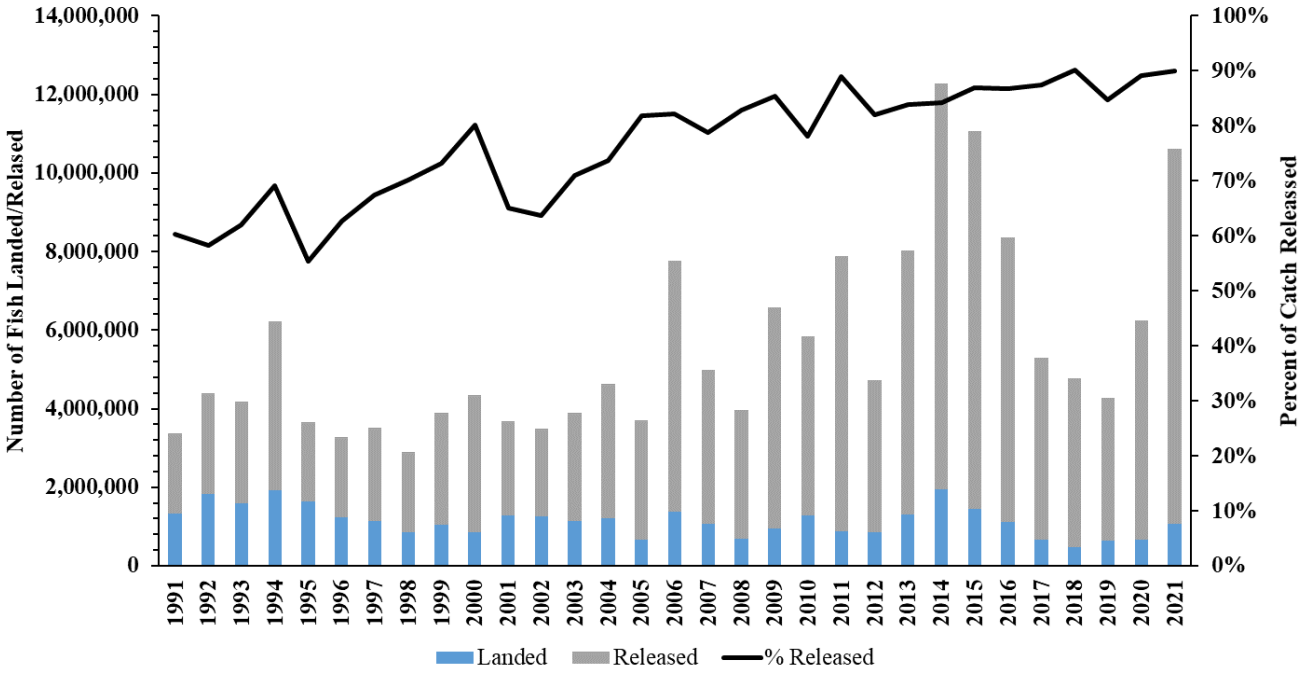

Figure 6. Recreational catch (landings and releases, in numbers) and the percent of catch that is released, 1991–2021 from the MRIP.

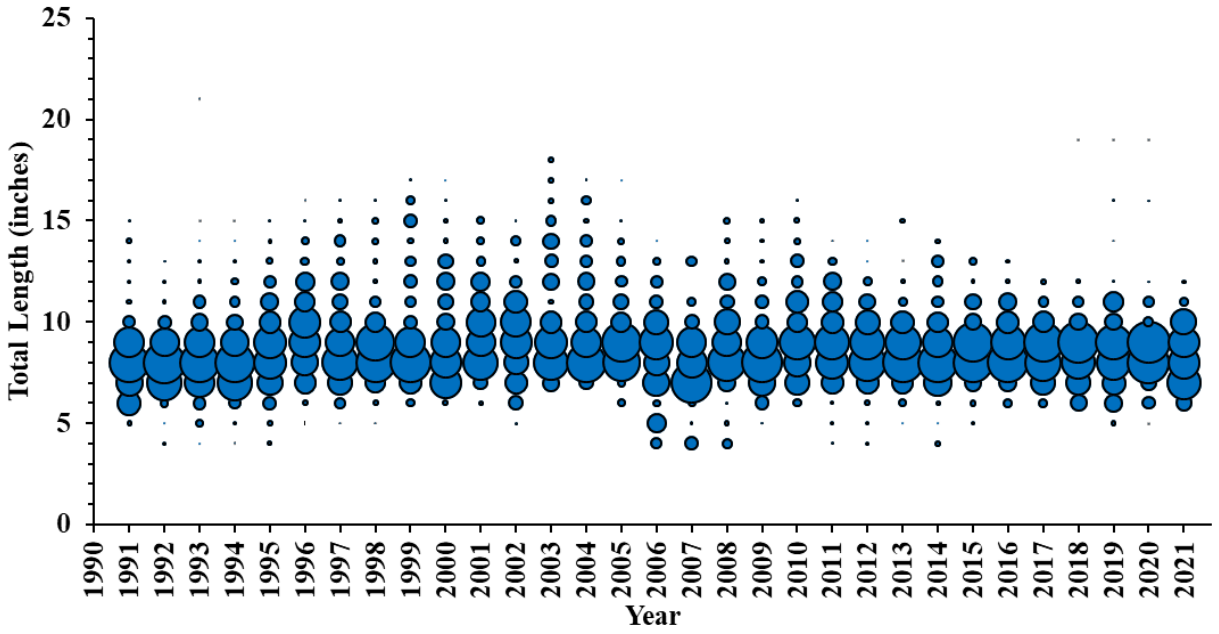

Figure 7. Recreational length frequency (total length, inches) of Atlantic croaker harvested, 1991–2020 (MRIP, n=35,408,568). Bubble represents the proportion of fish at length.

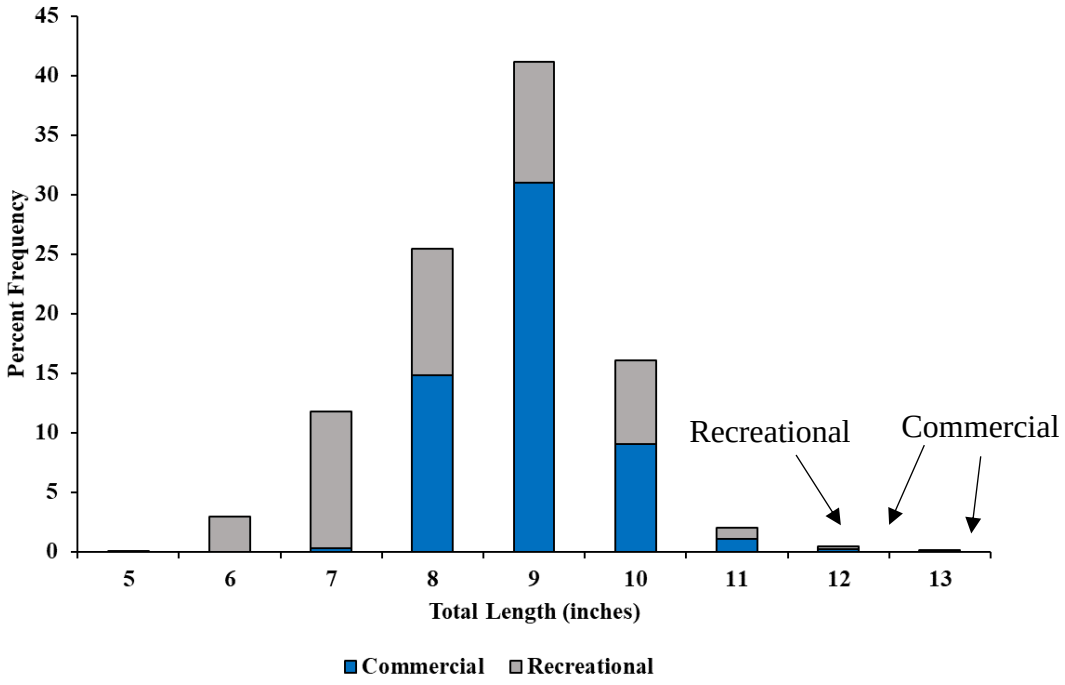

Figure 8. Commercial (n=1,392,477) and recreational (n=1,066,533) length frequency (TL, inches) distribution from Atlantic croaker harvested in 2021.

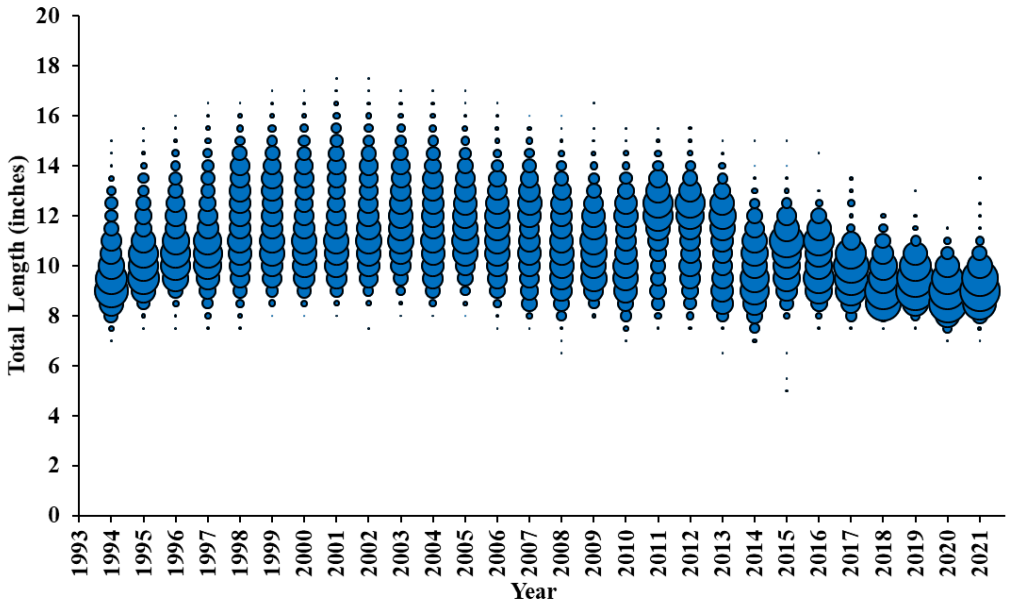

Figure 9. Commercial length frequency (total length, inches) of Atlantic croaker harvested from 1994–2021. Bubble represents the proportion of fish at length. Bait samples not included.

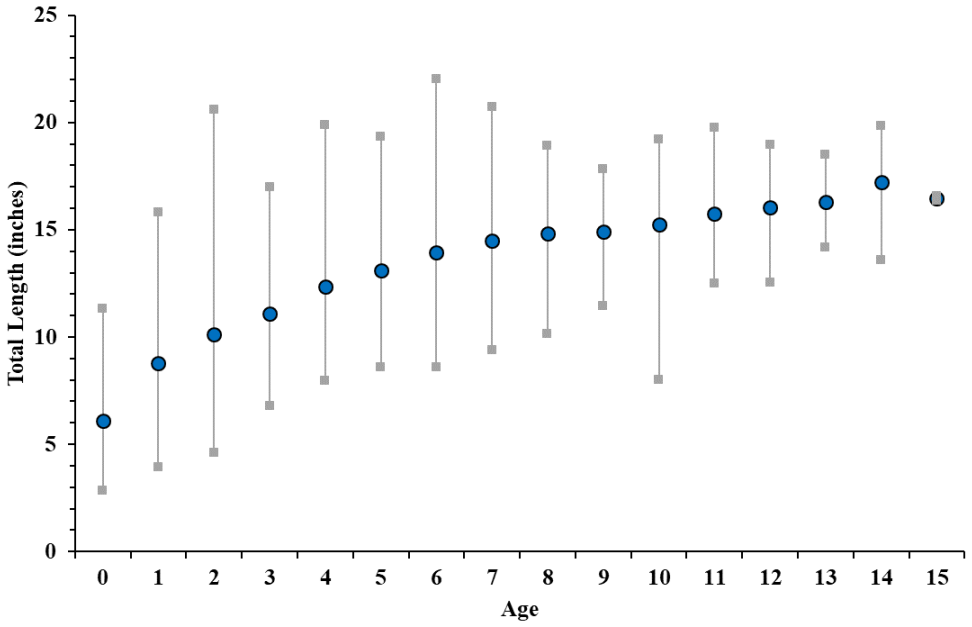

Figure 10. Atlantic croaker length at age based on all age samples collected from 1996 to 2020 (n=17,481). Blue circles represent the mean size at a given age while the grey squares represent the minimum and maximum observed size for each age.

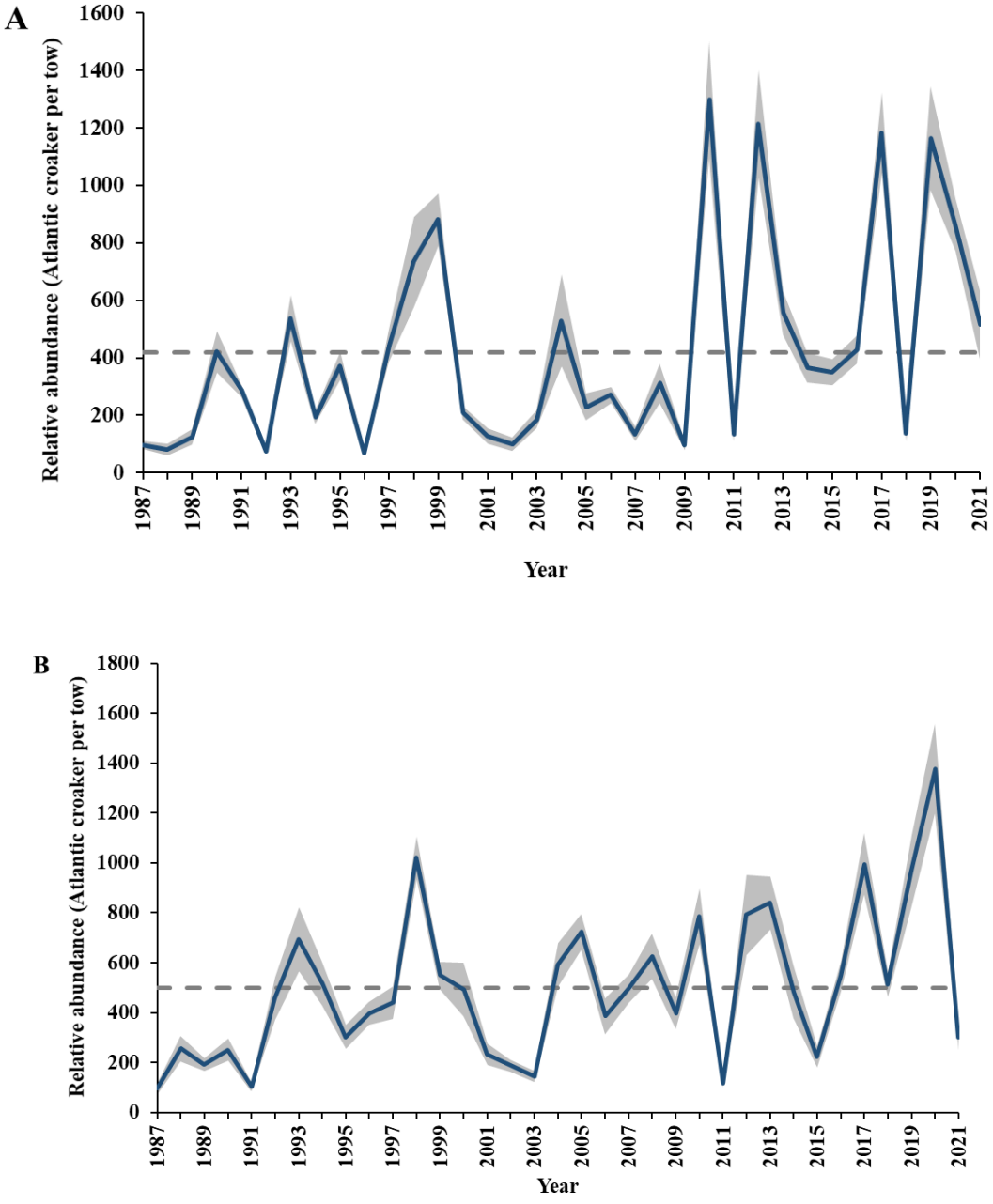

Figure 11. Atlantic croaker weighted juvenile relative abundance (number per tow) for A) June and B) September from the Pamlico Sound Survey, 1987–2021. Shaded area represents standard error and dashed line indicates time series average. Length cutoffs are <160 mm TL (6.3 in) in June and <210 mm TL (8.3 in) in September.

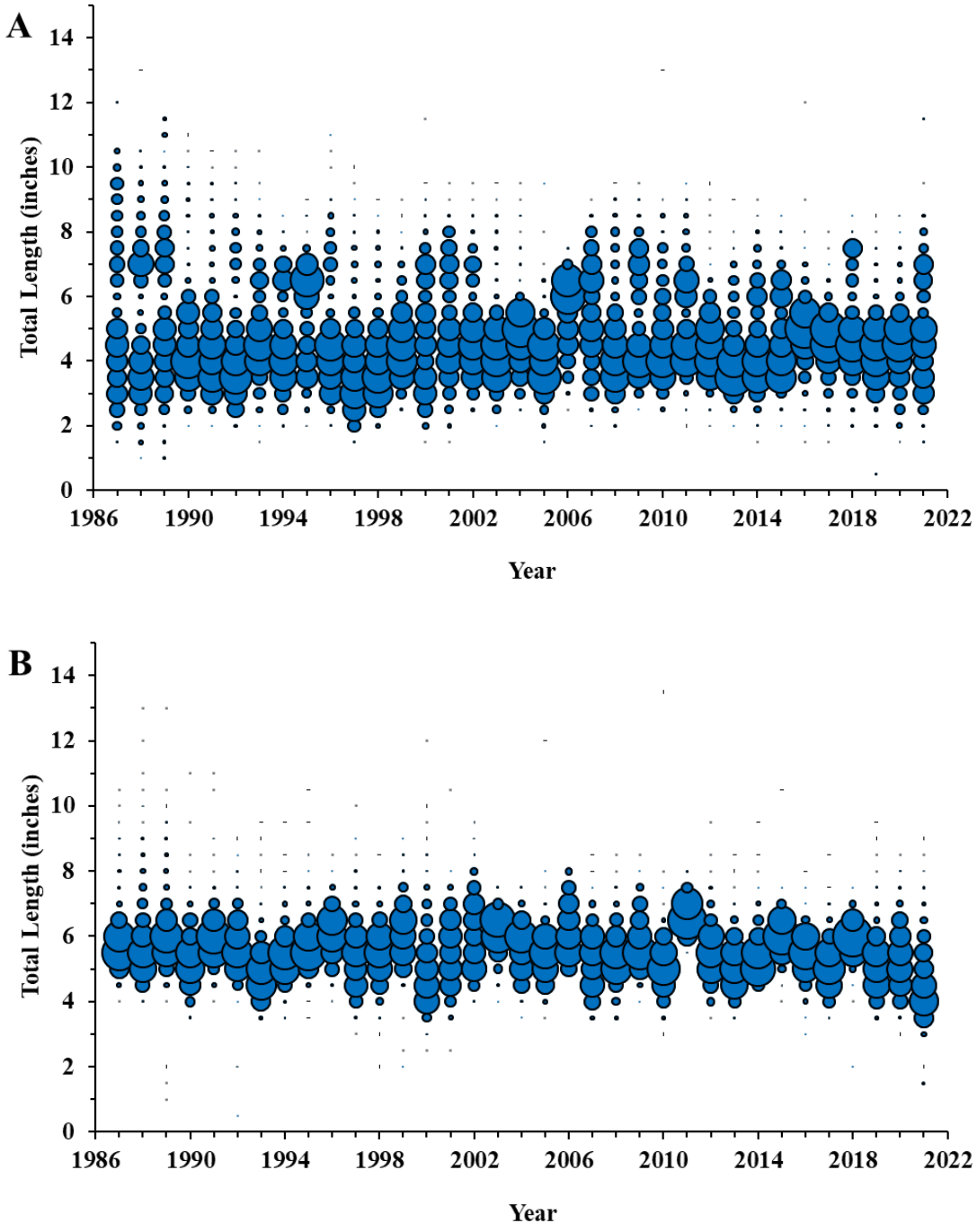

Figure 12. Length frequency (total length, inches) of all Atlantic croaker captured in Pamlico Sound Survey sampling during A) June and B) September 1987–2021.