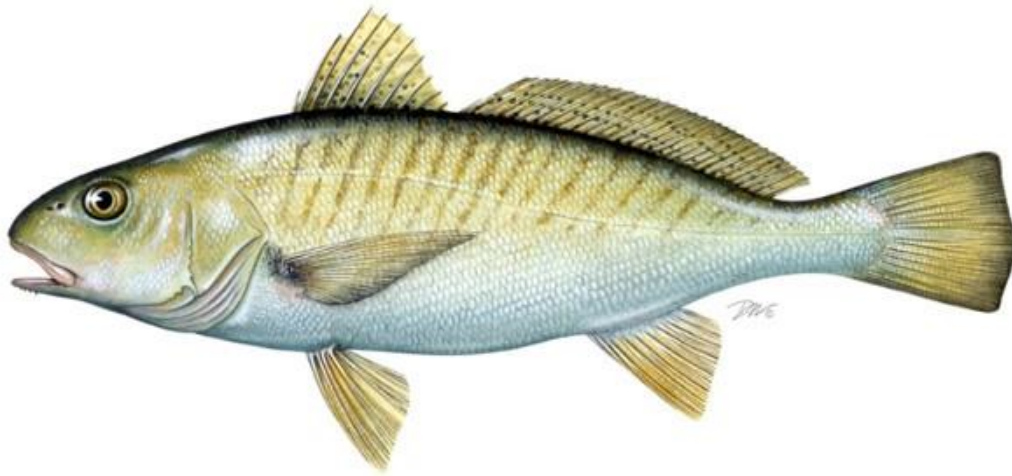


ATLANTIC STATES MARINE FISHERIES COMMISSION

REVIEW OF THE INTERSTATE FISHERY MANAGEMENT PLAN

FOR ATLANTIC CROAKER
(*Micropogonias undulatus*)

2018 FISHING YEAR



Prepared by the Plan Review Team

Approved by the South Atlantic State/Federal Fisheries Management Board
August 2019

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I. Status of the Fishery Management Plan

<u>Date of FMP Approval:</u>	Original FMP – October 1987
<u>Amendments:</u>	Amendment 1 – November 2005 (implemented January 2006) Addendum I – March 2011 Addendum II – August 2014
<u>Management Areas:</u>	The Atlantic coast distribution of the resource from New Jersey through Florida
<u>Active Boards/Committees:</u>	South Atlantic State/Federal Fisheries Management Board; Atlantic Croaker Technical Committee, Stock Assessment Subcommittee, and Plan Review Team; South Atlantic Species Advisory Panel

The Fishery Management Plan (FMP) for Atlantic Croaker was adopted in 1987 and included the states from Maryland through Florida (ASMFC 1987). In 2004, the South Atlantic State/Federal Fisheries Management Board (Board) found the recommendations in the FMP to be vague, and recommended that an amendment be prepared to define management measures necessary to achieve the goals of the FMP. The Interstate Fisheries Management Program Policy Board also adopted the finding that the original FMP did not contain any management measures that states were required to implement.

In 2002, the Board directed the Atlantic Croaker Technical Committee to conduct the first coastwide stock assessment of the species to prepare for developing an amendment. The Atlantic Croaker Stock Assessment Subcommittee developed a stock assessment in 2003, which was approved by a Southeast Data Assessment Review (SEDAR) panel for use in management in June 2004 (ASMFC 2005a). The Board quickly initiated development of an amendment and, in November 2005, approved Amendment 1 to the Atlantic Croaker FMP (ASMFC 2005b). The amendment was fully implemented by January 1, 2006.

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

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

Amendment 1 expanded the management area to include the states from New Jersey through Florida. Consistent with the stock assessment completed in 2004, the amendment defined two Atlantic coast management regions: the south-Atlantic region, from Florida through South Carolina; and the mid-Atlantic region, from North Carolina through New Jersey.

Amendment 1 established biological reference points (BRPs) to define an overfished and overfishing stock status for the mid-Atlantic region only. Reliable stock estimates and BRPs for the South Atlantic region could not be developed during the 2004 stock assessment due to a lack of data. The BRPs were based on maximum sustainable yield (MSY), and included threshold and target levels of fishing mortality (F) and spawning stock biomass (SSB): F threshold = F_{MSY} (estimated to be 0.39); F target = $0.75 \times F_{MSY}$ (estimated to be 0.29); SSB threshold = $0.7 \times SSB_{MSY}$ (estimated to be 44.65 million pounds); and SSB target = SSB_{MSY} (estimated to be 63.78 million pounds). An SSB estimate below the SSB threshold resulted in an overfished status determination, and an F estimate above the F threshold resulted in an overfishing status determination. The Amendment established that the Board would take action, including a stock rebuilding schedule if necessary, should the BRPs indicate the stock is overfished or overfishing is occurring.

Amendment 1 did not require any specific measures restricting recreational or commercial harvest of Atlantic croaker. States with more conservative measures were encouraged to maintain those regulations (Table 1). The Board was able to revise Amendment 1 through adaptive management, including any regulatory and/or monitoring requirements in subsequent addenda, along with procedures for implementing alternative management programs via conservation equivalency.

The Board initiated Addendum I to Amendment I at its August 2010 meeting, following the updated stock assessment, in order to address the proposed reference points and management unit. The stock assessment evaluated the stock as a coastwide unit, rather than the two management units established within Amendment I. In approving Addendum I, the Board endorsed consolidating the stock into one management unit, as proposed by the stock assessment. In addition, Addendum I established a procedure, similar to other species, by which the Board may approve peer-reviewed BRPs without a full administrative process, such as an amendment or addendum.

In August 2014, the Board approved Addendum II to the Atlantic Croaker FMP. The Addendum established the Traffic Light Approach (TLA) as the new precautionary management framework to evaluate fishery trends and develop management actions. The TLA was originally developed as a management tool for data poor fisheries. The name comes from assigning a color (red, yellow, or green) to categorize relative levels of population indicators. When a population characteristic improves, the proportion of green in the given year increases. Harvest and abundance thresholds of 30% and 60% were established in Addendum II, representing moderate and significant concern for the fishery. If thresholds for both population characteristics achieve or exceed a threshold for a three year period, then management action is enacted.

The TLA framework replaces the management triggers stipulated in Addendum I, which dictated that action should be taken if recreational and commercial landings dropped below 70% of the previous two year average. Those triggers were limited in their ability to illustrate long-term declines or increases in stock abundance. In contrast, the TLA approach is capable of better illustrating trends in the fishery through changes in the proportion of green, yellow, and red coloring. A 2018 TC report recommended several updates to the current TLA approach (ASMFC 2018). The Board has initiated an addendum to incorporate these updates.

Addenda I and II did not add or change any management measures or requirements. The only existing requirement is for states to submit an annual compliance report by July 1st of each year that contains commercial and recreational landings as well as results from any monitoring programs that intercept Atlantic croaker.

II. Status of the Stock

The most recent stock assessment, conducted in 2017, upon peer review was not recommended for management use. Therefore, current stock status is unknown, although the Peer Review Panel did not indicate problems in the Atlantic croaker fishery that would require immediate management action. The Peer Review Panel did recommend continued evaluation of the fishery using the annual TLA.

The conclusions of the 2010 stock assessment (ASMFC 2010), which is the most recent assessment that was recommended by peer review for management use, were that Atlantic croaker was not experiencing overfishing and biomass had increased and fishing mortality decreased since the late 1980s. The 2010 assessment was unable to confidently determine stock status, particularly with regards to biomass, due to an inability to adequately estimate removals from discards of the South Atlantic shrimp trawl fishery. Improvements on estimation of these discards were made in the 2017 assessment, allowing the potential for shrimp trawl discards to be included as supplemental information with the annual TLA. Annual monitoring of shrimp trawl fishery discards is important because these discards represent a considerable proportion of Atlantic croaker removals, ranging from 7% to 78% annually during 1988-2008, according to the 2010 assessment (ASMFC 2010).

One of the primary reasons that the 2017 stock assessment did not pass peer review was due to conflicting signals in harvest and abundance metrics. Theoretically, increases in adult abundance should result in more fish available to be caught by the fishery; thus, fishing would be more efficient (greater catch per unit effort) and harvest would increase in a pattern similar to adult abundance. However, several of the most recent abundance indices have shown increases while harvest has declined to some of the lowest levels on record. One factor that has been identified to contribute to overestimates of adult abundance is an increase in the number of juveniles misclassified as adults in surveys that historically have typically caught adults. In response to this conflict, the Atlantic Croaker Technical Committee has recommended several changes to the annual TLA such as additional abundance indices and survey length-composition

information so that the TLA abundance metric would more accurately reflect trends in the stock. These changes may be incorporated through an addendum currently being developed.

III. Status of the Fishery

This report includes updated recreational estimates from the Marine Recreational Information Program's transition to the mail-based Fishing Effort Survey (FES) on July 1, 2018. Past recreational estimates have been calibrated to the FES and, therefore, are different from those shown in FMP Reviews and state compliance reports prior to 2018.

Total Atlantic croaker harvest from New Jersey through the east coast of Florida in 2018 is estimated at 6.5 million pounds (Tables 2 and 3, Figure 1). This represents an 86% decline in total harvest since the peak of 47.4 million pounds in 2003 (87% commercial decline, 85% recreational decline). The commercial and recreational fisheries harvested 57% and 43% of the 2018 total, respectively.

Atlantic coast commercial landings of Atlantic croaker exhibit a cyclical pattern, with low harvests in the 1960s to early 1970s and the 1980s to early 1990s, and high harvests in the mid-to-late 1970s and the mid-1990s to early 2000s (Figure 1). Commercial landings increased from a low of 3.7 million pounds in 1991 to 28.6 million pounds in 2001 (Table 2); however, landings have declined every year since 2010 to 3.7 million pounds in 2018, well below the time series (1950-2018) average of 12.5 million pounds. Within the management unit, the majority of 2018 commercial landings came from Virginia (53%) and North Carolina (44%).

From 1981-2018, recreational landings of Atlantic croaker from New Jersey through Florida have varied by count between 7.1 million fish and 36.2 million fish and by weight between 2.8 million pounds and 18.9 million pounds (Tables 3 and 4, Figure 2). Landings generally increased until 2003, after which they showed a declining trend through 2018. The 2018 landings are estimated at 7.1 million fish and 2.8 million pounds, the lowest recreational harvest on record. Virginia was responsible for 68% of the 2018 recreational landings, in numbers of fish, followed by Florida (13%).

The number of recreational releases generally increased over the time series until 2013, after which numbers of releases have generally decreased through 2018 (Figure 2). However, percentage of released recreational catch has shown a slight increasing trend from the 1990s through 2018. In 2018, anglers released 16.8 million fish, a decline from the 23.9 million fish released in 2017. Anglers released an estimated 70% of the recreational croaker catch in 2018, the highest percentage on record (Figure 2).

IV. Status of Assessment Advice

A statistical catch-at-age (SCA) model was used in the 2010 Atlantic croaker stock assessment (ASMFC 2010). This model combines catch-at-age data from the commercial and recreational fisheries with information from fishery-independent surveys and biological information such as growth rates and natural mortality rates to estimate the size of each age class and the

exploitation rate of the population. The assessment was peer reviewed by a panel of experts in conjunction with the Southeast Data, Assessment, and Review (SEDAR) process.

The Review Panel was unable to support some of the 2010 assessment results due to uncertainty regarding the estimation of Atlantic croaker discards in the shrimp trawl fishery, and the application of estimates in modeling. Specifically, model-estimated values of stock size, fishing mortality, and biological reference points are too uncertain for use; however, the trends in model-estimated parameters and ratio-based fishing F reference points are considered reliable. Despite the uncertainty in assessment results caused by shrimp trawl bycatch, the Review Panel concluded that it is unlikely that the stock is in trouble. The stock is not experiencing overfishing, biomass has been trending up, commercial catches are stable, and discards from the shrimp trawl fishery have been reduced.

A benchmark stock assessment was conducted in 2017, but was not recommended for management use due to uncertainty in biomass estimates resulting from conflicting signals among abundance indices and catch time series as well as sensitivity of model results to assumptions and model inputs. Because the most recent assessment was not recommended for management use, current stock status is unknown. One noted improvement in this assessment was in the estimation of Atlantic croaker discards by the shrimp trawl fishery. The Review Panel recommended incorporation of shrimp trawl discard estimates into the annual monitoring of Atlantic croaker through the TLA. The TC has recommended several changes to the TLA that would help resolve some of the conflict between harvest and abundance signals. The Board has initiated an addendum to the Atlantic Croaker FMP to incorporate these changes.

V. Status of Research and Monitoring

There are no research or monitoring programs required of the states except for the submission of an annual compliance report. The following fishery-dependent (other than catch and effort data) and fishery-independent monitoring programs were reported in the 2018 compliance reports.

Fishery-Dependent Monitoring

- New Jersey: initiated biological monitoring of commercially harvested Atlantic croaker in 2006 in conjunction with ACCSP (2018 n=52 lengths, weights, and ages)
- Delaware: collects trip-based information on pounds landed, area fished, effort, and gear type data through mandatory monthly state logbook reports submitted by fishermen.
- Maryland: commercial pound net fishery biological sampling; seafood dealer sampling (121 lengths and weights)
- PRFC: has a mandatory commercial harvest daily reporting system, with reports due weekly.
- Virginia: commercial fishery biological sampling (8,127 length measurements, 8,074 weight measurements, 274 otolith ages, and 419 sex determinations in 2018)
- North Carolina: commercial fishery biological sampling since 1982 for length (2018 n=3,766), weight, otolith, sex determination, and reproductive condition.

- South Carolina: recreational fishery biological sampling via SCDNR State Finfish Survey, MRIP, and a SCDNR-managed mandatory trip reporting system for licensed charter boat operators. In 2013, SCDNR took over its portion of MRIP data collection.
- Georgia: collects biological information, including length, sex, and maturity stage, through the Marine Sportfish Carcass Recovery Project (1 fish in 2018)
- Florida: commercial fishery biological sampling

Fishery-Independent Monitoring

- New Jersey: 3 nearshore ocean (within 12 nm) juvenile trawl surveys (New Jersey Ocean Trawl Survey, 1988-present: 2018 CPUE (0.82) was well below time-series average (1.94); nearshore Delaware Bay juvenile trawl survey, 1991-present: 2018 survey index (0.33) was well below time series average (4.23); Delaware River juvenile seine survey, 1980-present: 2018 survey index (0.02) was well below time series average (0.22).
- Delaware: offshore Delaware Bay adult finfish trawl survey (1990-present; 2017 #/tow = 11.6; 99% increase in relative abundance from 2017 index, below mean for time series); nearshore Delaware Bay juvenile finfish trawl survey (1980-present; 2018 index increased from 0.81 in 2017 to 5.43; Inland Bays index increased from 0.30 in 2017 to 2.41 in 2018).
- Maryland: summer gill net survey was initiated in 2013 on lower Choptank (8 fish were captured in 2018); Atlantic coast bays juvenile otter trawl survey (standardized from 1989-present; 2018 GM of 0.46 fish/hectare is the fifth lowest value of the 30-year time series); Chesapeake Bay juvenile trawl index (standardized from 1989-present; CPUE decreased from 2.35 fish/tow in 2017 to 1.13 in 2018).
- PRFC: Maryland DNR conducts an annual juvenile beach haul seine survey in the Potomac River (1954-present; YOY GM decreased from 0.35 in 2017 to 0.00 in 2018).
- Virginia: Virginia Institute of Marine Science (VIMS) Juvenile Finfish and Blue Crab Trawl Survey (1988-present; 2018 index was 15.64, which is up from the 2017 value of 0.614).
- North Carolina: Pamlico Sound juvenile trawl survey (1987-present; 2018 juvenile abundance index (mean number of individuals/tow) was 136.8, down from 1,172.3 in 2017); Pamlico Sound gill net survey (2001-present; 2018 CPUE 0.5 fish per sample, below time series mean)
- South Carolina: SEAMAP shallow water (15-30 ft) trawl survey from Cape Hatteras to Cape Canaveral (1989-present; 2018 CPUE increased by 16% from 2017); inshore estuarine trammel net survey for adults (May-September, 1991-present; 2018 CPUE decreased 8.5% from 2017); estuarine electroshock survey for juveniles (2001-present; 2018 CPUE decreased by 76% since 2017, lowest value of time series); SCECAP estuarine trawl survey (1999-present, primarily targets juveniles, 2018: 41.9 #/hectare increased from 2017 by 757%).
- Georgia: Marine Sportfish Population Health Survey (trammel and gill net surveys in the Altamaha River Delta and Wassaw estuary, 2002-present; 2018 trammel net index (GM #/standard net set): 0.1, gill net index: 0.5); Ecological Monitoring Survey (trawl, 2003-present; 2018 index (GM #/standard trawl) was 11.3).

- Florida: YOY seine survey (2002-present; 2018 index increased by 167% from 2017); sub-adult/adult haul seine survey (2001-present; 2018 index value increased by 19% from 2017).

The Northeast Fishery Science Center (NEFSC) performs a randomly stratified groundfish survey along the U.S. east coast. Atlantic croaker are one of the main species caught throughout much of the survey area and, since the surveys started in 1972, it provides a long term data set. Regionally, mean CPUE (catch-per-unit-effort) of Atlantic croaker has increased from north to south. Since 1994, there has been an increase in annual catch variability. The NEFSC survey was not carried out in 2017 due to mechanical issues with the RV Bigelow. Catch levels in 2018 (394.0 fish per tow) declined 24.5% from 2016 (521.9 fish per tow) and dropped below the long term mean (498 fish per tow). The CPUE for 2017 was estimated as the mean of 2015-2016 and 2017 as a place holder in the index. The estimated CPUE for 2017 (457.9 fish per tow) was just below the long term mean. The TLA analysis of annual catch levels also reflected the decrease in CPUE in 2018 with the increasing proportion of yellow and a red proportion of 16.2%. The decline in catch levels in the last several years shows abundance levels just below the long term mean or yellow/green threshold for 2016-2018.

VI. Status of Management Measures and Issues

Fishery Management Plan

Amendment 1 was fully implemented by January 1, 2006, and provided the management plan for the 2009 fishing year. There are no interstate regulatory requirements for Atlantic croaker. Should regulatory requirements be implemented in the future, all state programs must include law enforcement capabilities adequate for successfully implementing the regulations. Addendum I to Amendment 1 was initiated in August 2010 and approved in March 2011, in order to 1) revise the biological reference points to be ratio-based, and 2) remove the distinction of two regions within the management unit, based on the results of the 2010 stock assessment. Addendum II was approved August 2014 and established the TLA management framework for Atlantic croaker in order to better illustrate long-term trends in the fishery.

Traffic Light Approach

Addendum II established the TLA as the new management framework for Atlantic croaker. Under this management program, if thresholds for both population characteristics (harvest and adult abundance) achieve or exceed the proportion of threshold for the specified three year period, management action will be taken.

Analysis of the harvest composite index for 2018 shows that this population characteristic tripped for a third consecutive year (Figure 3). Recreational harvest was estimated based on MRIP's mail-based Fishing Effort Survey calibration. The mean proportion of red color from 2014-2018 was 55.2%, with a red proportion in 2018 exceeding the 60% threshold. The harvest composite index was comprised of commercial and recreational landings. Both commercial and recreational indices were above the 60% threshold in 2018 with commercial landings exceeding the 60% level for the past two years.

The abundance composite TLA index was broken into two components based on age composition. The adult composite index was generated from the NEFSC and SEAMAP surveys, since the majority of Atlantic croaker captured in those surveys were ages 1+. The juvenile composite index was generated from the North Carolina (NC) Program 195 and VIMS surveys because these two captured primarily young-of-the-year Atlantic croaker.

Two of four TLA abundance indices showed increases in red proportions for 2018. The NEFSC survey was not conducted in 2017 due to mechanical issues with the RV Bigelow but the 2018 index showed an increased red proportion in 2018 from 2016. The SEAMAP index showed increased abundance in the fall and had no red in the index and an increase in the green proportion. The adult composite TLA characteristic (Figure 4) did not trigger in 2018 with a red proportion of 16.3%. The juvenile composite characteristic index (Figure 5) was 24% red and 4% green, due to a large increase in the VIMS index and a large decrease in the NC Program 195 survey. The higher annual variability for the different color proportions in the juvenile composite characteristic, in comparison to the adult composite characteristic, is likely a reflection annual recruitment variability rather than population trends.

Overall, management triggers were not tripped in 2018 since both adult population characteristics (harvest and adult abundance) were not above the 30% threshold for the 2016-2018 time period. This continues a trend of disconnect between the harvest and abundance indices since the mid-2000s, with the harvest metric generally decreasing and abundance metric generally increasing.

De Minimis Requests

States are permitted to request *de minimis* status if, for the preceding three years for which data are available, their average commercial landings or recreational landings (by weight) constitute less than 1% of the coastwide commercial or recreational landings for the same three year period. A state may qualify for *de minimis* in either its recreational or commercial sector, or both, but will only qualify for exemptions in the sector(s) that it qualifies for as *de minimis*. Amendment 1 does not include any compliance requirements other than annual state reporting, which is still required of *de minimis* states, thus *de minimis* status does not exempt states from any measures.

In the annual compliance reports, the following states requested *de minimis* status: Delaware (commercial fishery), South Carolina (commercial fishery), Georgia (commercial fishery), and Florida (commercial fishery). The commercial and recreational *de minimis* criteria for 2018 are based on 1% of the average coastwide 2016-2018 landings in each fishery: 47,066 pounds for the commercial fishery and 45,320 pounds for the recreational fishery. The Delaware commercial fishery qualifies for *de minimis* status, but landings are confidential. The South Carolina commercial fishery qualifies for *de minimis* status, but 2018 landings are confidential (the 2016-2017 average is 279 pounds). The Georgia commercial fishery qualifies for *de minimis* status with a three-year average of zero pounds. The Florida commercial fishery does not qualify for *de minimis* status with a three-year average of 51,660 pounds (1.1% of the coastwide three-year average). However, given Florida's longstanding *de minimis* status and the

small margin above the average landings threshold, the Atlantic Croaker Plan Review Team (PRT) recommends Florida maintain *de minimis* status.

Changes to State Regulations

In 2018, North Carolina enacted several gill net restrictions for coastal waters pertaining to area closures/openings, gear modifications, and attendance rules to avoid interactions with endangered species or bycatch species. These restrictions may indirectly affect the harvest and bycatch of Atlantic croaker and are defined by North Carolina Proclamations: M-10-2018, M-9-2018, M-7-2018, M-6-2018, and FF-48-2018.

Through 2017, Georgia had a general commercial fishing license. License applications had a voluntary survey asking purchasers to check off the species or species groupings they planned to pursue. The check-off was non-binding and the associated participation data were not useful for determining reporting requirements. In 2013, GADNR began issuing Letters of Authorization (LOAs) for several target species to improve the participation data. In 2017, the Georgia General Assembly approved the addition of species endorsements to commercial fishing licenses to replace LOAs (O.C.G.A. 27-2-23). In 2017, the Georgia General Assembly approved the addition of species endorsements to commercial fishing licenses to replace LOAs (O.C.G.A. 27-2-23) which was followed by the Board of Natural Resources implementation in December 2017 (Board Rule 391-2-4-.17). Species endorsements, including one for finfish, were issued starting with the 2018-2019 fishing season.

A new seafood dealer license was also implemented April 1, 2018 (O.C.G.A. 27-2-23 and Board Rule 391-2-4-.09). Seafood dealers are defined as “any person or entity, other than the end-consumer, who purchases seafood products from a harvester unless the harvester is a licensed seafood dealer.” Commercial harvesters fishing in Georgia waters and/or unloading seafood products must possess a commercial fishing license and the appropriate species endorsements. A harvester is required to have a dealer’s license if he is selling his catch to end consumers.

Atlantic Croaker Habitat

In winter of 2017, the ASMFC Habitat Committee released *Atlantic Sciaenid Habitats: A Review of Utilization, Threats, and Recommendations for Conservation, Management, and Research*, which outlines the habitat needs of Atlantic croaker at different life stages (egg, larval, juvenile, adult). This report also highlights threats and uncertainties facing these ecological areas and identifies Habitat Areas of Particular Concern. It can be found online at: http://www.asmfc.org/files/Habitat/HMS14_AtlanticSciaenidHabitats_Winter2017.pdf.

Bycatch Reduction

Atlantic croaker is subject to both direct and indirect fishing mortality. Historically, croaker ranked as one of the most abundant bycatch species of the south Atlantic shrimp trawl fishery, resulting in the original FMP’s recommendation that bycatch reduction devices (BRDs) be developed and required in the shrimp trawl fishery. Since then, the states of North Carolina through Florida have all enacted requirements for the use of BRDs in shrimp trawl nets in state waters, reducing croaker bycatch from this fishery (ASMFC 2010). However, bycatch and

discard monitoring from the shrimp trawl fishery have historically been inadequate, resulting in a major source of uncertainty for assessing this stock, as well as other important Mid- and South Atlantic species. Most of the discarded croaker are age-0 and thus likely have not yet reached maturity (ASMFC 2010). The North Carolina Division of Marine Fisheries conducted a two-year study, published in 2015, to collect bycatch data from state shrimp trawlers. It found that Atlantic croaker represent between 34-49% of the total observed finfish bycatch by weight in estuarine waters and between 20-42% in ocean waters. The at-net mortality for Atlantic croaker was found to be 23% (Brown 2015). These data will be valuable for incorporating estimates of removals in future stock assessments.

Atlantic croaker are also discarded from other commercial fishing gears, primarily due to market pressures and few restrictions on croaker harvest at the state level. The National Oceanic and Atmospheric Administration (NOAA) Fisheries Pelagic Observer Program provides data to estimate these discards for use in assessments; however, the time series is limited and only discards from gill nets and otter trawls could be estimated for the 2010 assessment based on the available data. Since 1988, estimated discards have fluctuated between 94 and 15,176 mt without trend, averaging 2,503 mt (ASMFC 2010).

Atlantic croaker is also a major component of the scrap/bait fishery. Landings from this fishery are not reported at the species level, except in North Carolina, which has a continuous program in place to sample these landings and enable estimation of croaker scrap landings for use in the stock assessment. As part of the 2010 stock assessment, North Carolina estimated the scrap/bait landings, which have declined in recent years, from a high of 1,569 mt in 1989 to a low of 84 mt in 2008, primarily due to restrictions placed on fisheries producing the highest scrap/bait landings (ASMFC 2010). Regulations instituted by North Carolina include a ban on flynet fishing south of Cape Hatteras, incidental finfish limits for shrimp and crab trawls in inside waters, minimum mesh size restrictions in trawls, and culling panels in long haul seines.

South Carolina has also begun a state monitoring program to account for scrap landings. The state initiated a bait harvester trip ticket program for all commercial bait harvesters licensed in South Carolina. The impetus for this program is to track bait usage of small sciaenid species (croaker, spot, and whiting) as well as other important bait species.

Several states have implemented other commercial gear requirements that further reduce bycatch and bycatch mortality, while others continue to encourage the use of the BRD devices. NOAA Fisheries published a notice on June 24, 2011 for public scoping in the Federal Register to expand the methods for reducing bycatch interactions with sea turtles, which may have additional effects on the bycatch of finfish like Atlantic croaker in trawls (76 FR 37050). Continuing to reduce the quantity of sub-adult croaker harvested should increase spawning stock biomass and yield per recruit.

Atlantic croaker are also subject to recreational discarding. The percentage of Atlantic croaker released alive by recreational anglers has generally increased over time. Discard mortality was

estimated to be 10% for the 2010 stock assessment (ASMFC 2010). The use of circle hooks and appropriate handling techniques can help reduce mortality of released fish.

VII. Implementation of FMP Compliance Requirements for 2019

The PRT finds that all states have fulfilled the requirements of Amendment 1.

VIII. Recommendations

Management and Regulatory Recommendations

- Consider approval of the *de minimis* requests from Delaware, South Carolina, Georgia, and Florida for their commercial fisheries.
- Encourage the use of circle hooks to minimize recreational discard mortality.
- Consider the basic research and monitoring information needed for informed management in light of the budgetary constraints limiting all state governments.

Research and Monitoring Recommendations

High Priority

- 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.
- Investigate environmental covariates in stock assessment models including climate cycles (e.g., Atlantic Multi-decadal Oscillation, AMO, and El Niño Southern Oscillation, El Niño) and recruitment and/or year class strength, spawning stock biomass, stock distribution, maturity schedules, and habitat degradation.
- Continue to develop estimates of length-at-maturity and year-round reproductive dynamics throughout the species range. Assess whether temporal 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, MD) and coastal data sets (MARMAP, EcoMon).
- Investigate the relationship between estuarine nursery areas and their proportional contribution to adult biomass, i.e., are select nursery areas along Atlantic coast ultimately contributing more to SSB than others, reflecting better quality juvenile habitat?

Medium Priority

- Conduct studies of discard mortality for recreational and commercial fisheries by each gear type in regions where removals are highest.

- In the recreational fishery, develop sampling protocol for collecting lengths of discarded finfish and collect otolith age samples from retained fish.
- Encourage fishery-dependent biological sampling, with proportional landings representative of the distribution of the fisheries. Develop and communicate clear protocols on truly representative sampling.
- Quantify effects of BRDs and TEDs implementation in the shrimp trawl fishery by examining their relative catch reduction rates on Atlantic croaker.
- Utilize NOAA Fisheries Ecosystem Indicators bi-annual reports to consider folding indicators into the assessment; identify mechanisms for how environmental indicators affect the stock.
- Encourage efforts to recover historical landings data, determine whether they are available at a finer scale for the earliest years than are currently reported.
- Collect data to develop gear-specific fishing effort estimates and investigate methods to develop historical estimates of effort.
- Develop gear selectivity studies for commercial fisheries with emphasis on age 1+ fish.
- Conduct studies to measure female reproductive output at size and age (fecundity, egg and larval quality) and impact on assessment models and biomass reference points.
- Develop and implement sampling programs for state-specific commercial scrap and bait fisheries in order to monitor the relative importance of Atlantic croaker. Incorporate biological data collection into the program.

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X. Figures

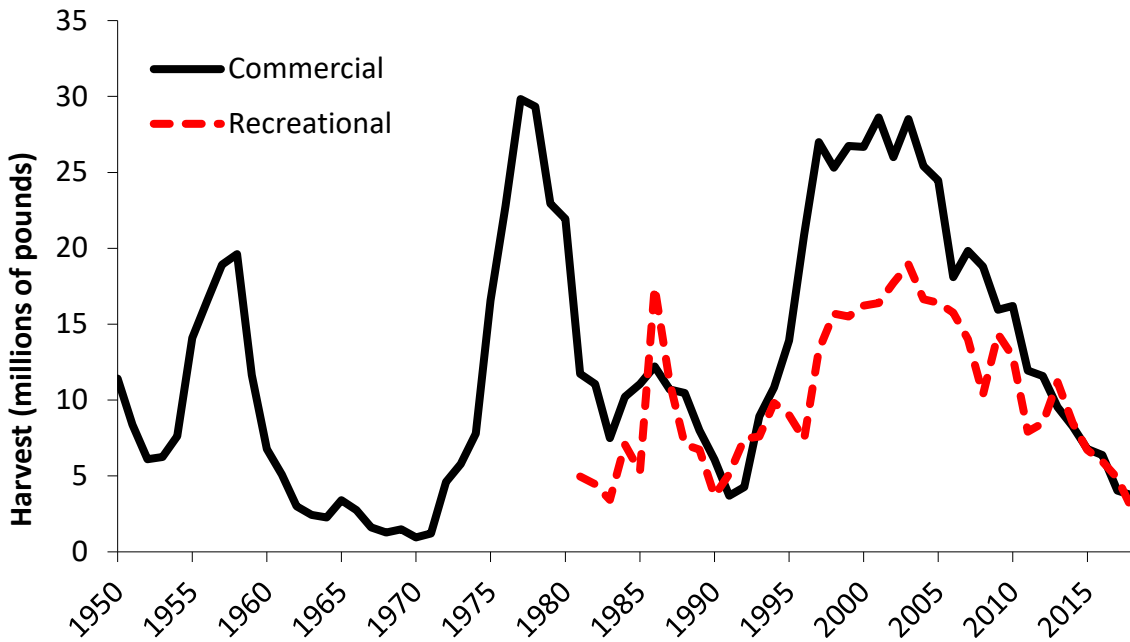


Figure 1. Atlantic croaker commercial and recreational landings (pounds) from 1950-2018. (See Tables 2 and 3 for source information. Commercial landings estimate for 2018 is preliminary. Reliable recreational landings estimates are not available prior to 1981. Recreational landings estimates are based on the mail-based Fishing Effort Survey.)

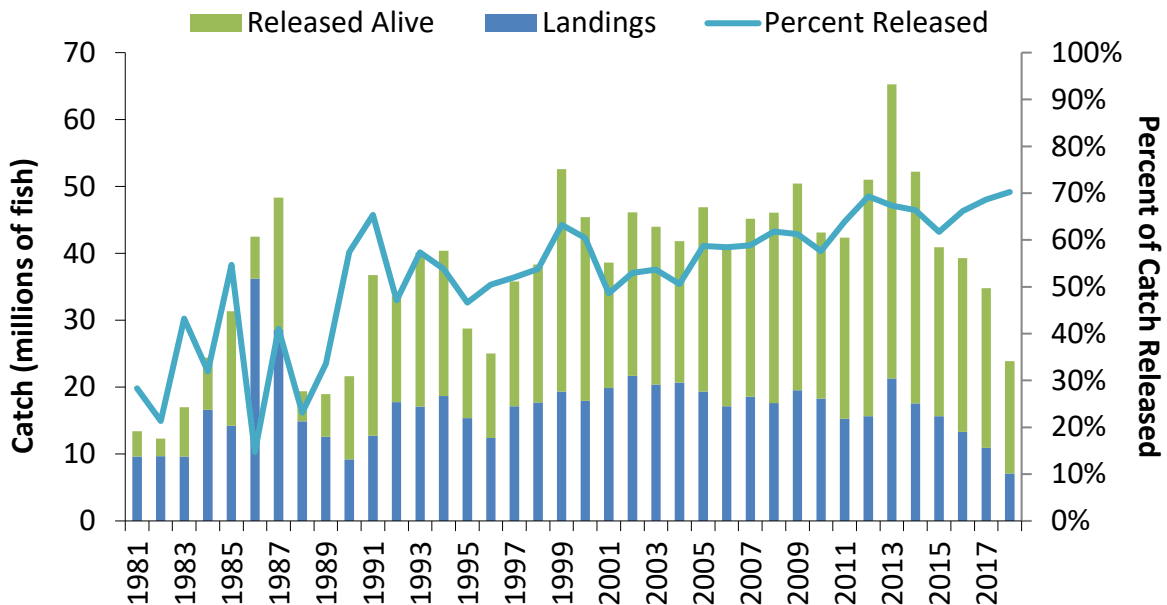


Figure 2. Recreational catch (landings and alive releases, in numbers) and the percent of catch that is released, 1981-2018, based on the mail-based Fishing Effort Survey calibration. (See Tables 4 and 5 for values and source information.)

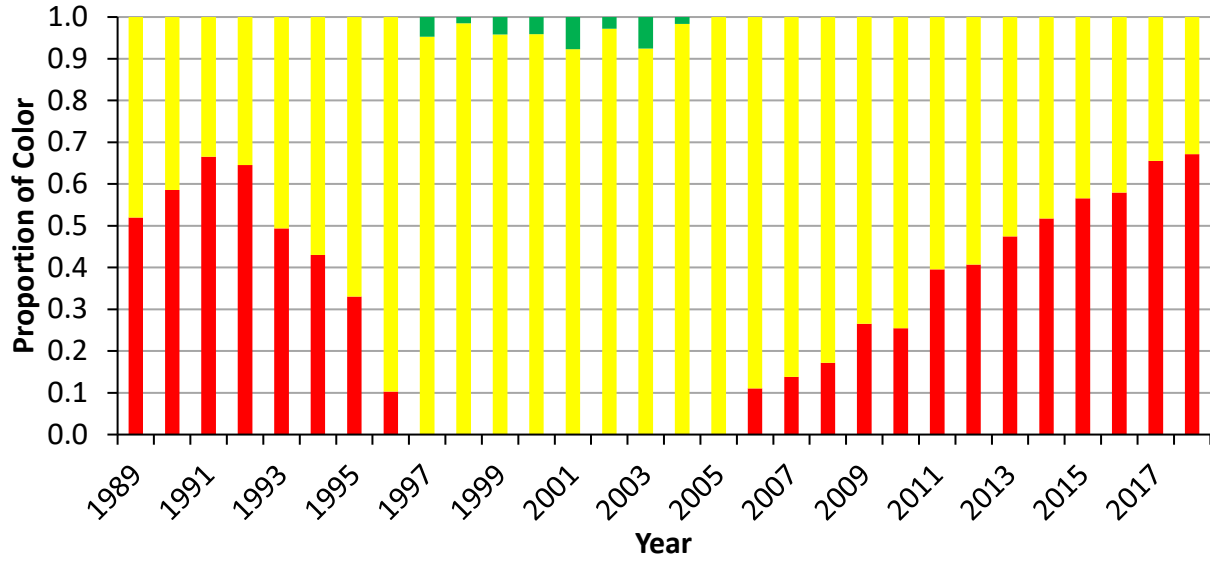


Figure 3. Annual color proportions for the harvest composite TLA analysis for Atlantic croaker recreational and commercial landings.

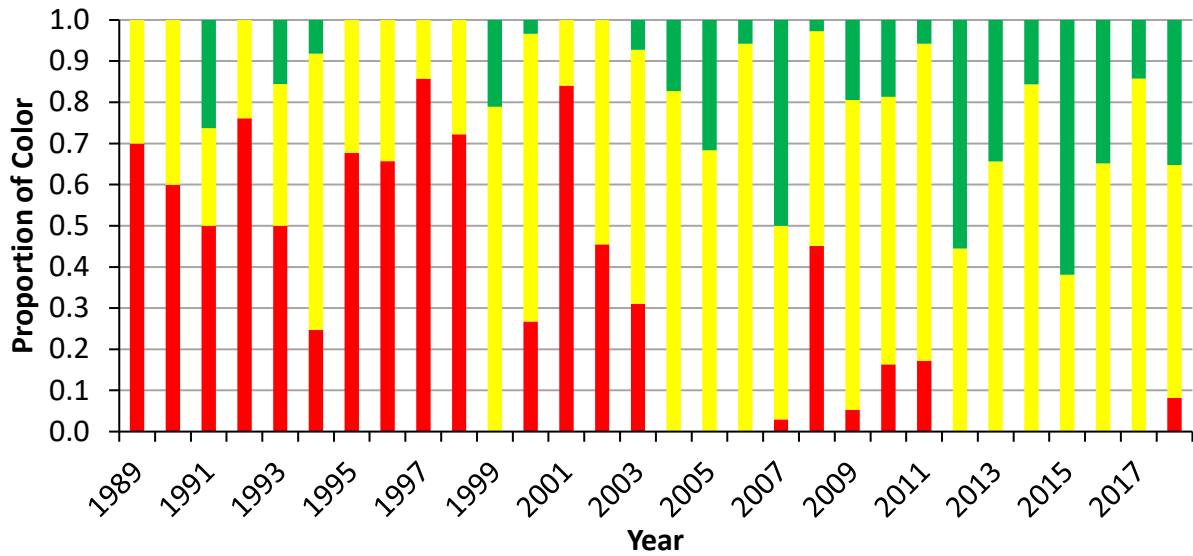


Figure 4. Adult croaker TLA composite characteristic index (NEFSC and SEAMAP surveys). The NEFSC survey was not conducted in 2017 due to mechanical problems with the RV Bigelow. The 3-year average of 2014-2016 values was imputed to estimate the 2017 value for this index.

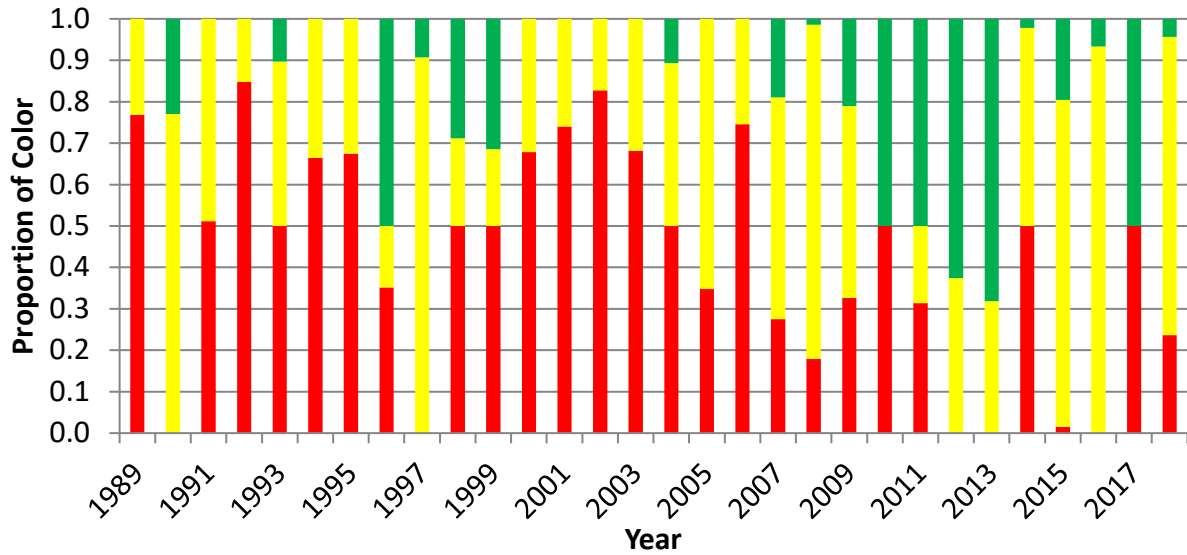


Figure 5. Juvenile croaker TLA composite characteristic index (NC 195 and VIMS surveys).

XI. Tables

Table 1. Summary of state regulations for Atlantic croaker in 2018.

State	Recreational	Commercial
NJ	none	otter/beam trawl mesh restriction for directed croaker harvest (>100 lbs in possession)
DE	8" minimum; recreational gill nets (up to 200 ft.) with license	8" minimum
MD	9" min, 25 fish/day, charter boat logbooks	9" minimum; open 3/16 to 12/31
PRFC	25 fish/day	pound net season: 2/15 to 12/15
VA	none	none
NC	recreational use of commercial gears with license and gear restrictions	
SC	mandatory for-hire logbooks, small Sciaenidae species aggregate bag limit of 50 fish/day	
GA	25 fish/day	25 fish/day limit except for trawlers harvesting shrimp for human consumption (no limit)
FL	none	none

* A commercial fishing license is required to sell croaker in all states with fisheries. For all states, general gear restrictions affect commercial croaker harvest.

Table 2. Commercial harvest (pounds) of Atlantic croaker by state, 2009-2018.

(Estimates for 2018 are preliminary. Sources: 2019 state compliance reports for 2018 fishing year and for years prior to 2018, personal communication with ACCSP, Arlington, VA [07/10/2019], except PRFC [compliance reports only].)

Year	NJ	DE	MD	PRFC	VA	NC	SC	GA	FL	Total
2009	585,552	C	448,589	234,101	8,489,772	6,135,437	75		32,151	15,942,018
2010	342,116	C	542,233	162,571	7,796,179	7,312,159	C		37,229	16,198,548
2011	458,397	C	714,347	243,196	5,415,432	5,054,186	C		47,649	11,945,181
2012	363,381	C	915,432	273,849	6,842,005	3,106,616	C		74,527	11,578,682
2013	332,813	C	820,777	130,285	6,237,602	1,927,938	C		76,463	9,532,551
2014	265,166	C	443,661	177,777	4,697,381	2,629,908	247		45,587	8,269,374
2015	81,311	C	294,038	118,996	4,426,957	1,819,067	C		39,096	6,783,689
2016	55,210	C	101,949	168,889	3,825,737	2,164,015	302		57,538	6,374,435
2017	1,068	C	42,958	114,319	2,822,005	1,007,963	256		43,033	4,031,880
2018	C	C	44,305	16,561	1,953,794	1,643,607	C		54,409	3,713,470

C: Confidential data

Table 3. Recreational harvest (pounds) of Atlantic croaker by state, 2009-2018. (Sources: 2019 state compliance reports for 2018 fishing year and for years prior to 2018, personal communication with ACCSP, Arlington, VA [07/10/2019])

Year	NJ	DE	MD	VA	NC	SC	GA	FL	Total
2009	662,763	615,692	3,012,580	8,282,280	359,703	214,212	69,031	1,120,776	14,337,037
2010	79,889	106,268	2,472,032	9,295,413	638,817	27,184	35,593	209,519	12,864,715
2011	50,153	123,487	1,188,916	4,584,599	360,390	583,280	38,219	995,506	7,924,550
2012	259,645	147,737	1,980,417	4,664,264	307,338	30,149	29,815	1,063,337	8,482,702
2013	1,637,516	253,447	1,581,384	6,442,166	453,881	84,248	89,781	642,887	11,185,310
2014	750,580	427,615	1,265,217	4,354,046	758,751	104,434	138,423	712,090	8,511,156
2015	263,749	189,320	871,596	3,514,410	557,735	181,909	248,431	881,185	6,708,335
2016	7,133	10,959	407,010	2,998,022	443,728	81,896	116,313	1,893,203	5,958,264
2017	0	26,429	238,659	3,383,506	237,160	310,621	100,565	555,389	4,852,329
2018	34,125	5,859	191,854	1,935,837	128,011	81,251	82,174	326,265	2,785,376

Table 4. Recreational harvest (numbers) of Atlantic croaker by state, 2009-2018. (Sources: 2019 state compliance reports for 2018 fishing year and for years prior to 2018, personal communication with ACCSP, Arlington, VA [07/10/2019])

Year	NJ	DE	MD	VA	NC	SC	GA	FL	Total
2009	1,059,267	983,173	2,586,887	10,789,517	958,128	733,845	185,129	2,252,473	19,548,419
2010	142,887	207,601	2,994,889	12,961,723	1,280,446	88,399	121,252	470,168	18,267,365
2011	91,014	212,613	1,530,723	8,891,276	873,659	949,132	129,941	2,593,963	15,272,321
2012	830,891	202,283	2,565,599	8,786,350	848,495	132,264	104,944	2,190,268	15,661,094
2013	2,707,410	530,236	2,308,987	12,517,286	1,300,804	336,140	264,984	1,332,465	21,298,312
2014	852,733	806,256	2,197,125	9,533,829	1,935,961	600,482	289,781	1,359,207	17,575,374
2015	339,021	334,676	1,738,576	8,024,381	1,437,019	555,263	790,014	2,429,723	15,648,673
2016	8,236	24,546	659,318	7,276,719	1,109,570	268,470	402,254	3,553,777	13,302,890
2017	0	65,575	425,987	7,637,843	666,930	765,227	371,301	969,146	10,902,009
2018	104,321	12,371	305,469	4,815,585	372,397	335,833	241,957	919,981	7,107,914

Table 5. Recreational releases (number) of Atlantic croaker by state, 2009-2018. (Sources: 2019 state compliance reports for 2018 fishing year and for years prior to 2018, personal communication with ACCSP, Arlington, VA [07/10/2019])

Year	NJ	DE	MD	VA	NC	SC	GA	FL	Total
2009	406,639	1,284,262	2,424,818	16,732,646	5,623,278	1,232,519	1,169,782	2,015,296	30,889,240
2010	380,916	1,056,528	3,060,983	13,470,836	4,571,287	621,497	651,984	1,014,552	24,828,583
2011	252,419	214,603	937,220	14,160,124	7,005,152	1,187,686	748,696	2,559,976	27,065,876
2012	3,336,964	1,036,383	7,090,976	15,140,369	3,878,710	1,070,703	781,302	2,999,225	35,334,632
2013	2,980,744	1,811,661	7,557,223	18,480,099	6,729,556	3,754,143	1,361,943	1,265,571	43,940,940
2014	703,031	1,396,970	2,806,693	10,314,405	10,347,332	4,742,718	2,057,898	2,265,961	34,635,008
2015	240,840	309,389	1,236,293	6,815,343	9,632,560	3,236,774	1,320,939	2,451,253	25,243,391
2016	139,085	390,655	726,662	6,993,470	7,254,382	5,233,835	1,178,630	4,073,001	25,989,720
2017	152,540	230,934	2,833,760	8,443,528	4,631,445	4,755,853	1,059,539	1,770,846	23,878,445
2018	144,637	85,424	203,081	4,980,703	3,580,227	5,568,892	1,395,514	816,536	16,775,014