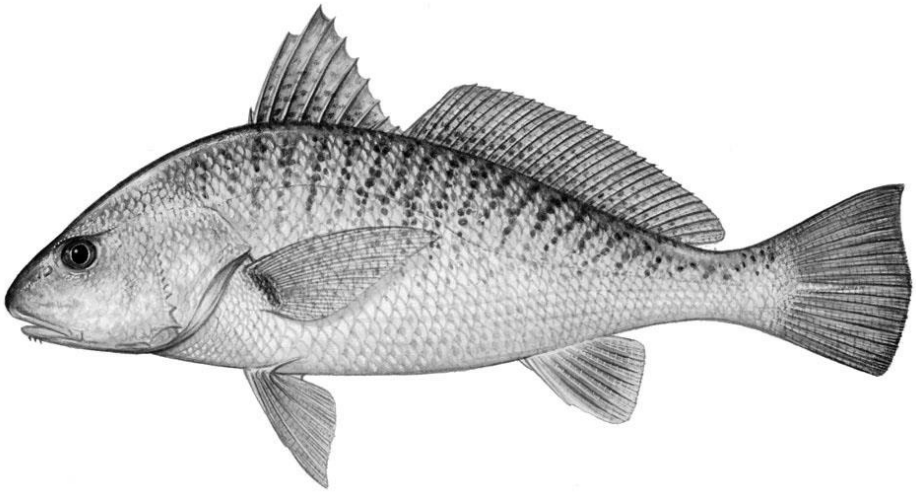
Traffic Light Analysis of Atlantic Croaker (*Micropogonias undulatus)* for the Atlantic States Marine Fisheries Commission Fishery Management Plan Review.

Update for 2017 Fishing Year
&
Proposed Changes to TLA Management Scheme



Atlantic Croaker Plan Review Team

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Introduction

Atlantic croaker are managed under Amendment 1 to the Interstate Fishery Management Plan for Atlantic Croaker (2005) and Addendum I (2011). The Amendment does not require any specific measures restricting harvest but encourages states with conservative measures to maintain them. It also implemented a set of management triggers, based on an annual review of certain metrics, to respond to changes in the fishery or resource and initiate a formal stock assessment on an accelerated timeline if necessary. The Addendum revises the management program's biological reference points to assess stock condition on a coastwide basis as recommended by the 2010 stock assessment.

In August 2014, the South Atlantic State/Federal Fisheries Management Board approved Addendum II to Amendment I to the Atlantic Croaker Fishery Management Plan (FMP). The Addendum establishes a new management framework (i.e., Traffic Light Approach or TLA) to evaluate fisheries trends and develop state-specified management actions (i.e., bag limits, size restrictions, time & area closures, and gear restrictions) when harvest and abundance thresholds are exceeded. The TLA is a statistically-robust way to incorporate multiple data sources (both fishery-independent and -dependent) into a single, easily understood metric for management advice. It is often used for data-poor species, or species which are not assessed on a frequent basis, such as blue crabs in North Carolina and snow crabs in the Gulf of St. Lawrence. As such, its serves as an excellent management tool for Atlantic croaker.

The name comes from assigning a color (red, yellow, or green) to categorize relative levels of indicators on the condition of the fish population (abundance metric) or fishery (harvest metric). For example, as harvest or abundance increase relative to their long-term mean, the proportion of green in a given year will increase and as harvest or abundance decrease, the amount of red in that year becomes more predominant. Under the Addendum II, state-specific management action would be initiated when the proportion of red exceeds specified thresholds (30% or 60%), for both harvest and abundance, over three consecutive years.

The current management triggers for Atlantic croaker compare annual changes in various indices (e.g. recent landings and survey information) to review trends in the fisheries. The Atlantic Croaker Technical Committee expressed concern that previous review methodology did not illustrate long-term trends in the stock nor did it include specific management measures to implement in response to declines in the stock or fishery. This resulted in the change to the TLA for annual review of Atlantic croaker. A new stock assessment for Atlantic croaker was completed in 2017 and recommendations for further refinement of the management triggers from the TLA are contained in the second part of this report.

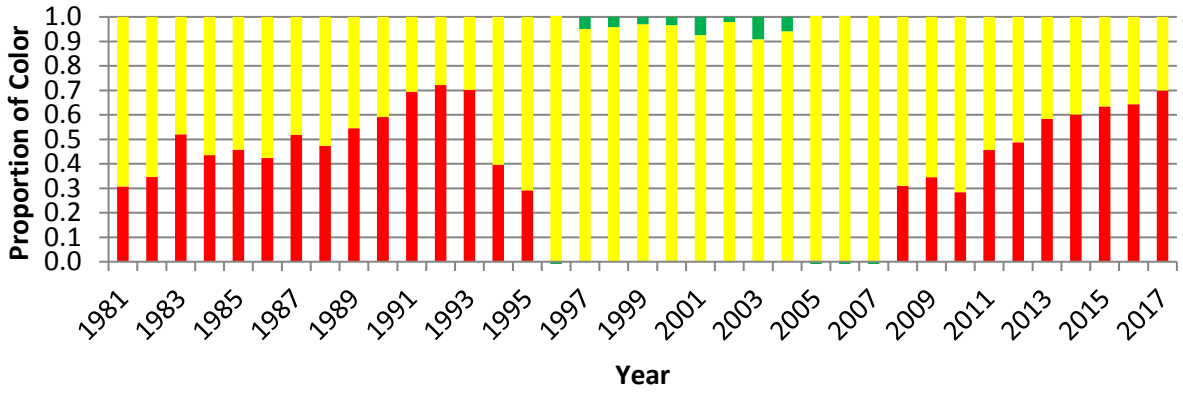
The indices used for the TLA include both commercial and recreational harvest (fishery dependent) and four fishery-independent monitoring surveys that occur in different areas of the Atlantic coast of the United States. The fishery-independent surveys include the Northeast Fisheries Science Center (NMFS) fall ground fish trawl survey, the Virginia Institute of Marine Science (VIMS) trawl survey, the North Carolina Division of Marine Fisheries trawl program 195, and the Southeast Area Monitoring Assessment Program (SEAMAP) trawl survey.

Traffic Light Analysis (Fishery Dependent)

Commercial Landings

- Commercial landings declined 27% in 2017 (1,550 metric tons) from 2016 (2,127 metric tons) and represented the 11th year of decline in commercial croaker landings.
- The TLA for commercial landings has been above the 30% every year since 2011 (Fig. 1) and was the 7th year in a row where landings were above the 30%.
- More concerning is that the red proportion has been above the 60% red threshold for the last four years (2014-2017).
- The three year mean red proportion for croaker has exceeded 30% since 2010 and has exceeded 60% for the last three years. The continued steady decline in croaker landings in recent years represent some of the lowest landings levels in the time series and indicate some management response is required.

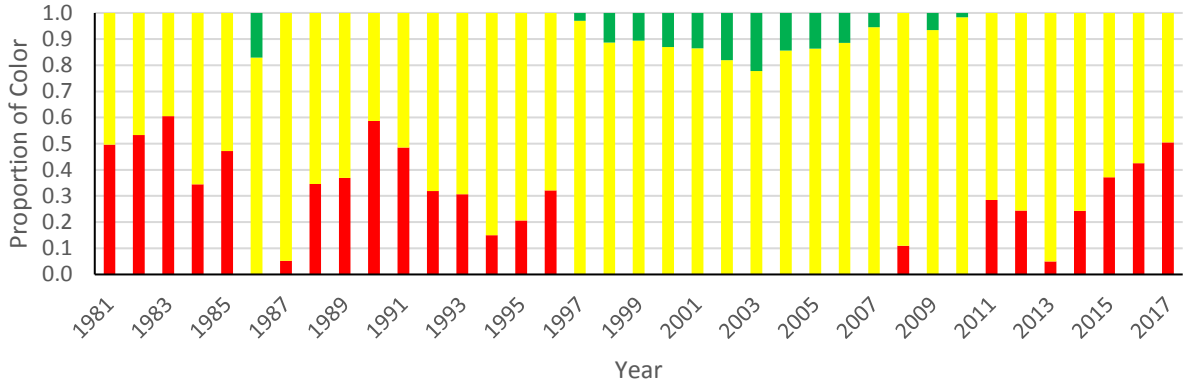
Figure 1. Annual TLA color proportions for Atlantic croaker commercial landings for the Atlantic coast of the US.



Recreational Harvest

- The recreational index this was computed using the newly revised MRIP harvest estimates.
- The recreational harvest index continued to decline, down 18.6% (2,205 metric tons) in 2017 from harvest levels seen in 2016 (2,708 metric tons).
- The recreational harvest level in 2017 (2,205 metric tons) was among the lowest annual harvests in the entire time series (1981-2017).
- Annual percent standard error (PSE) levels were elevated (> 20%) but not quite at the level where considered completely unreliable (> 50%).
- The proportion of red in the TLA was 50.4% in 2017 and 42.5% in 2016 (Fig. 2), indicating the recreational index would have triggered the last two years at the 30% level.
- As with commercial landings, the continued decline in harvest levels for Atlantic croaker in the recreational fishery are also cause for concern indicating management measures may be necessary.

Figure 2. Annual TLA color proportions for Atlantic croaker from Atlantic coast (NJ-FL) recreational harvest of the U.S. based on a 1996-2008 reference period.

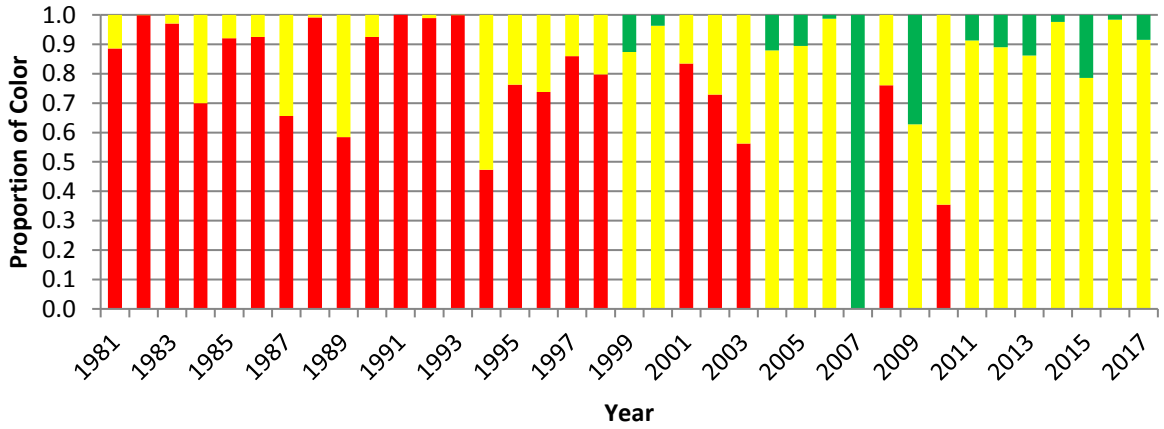


Traffic Light Analysis (Fishery-independent Surveys)

NEFSC/NMFS Fall Groundfish Survey

- The NEFSC/NMFS was not carried out in 2017 due to mechanical problems with the RV Bigelow. In the interim, a placeholder index for 2017 was calculated as the mean for the previous three years (2014-2016) (Fig. 3).
- The index stayed above the long term mean in 2017 using the previous three year average.
- The TLA trigger would not have tripped on the NMFS index in 2017 using the 2014-2016 average.

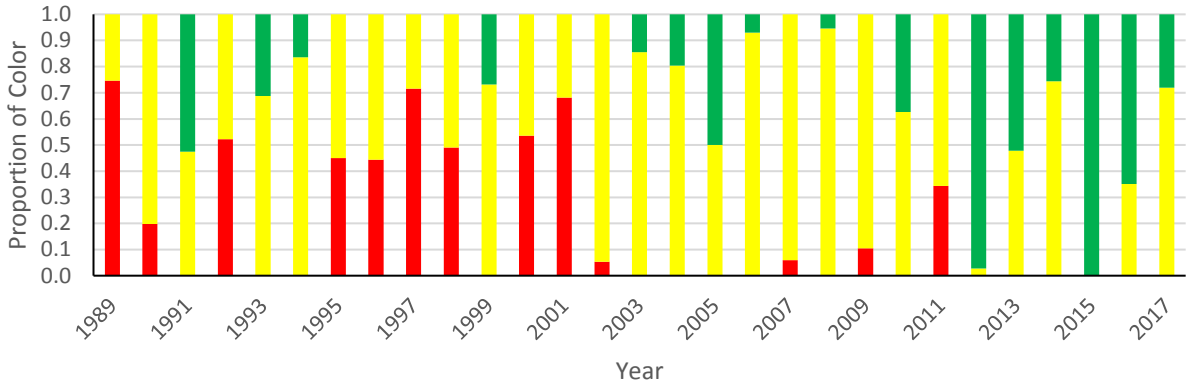
Figure 5. Annual TLA color proportions for Atlantic croaker from NMFS ground-fish trawl survey based on 1996-2008 reference period.



SEAMAP Survey

- The SEAMAP index declined 36.1% in 2017 (8.9 kg/tow) from 2016 (13.9 kg/tow).
- Index values remained above the long term mean so there was no red in the TLA (Fig. 4).
- The TLA trigger for the SEAMAP survey did not trip in 2017.

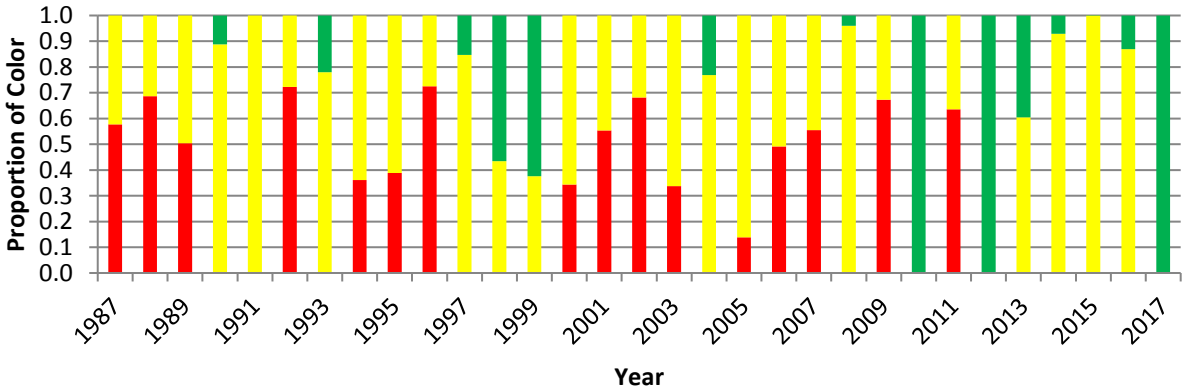
Figure 4. Traffic Light Model for SEAMAP catch data by weight using a 1996-2008 reference period.



North Carolina Program 195

- The North Carolina index increased 217% in 2017 (1,172.3 fish/tow versus 369.8 fish/tow in 2016) and was well above the long term mean resulting in all green in the TLA.
- The high catch level in 2017 was the second highest in the entire time series.

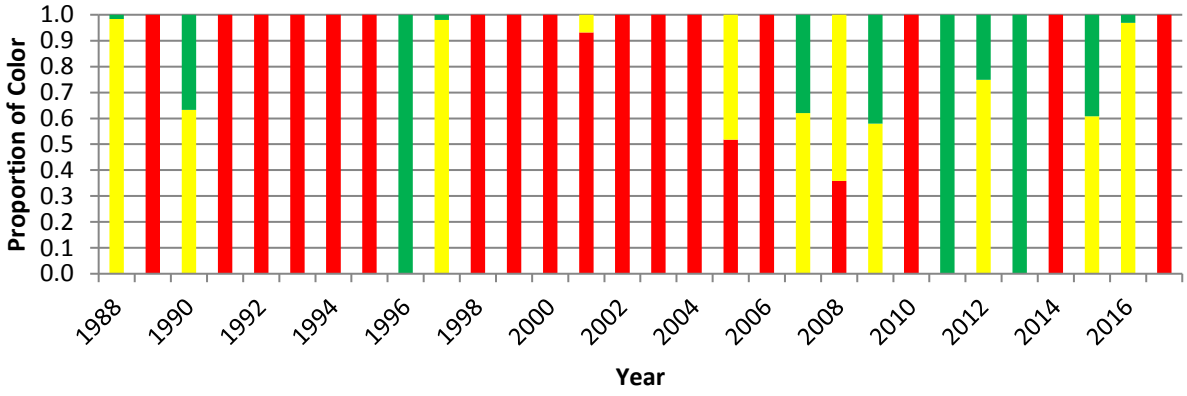
Figure 5. NCDMF Program 195 TLA color proportions for Atlantic croaker using 1996-2008 reference period.



VIMS Survey

- The VIMS index declined significantly (95.3%) in 2017 from 2016 going from 13.2 fish per tow in 2016 to 0.614 fish per tow in 2017. The alternating high variability in annual index values was evident in the alternating proportions of red and green in the TLA for the last 6 years (Fig. 6). High variability in the TLA color proportions was likely due to annual recruitment variations, which would not be uncommon for a juvenile index. However, the index decline in 2017 did represent one of the lowest values in the entire time series.
- The index value was well below the long term mean in 2017 but the three year average red proportion was above 30% in 2017 (44.4%), so the index would have tripped the TLA trigger in 2017.

Figure 6. Annual TLA color proportions for Atlantic croaker from VIMS spring trawl survey using 1996-2008 reference period.

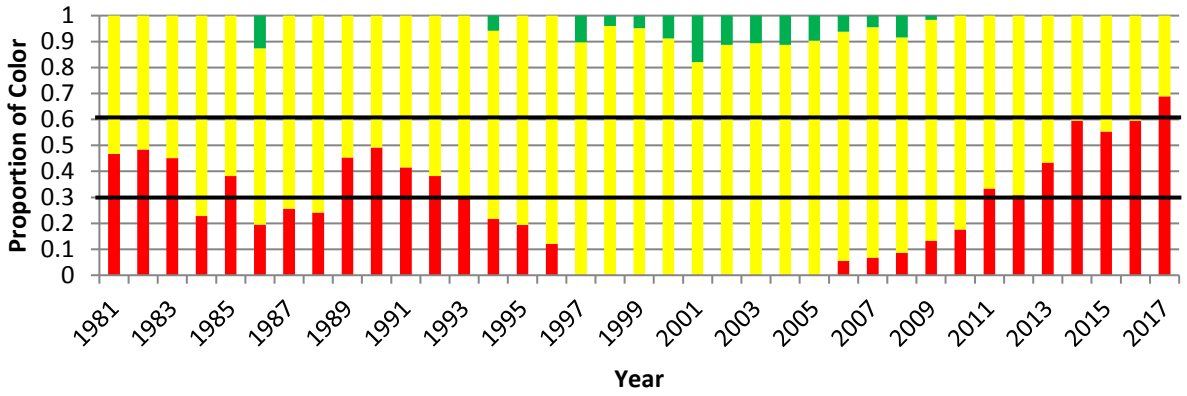


Traffic Light Analysis (Composite Indexes)

Harvest Composite Index

- The harvest composite TLA index indicates that the management response trigger would have been tripped for the fifth year in a row.
- The mean red proportion for the most recent three year time period (2015-2017) was above 60% for two of the three years and averaged 61.2%, which was well above the significant level of concern threshold.
- The important trend to point out is the continuing decline in recreational and commercial landings for Atlantic croaker.

Figure 7. Annual color proportions for harvest composite TLA of Atlantic Croaker recreational and commercial landings



Abundance Composite Characteristic Indexes

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

- Three of the four abundance indexes showed increases in 2017.
- The adult composite TLA characteristic (Fig. 8) showed a trend of declining green proportions over the last three years.

- The juvenile composite TLA characteristic (Fig. 9) in 2017 was unusual in that it only had red and green with no yellow in the index. This was due to the very high survey value for NC195 (100% green) and very low value for VIMS (100% red).

Figure 8. Adult croaker TLA composite characteristic index (NMFS and SEAMAP surveys).

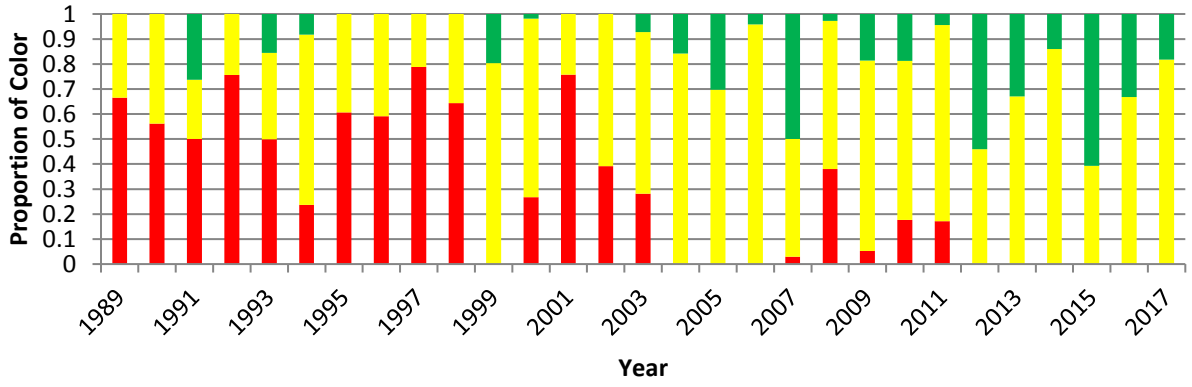
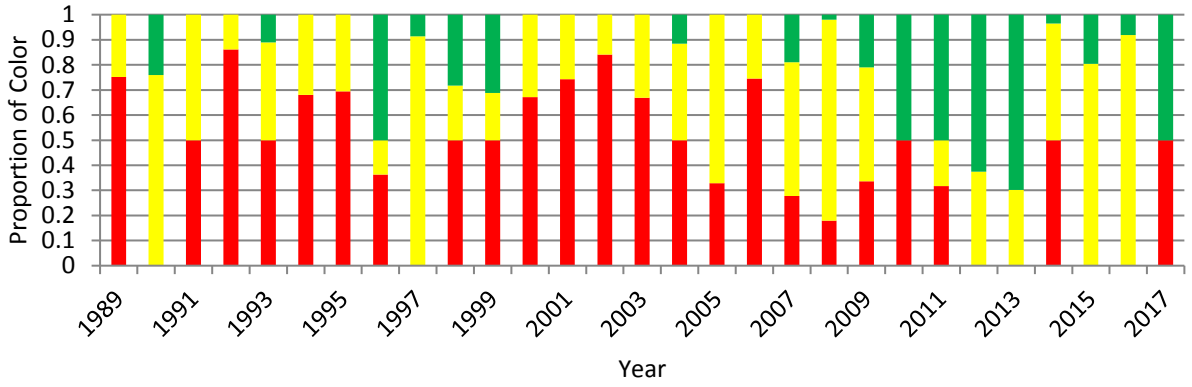


Figure 9. Juvenile croaker TLA composite characteristic index (NC 195 and VIMS surveys).



Neither the adult or juvenile composite characteristic index tripped in either 2017 with red proportions greater than 30% for two of the three terminal years.

- The higher annual variability for the different color proportions in the juvenile composite characteristic (compared to the adult composite characteristic) is likely a reflection of annual recruitment variability rather than population trends.

Summary

The harvest composite TLA tripped in 2017 (for the fifth year in a row) while the abundance TLA composite did not trip. The continued declining trend in the commercial and recreational harvests for the Atlantic coast is a concern since the decline has become greater in the last two years. The recently completed Atlantic croaker stock assessment was not accepted for management use, in part due to the conflicting signals shown by abundance and harvest metrics. The explanation for this discrepancy may lie in differing size and age structures of the different fishery-independent surveys and commercial and recreational landings, with older/larger fish being the more likely target of the fishery. Using an age partitioning approach while examining different (and additional) indices on a regional perspective may allow better refinement of the TLA, providing more synchrony between the harvest and landings metrics for adults as well as juveniles. The next section of this report illustrates this point by presenting both an age structured and regional TLA with additional fishery-independent surveys.

Proposed Changes to Existing Management Traffic Light Approach for Atlantic Croaker

The current Traffic Light Analysis (TLA) approach for Atlantic croaker has not triggered management action to date despite declining trends in commercial and recreational harvest since the early 2000s. There has also been discussion about regional differences and the reliability of data sources with contradictory trends for tracking changes in abundance. Data sources considered in the TLA and assessment were explored in attempts to explain differences in trends and identify potential changes in TLA metrics.

Four options were developed by the TLA subcommittee (TLA-SC) for the Technical Committee's (TC) review. These options were presented for consideration in February 2018 at the Winter Meeting of the South Atlantic Fisheries Management Board (SAB) of the Atlantic States Marine Fisheries Commission (ASMFC). The four options considered included the following:

1. Status Quo (not recommended)
2. Coastwide TLA with Revised Indices
3. Regional TLA with Revised Indices
4. Relative Exploitation

The SAB requested that the TC further explore Option 3 (Regional TLA with Revised Indices) and present a revised TLA using this option along with the current TLA for the Summer Meeting of the ASMFC (August 2018). As decided during previous meetings, the South Atlantic shrimp trawl discards will be included with all options, but for informational purposes only (i.e., cannot trigger management). In addition, as is done in the current TLA, a recruitment metric is included with all options, not as a direct management trigger but for the TC's consideration during annual TLA updates to better inform management. The TLA recruitment metric includes a composite of VIMS and NC Program 195 indices for the following options, although the NMFS-NEFSC trawl and SEAMAP (ages 0 and 1) indices are available too.

The TLA-SC suggests a change in the management triggers so that management action should be considered if 2 of the 3 latest years have tripped based on previous guidelines (30% red represents a moderate concern and 60% red represents a significant concern). Again, these would be based on the adult composite index and the harvest metrics, not the recruitment metric.

For all options, the TC had the responsibility of evaluating informational metrics (recruitment, shrimp trawl discards) during annual TLA updates, especially in years when management action was not triggered, to determine other signs of concern with the population. Under Amendment I, the TC can recommend management action during years when the adopted option does not trigger management.

Option 3. Regional TLA with Revised Indices

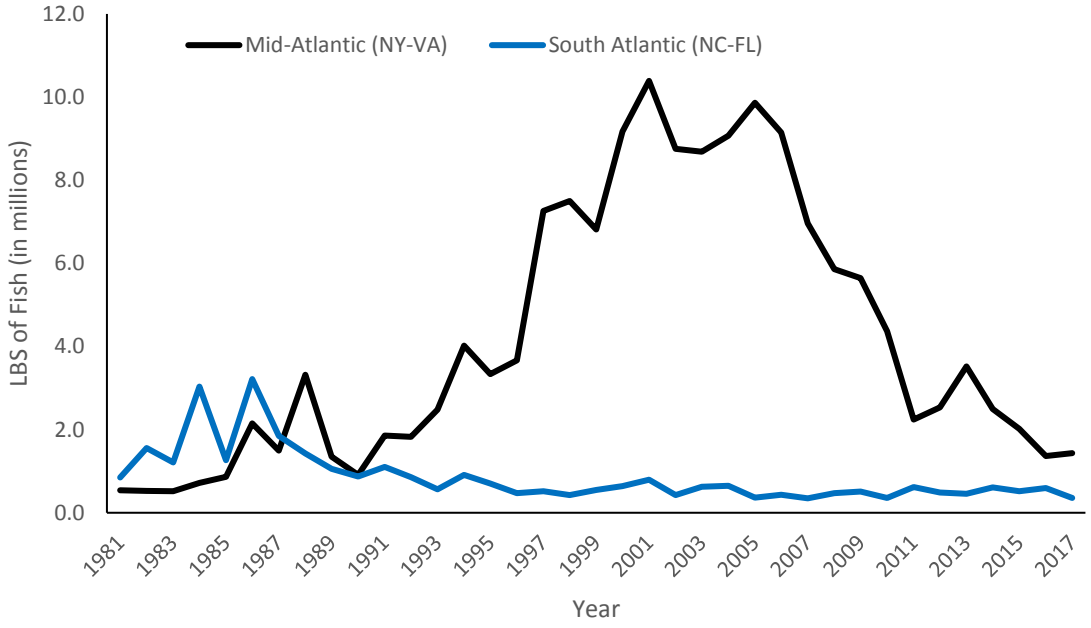
For this option, the TLA-SC revised the abundance indices for Atlantic croaker to split them by age (recruitment indices and age 2+ indices) and region (Mid-Atlantic and South Atlantic) to better reflect the population. Adult indices for the regional TLA would be NMFS-NEFSC (age-2+, excluding NC strata) and ChesMMAP for the Mid-Atlantic and SEAMAP (age-2+) and SC

Trammel survey for the South Atlantic. All adult indices were developed in weight per tow, except the trammel survey. The reference period for the TLA would be based on a 2002-2016 time period since this time frame was covered by all the proposed indices. In addition to an adult index for each region, there would also be regional harvest TLAs for the commercial and recreational fisheries based on annual landings.

Harvest Composite Index

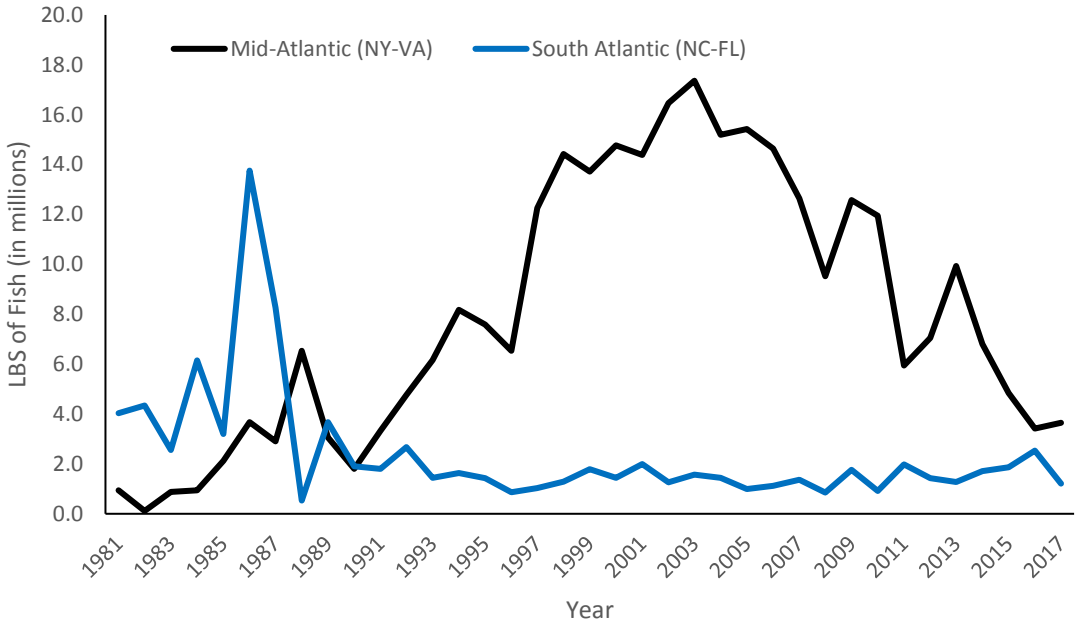
The bulk of coastal commercial landings for Atlantic croaker are driven by trends in the mid-Atlantic (NY-VA) versus relative landings in the South Atlantic region (NC-FL) (Fig. 10). However, the general trend in the south Atlantic has been one of long term decline for Atlantic croaker with the highest landings occurring early in the time series.

Figure 10. Annual commercial landings of Atlantic croaker by region on the Atlantic coast of the United States.



The landings trends for the recreational Atlantic croaker fishery was almost identical to the commercial fishery with general landings trends being driven by the mid-Atlantic coastwide (Fig. 11). As with the commercial landings, the recreational landings in the southern regions showed a general long term decline with the highest landings occurring in the early years of the time series.

Figure 11. Annual recreational harvest by region for Atlantic croaker on the Atlantic coast of the United States.



The harvest composite TLA for both regions mirrored the general trends seen in the annual landings. In the mid-Atlantic, the high proportions of red in recent years were of concern with proportions above 30% since 2011 (Fig. 12). In the south Atlantic, the TLA shows the continued declining trend that has occurred since the early 1990s with red proportions exceeding 30% since 2012 (Fig. 13). The three year average red proportion for the most recent years exceeded 60% for both regions. The management trigger using two out of three years being greater than 30% red would have resulted in the composite harvest metric triggering in both regions from 2012 onward.

Figure 12. Harvest composite TLA for Atlantic croaker from the mid-Atlantic (NJ-VA) using a 2002-2016 reference period.

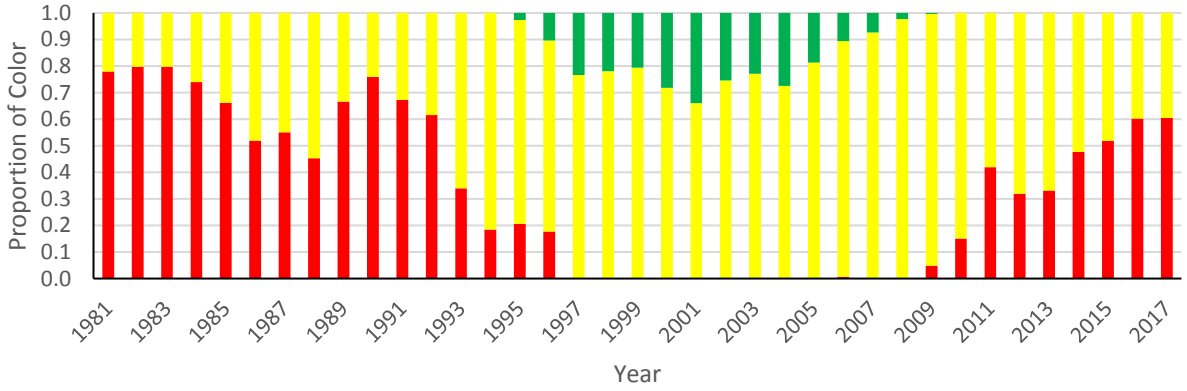
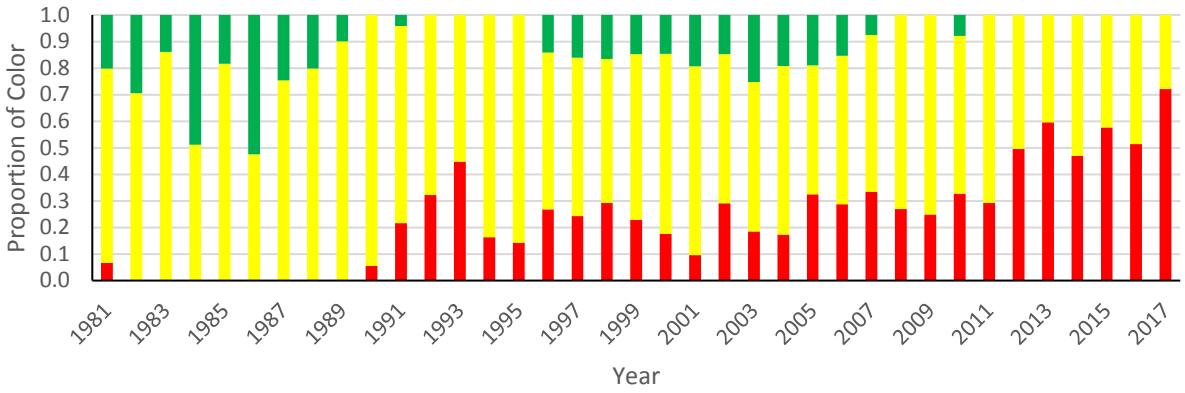


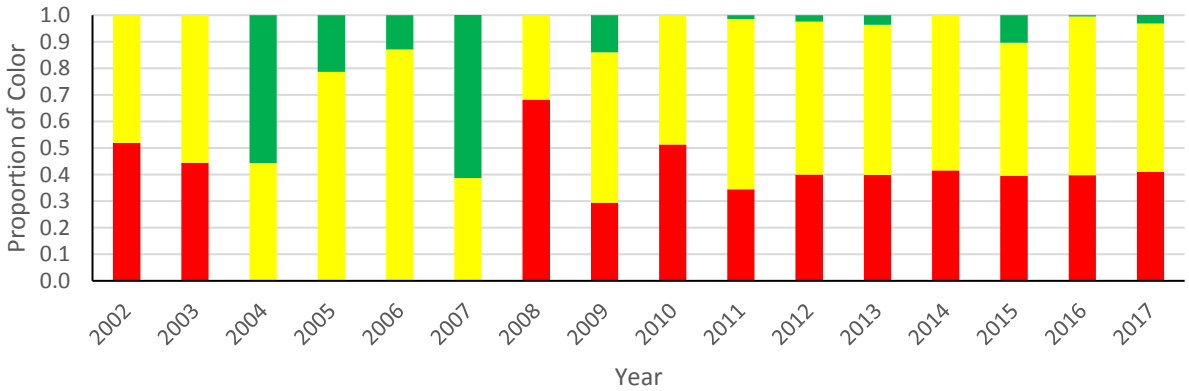
Figure 13. Harvest composite TLA for Atlantic croaker from the south Atlantic (NC-FL) using a 2002-2016 reference period.



Adult Composite Indices

The time period used for the adult composite TLA matched the reference period since that was the year when all the surveys overlapped. In the mid-Atlantic, the TLA illustrated a declining trend since 2007 with red proportions greater than 30% for all years except one (2009) since 2008 (Fig. 14). The high red proportions in recent years was being driven primarily by the ChesMMAP survey which has shown a significant declining trend. Using the 2 out of 3 year rule for red proportions greater than 30%, the mid-Atlantic TLA would have tripped every year since 2010.

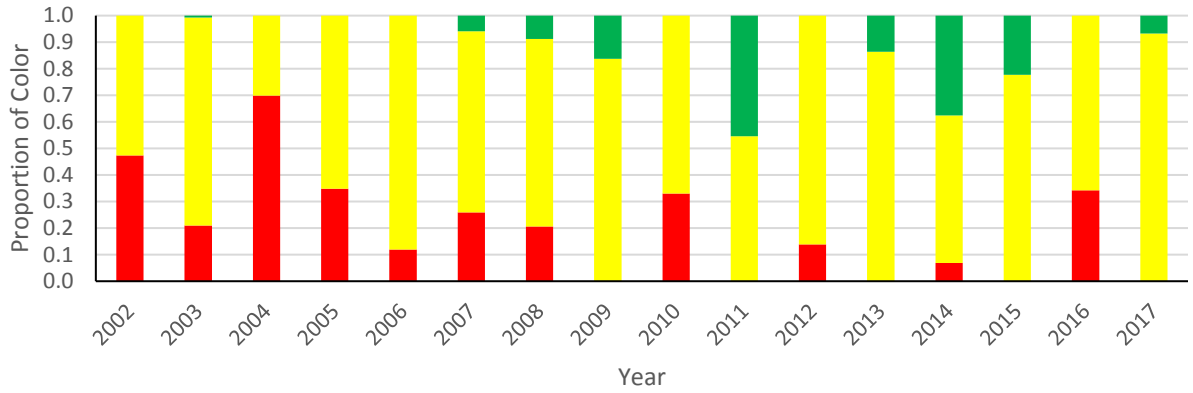
Figure 14. Mid-Atlantic adult composite TLA for Atlantic croaker using a 2002-2016 reference period. Indexes included NMFS and ChesMMAP.



In the south Atlantic, the composite TLA has only had one year (2016) with a red proportion greater than 30%. The south Atlantic composite TLA used the spring time frame for the SEAMAP survey and May through September for the SCDNR trammel survey. Both of these surveys catch only adult croaker during these time periods compared to the fall when 1 year olds and some age 0 fish can show up in the catches of either survey. Higher proportions of red in the early 2000s reflected low catch rates in both surveys during this time period. However, the southern region composite TLA did show greater abundance during years (2011-2015) where

declining abundance occurred in the mid-Atlantic. However, it should be noted that recreational harvest actually showed an increasing trend in the south Atlantic during these same years. Although the recreational harvest increase was modest, the trends do generally match up with the TLA composite during those years.

Figure 15. South Atlantic adult composite TLA for Atlantic croaker using 2002-2016 reference period. Indexes included SEAMAP and SCDNR trammel survey.



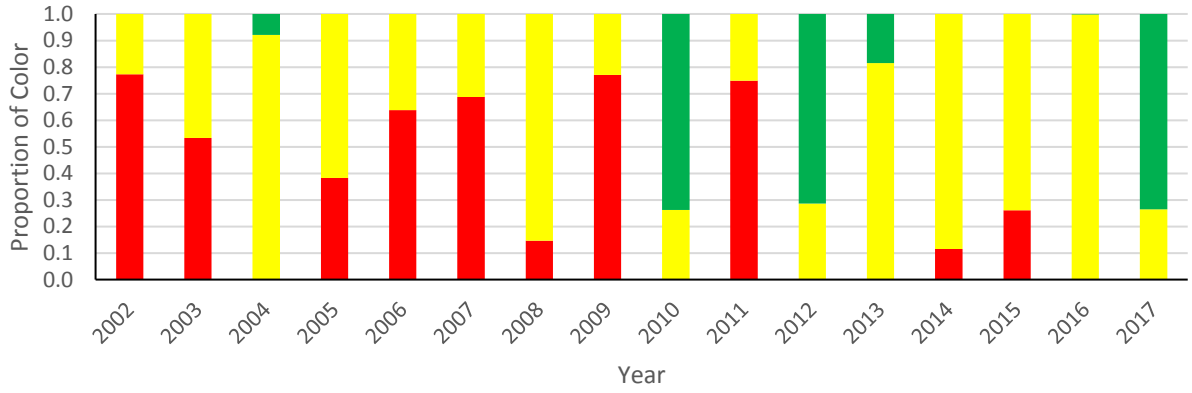
Regional Advisory Indices

Juvenile Composite TLA

The mid-Atlantic composite TLA for juvenile Atlantic croaker showed relatively poor recruitment in most years since 2002 (Fig. 16), which would have certainly contributed to the declining trends seen in adult Atlantic croaker. The TLA red proportions in the mid-Atlantic were above 30% in all but 4 years since 2002.

There was only one juvenile index used for TLA comparisons in the south Atlantic (NC Program 195). The NC195 survey showed relatively poor recruitment in the early to mid 2000's with

Figure 17. South Atlantic juveniile TLA using the North Carolina Program 195 survey with a 2002-2016 reference period.



higher recruitment in recent years. Peak recruitment years in the south Atlantic occurred in 2010, 2012, and 2017. In contrast, the mid-Atlantic juvenile TLA showed poor recruitment in 2010 and 2017 and only moderately better recruitment in 2012.

South Atlantic Shrimp Trawl Discards

Current estimates of relative Atlantic croaker by-catch from the south Atlantic shrimp fishery is only available through 2016 at the writing of this report. This will be amended when the by-catch index for 2017 become available.

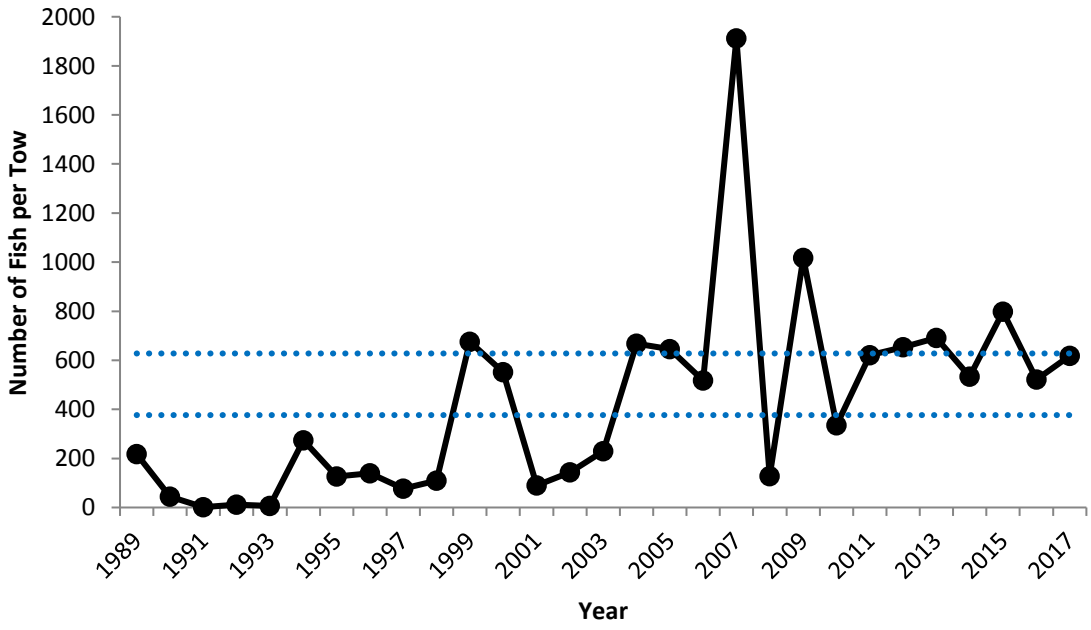
Supplemental Material: Fishery-independent Individual Index TLA's

NMFS

- Since there was no NMFS sampling along the mid-Atlantic due to mechanical issues on the RV Bigleow, A placeholder index using the three year (2014-2016) was used for the TLA. The TC shall have to decide if the NMFS index should remain in the 2017 index or not be used for this one year. Given the current trends over the last few years with this index, the author suggests using the placeholder proxy for 2017 only as trends have been consistent across the last few years and unless something drastic changes the index it is like to have a minimal impact on the TLA.

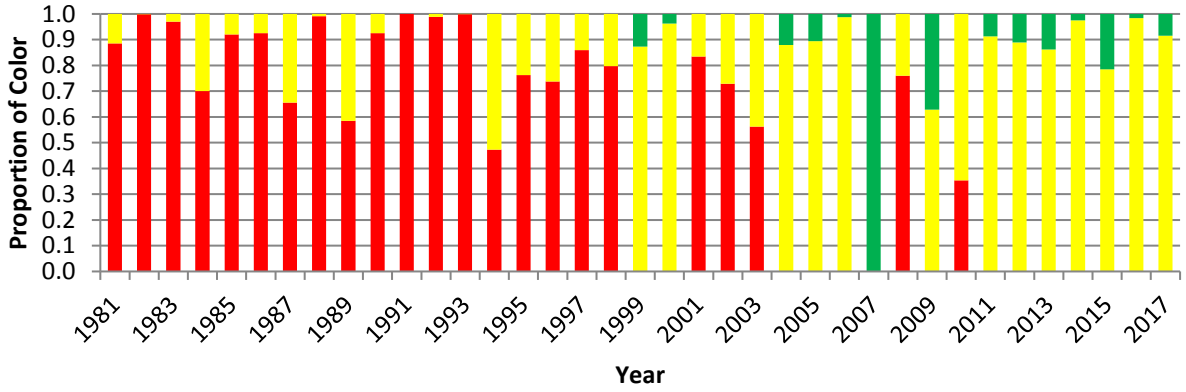
Mean annual CPUE has declined since the peak in 2007 but has remained at or about the long term mean (top blue line on Fig. 18) since 2011 indicating some relative stability in abundance.

Figure 18. Stratified mean annual CPUE for Atlantic croaker for NMFS survey.



This same trend was reflected in the TLA with some green but mostly yellow since 2011. The use of a 3 year mean (2014-2016) as a placeholder should be adequate as it would have taken an extreme drop to effect the index and how it is used in the TLA.

Figure 19. Annual TLA color proportions for Atlantic croaker from NMFS ground-fish trawl survey based on 1996-2008 reference period.



ChesMMAP

The Chesapeake Marine Monitoring Program (ChesMMAP) is a general fish abundance trawl survey run by the Virginia Institute of Marine Science (VIMS) that covers the central portion of the Chesapeake Bay from the mouth up to approximately Aberdeen, MD. Atlantic croaker are one of most abundant species in the survey. ChesMMAP has been in operation since 2002 with 15 years of currently available data. While not as geographically expansive as some of the other larger regional surveys (NMFS, NEAMAP, and SEAMAP), ChesMMAP does cover the full length of the Chesapeake Bay including both Virginia and Maryland.

The overall declining trend in catch of Atlantic croaker was evident in both the adult (age 2+) and juvenile (ages 0-1) indices, although the adult index was higher than the juvenile index (Fig. 20) in the early years of the survey. The series peak for juveniles occurred in 2007 and the series peak for adults occurred in 2004. Since 2008 abundances for both age groups have remained relatively low.

The TLA reflected these trends with high proportions of red since 2008 (Figs. 21 &22). Proportionately, the decline was slightly greater for juveniles than for adults in recent years.

Figure 20. Stratified mean annual CPUE for Atlantic croaker by age group for ChesMMAP.

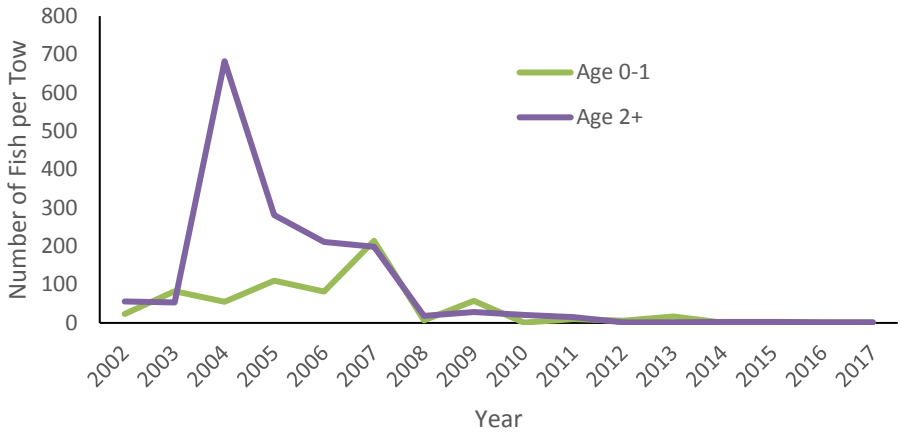


Figure 21. Annual TLA for Atlantic croaker from ChesMMAP for ages 0-1

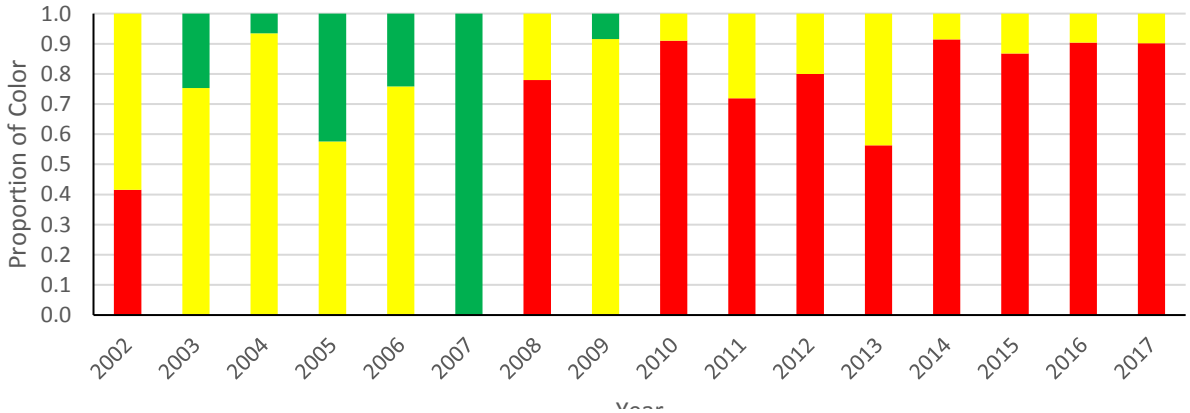
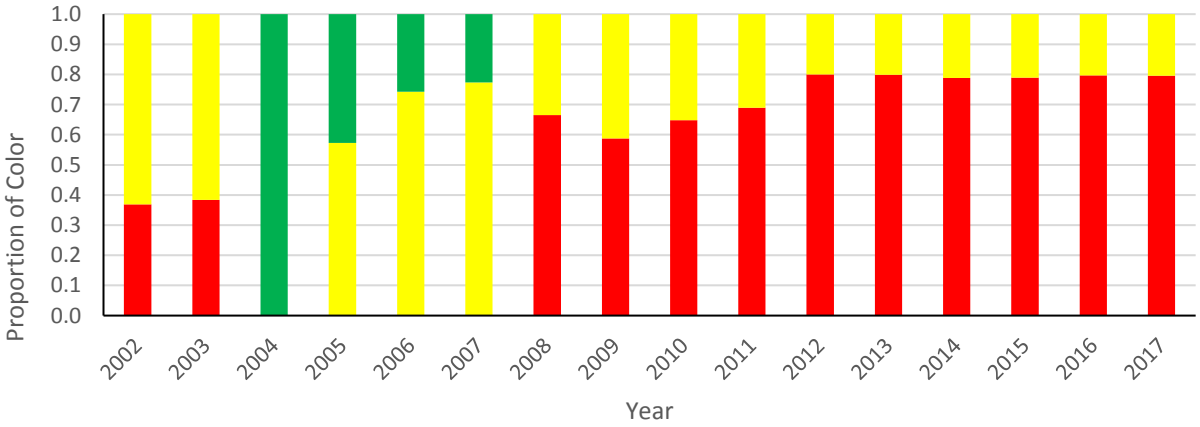


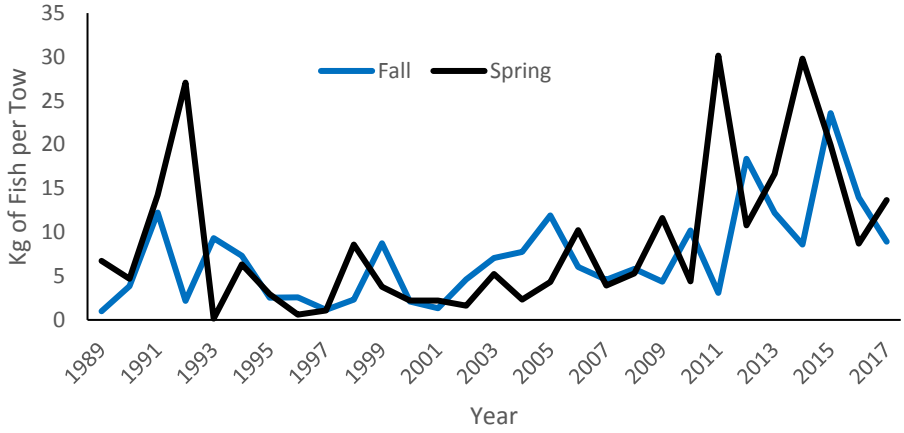
Figure 22. Annual TLA for Atlantic croaker from ChesMMAP for ages 2+



SEAMAP

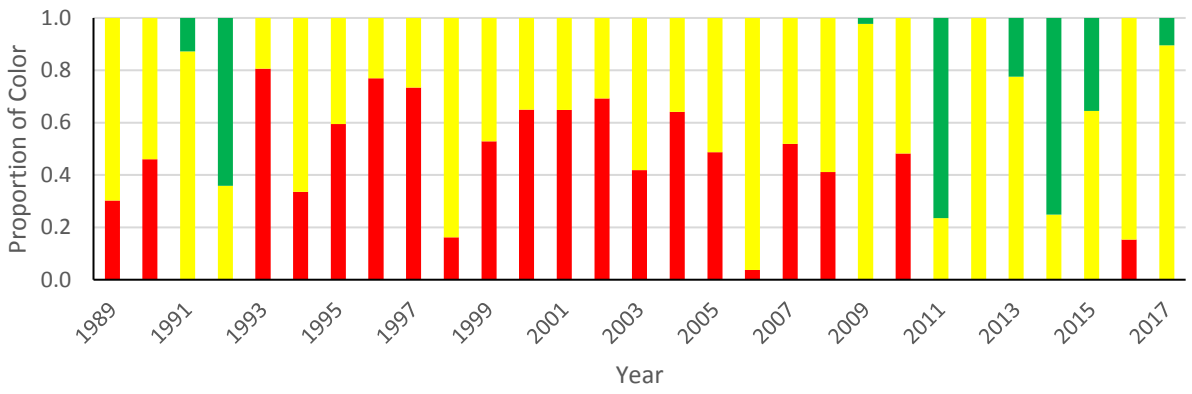
The SEAMAP survey samples during three seasons of the year (spring, summer, and fall) and historically the index used for Atlantic croaker for the trigger management exercises has always been the fall index. The reasons for this were several having to do with the co-occurrence in time frame with other surveys (NMFS), greater abundances in the fall, and higher levels of positive tow intercepts. The fall survey also had the greatest age range sampled for Atlantic croaker with higher numbers of ages 0 and 1. The spring survey had very few age 1 fish and no age 0 fish, therefore the spring survey was a much better index for tracking adult (age 2+) Atlantic croaker. With the proposed age regional and age split TLA, the spring survey would be better for tracking these adult croaker. Additionally, annual CPUE values correlated significantly ($r = 0.731$, $p<0.05$) when the spring index was lagged forward by one year such that peaks in the fall CPUE corresponded to peaks in the following spring CPUE (Fig. 23).

Figure 23. Mean annual CPUE for Atlantic croaker from SEAMAP survey by season.



The TLA for spring showed low abundances from the late 1990s through the mid-2000s (Fig. 24). Since 2009 there has been a generally increasing trend with the two peaks in abundance for the entire time series occurring in 2011 and 2014 being reflected by the high green proportions for those years (Fig. 24).

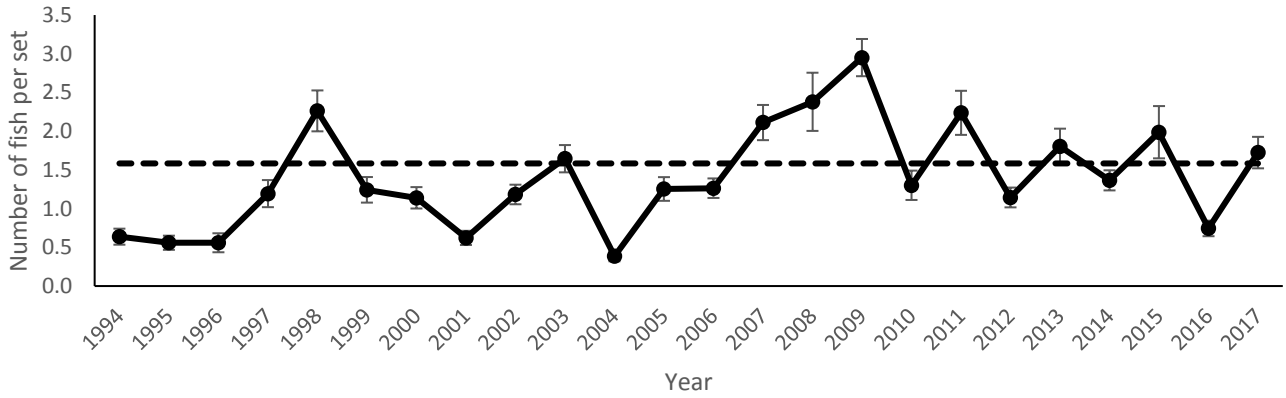
Figure 24. Annual TLA color proportions for adult Atlantic croaker from SEAMAP survey for the spring



SCDNR Trammel Net Survey

The SCDNR trammel net survey is a randomly stratified monthly survey that has been ongoing since 1991. There have been 8 estuarine strata covered during the entire time frame but there is a core group of 5 strata that have been sampled continuously from 1994 through 2017 which are used to calculate the annual abundance index. There were only two years above the long term mean prior to 2007 with a general increasing trend in the index since 2004 and the series peak

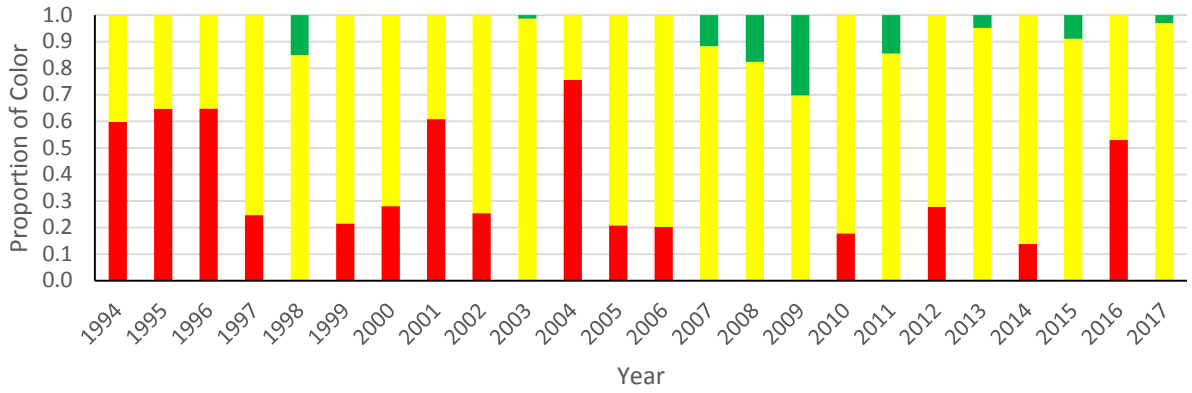
Figure 25. Stratified annual CPUE for Atlantic croaker from core strata from May - Sept. for SCDNR Trammel Net Survey. Error bars are SEM and dashed line is long term mean.



occurring in 2009 (Fig. 25). Since 2007, annual CPUE values have declined although annual values have varied above and below the long term mean.

The TLA mirrored this trend with higher red proportions in the 1990s and early 2000s and higher green proportions from 2007-2009 (Fig. 26). There has been only one year since 2010 that has had a red proportion greater than 30% (2016).

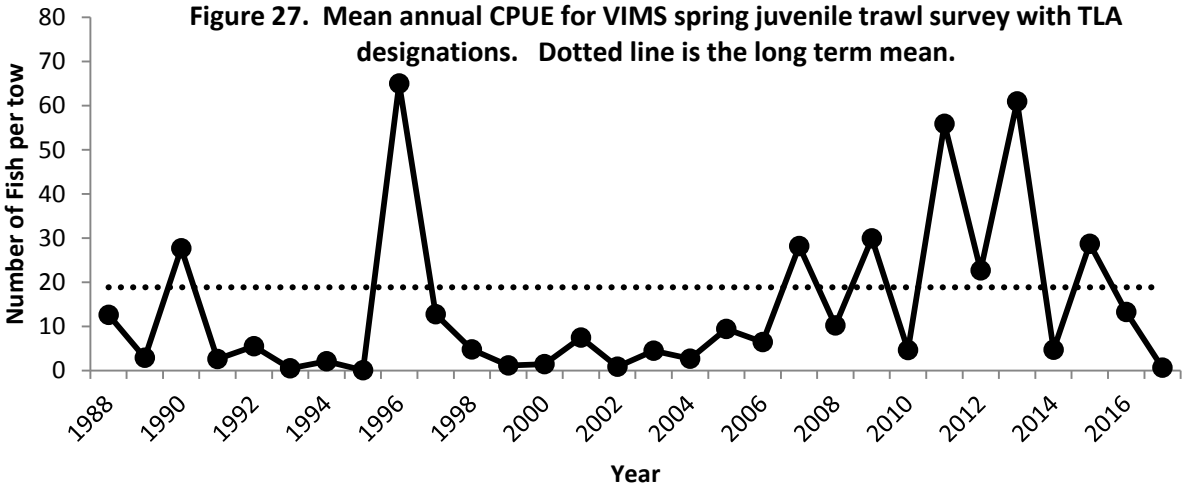
Figure 26. Annual color proportions for TLA of SCDNR trammel survey for Atlantic croaker from core strata.



VIMS Spring Juvenile Fish Survey

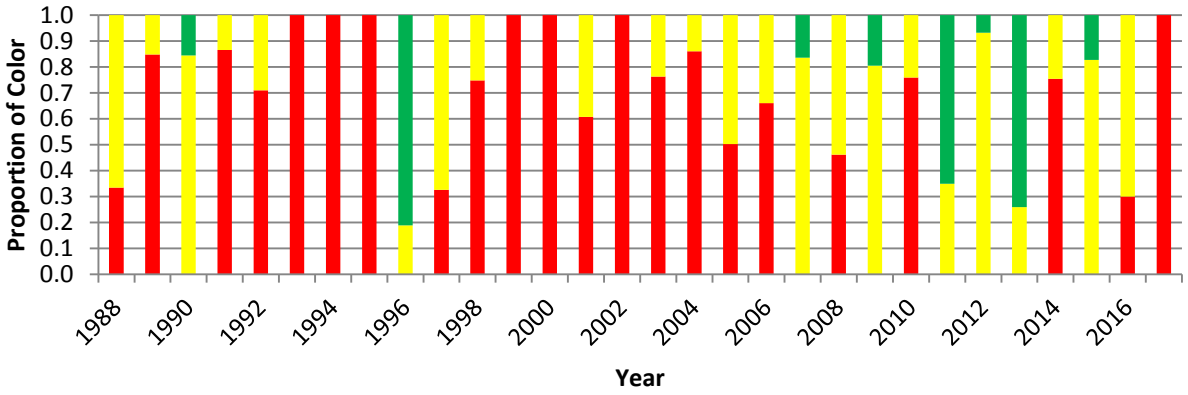
The annual CPUE for the VIMS survey stayed below the long term mean in most years prior to 2007 (Fig. 27). There was an increasing trend from 2006-2013 to with two of the three highest CPUE values in the data series. Since 2013 CPUE has declined to the point where 2017 had one of the lowest values in the series.

Figure 27. Mean annual CPUE for VIMS spring juvenile trawl survey with TLA designations. Dotted line is the long term mean.



The high proportions of red in the TLA during the early years was a reflection of the reference period encompassing the peak time period in the survey (Fig. 28). While annual TLA proportions have been highly variable since 2010, the index would have tripped in 2017 with red proportions > 30% in 2016 and 2017 (two of the three previous years).

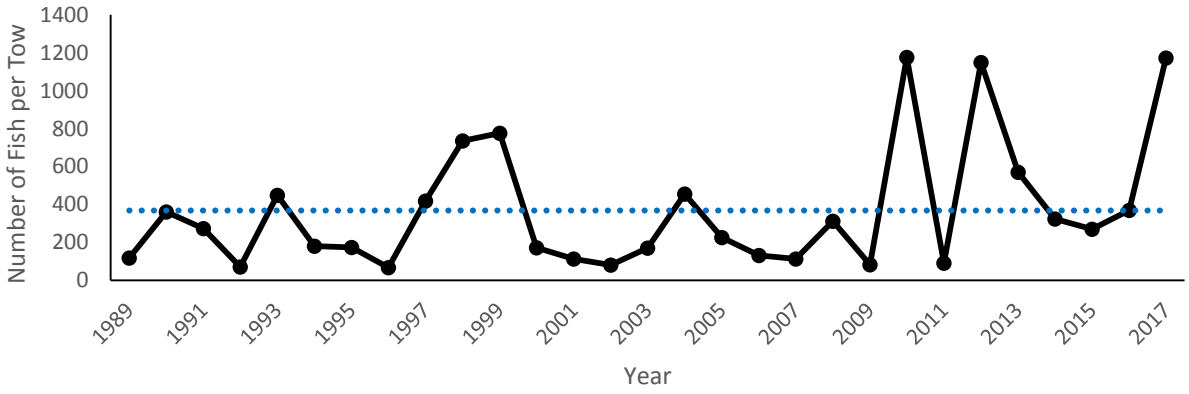
Figure 28. Annual TLA color proportions for Atlantic croaker from VIMS spring trawl survey using 2002-2016 reference period.



North Carolina DMF Program 195

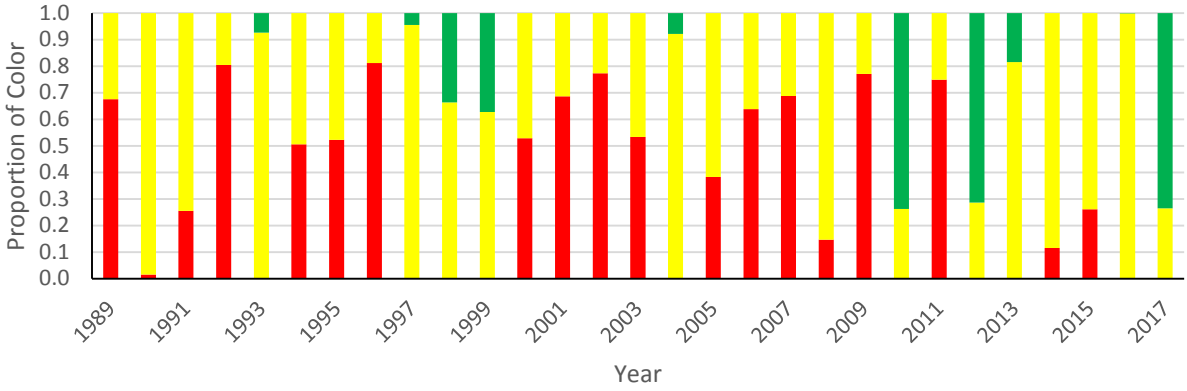
Annual abundance has been on an increasing trend since 2009 with the three highest annual CPUE values occurring since 2010 (Fig. 29). The high degree of annual variability is typical of juvenile fish surveys but the high annual values indicate increased recruitment in recent years.

Figure 29. Stratified mean annual CPUE for Atlantic croaker from NCDMF Program 195. Dotted line is the long term mean for 2002-2016.



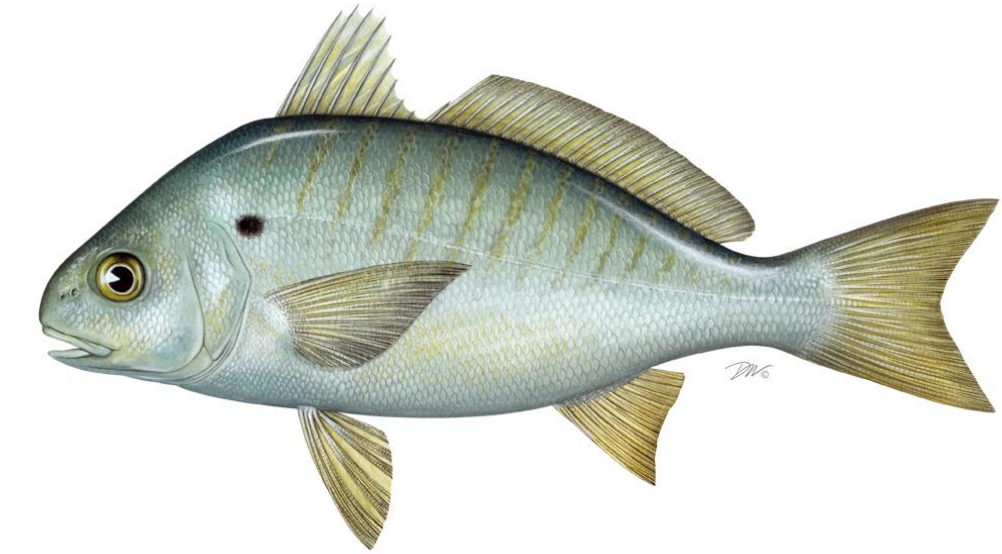
The TLA illustrated this trend with the high proportions of green in 2010, 2012, and 2017 (Fig. 30). This index would not have triggered at the 30% level since 2011. Prior to that it would have triggered most years during the 2000s.

Figure 30. Annual TLA color proportions for NCDMF Program 195 juvenile Atlantic croaker using 2002-2016 reference period



2018 Traffic Light Analysis of Spot (*Leiostomus xanthurus)* for the Atlantic States Marine Fisheries Commission Fishery Management Plan Review.

2017 Fishing Year
&
Proposed Changes to TLA Management Scheme



Plan Review Team

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Introduction

Spot is managed under the Omnibus Amendment for Spot, Spotted Seatrout, and Spanish Mackerel (2011) and Addendum I (2014). The Omnibus Amendment updates all three species plans with requirements of the Commission's ISFMP Charter. The Benchmark Stock Assessment for spot in 2017 was not accepted for management purposes due to the lack of reliable stock biomass and the impact of the shrimp trawl fishery on the population.

Previously, in the absence of a coastwide stock assessment, the South Atlantic Board approved Addendum I to the Spot FMP in 2014. The Addendum establishes use of a Traffic Light Analysis (TLA), similar to that used for Atlantic croaker, to evaluate fisheries trends and develop state-specified management actions (e.g., bag limits, size restrictions, time and area closures, and gear restrictions) when harvest and abundance thresholds are exceeded for two consecutive years. The TLA is a statistically-robust way to incorporate multiple data sources (both fishery-independent and -dependent) into a single, easily understood metric for management advice. It is often used for data-poor species, or species which are not assessed on a frequent basis. The name comes from assigning a color (red, yellow, or green) to categorize relative levels of indicators on the condition of the fish population (abundance metric) or fishery (harvest metric). For example, as harvest or abundance increase relative to their long-term mean, the proportion of green in a given year will increase and as harvest or abundance decrease, the amount of red in that year becomes more predominant. The TLA improves the management approach as it illustrates long-term trends in the stock and includes specific management recommendations in response to declines in the stock or fishery. Under the Addendum, state-specific management action would be initiated when the proportion of red exceeds specified thresholds (30% or 60%), for both harvest and abundance, over two consecutive years.

The current management triggers for spot compare annual changes in various indices (e.g. recent landings and survey information) to review trends in the fisheries. The spot Plan Review Team expressed concern that the previous review methodology did not illustrate long-term trends in the stock nor did it include specific management measures to implement in response to declines in the stock or fishery. The indices used for the TLA include both commercial and recreational harvest (fishery dependent) and three fishery independent monitoring surveys that occur in different areas of the Atlantic coast of the United States. The fishery independent surveys include the Northeast Fisheries Science Center (NMFS) fall ground fish trawl survey, the Maryland Dept. of Natural Resources juvenile striped bass seine survey, and the Southeast Area Monitoring Assessment Program (SEAMAP) trawl survey.

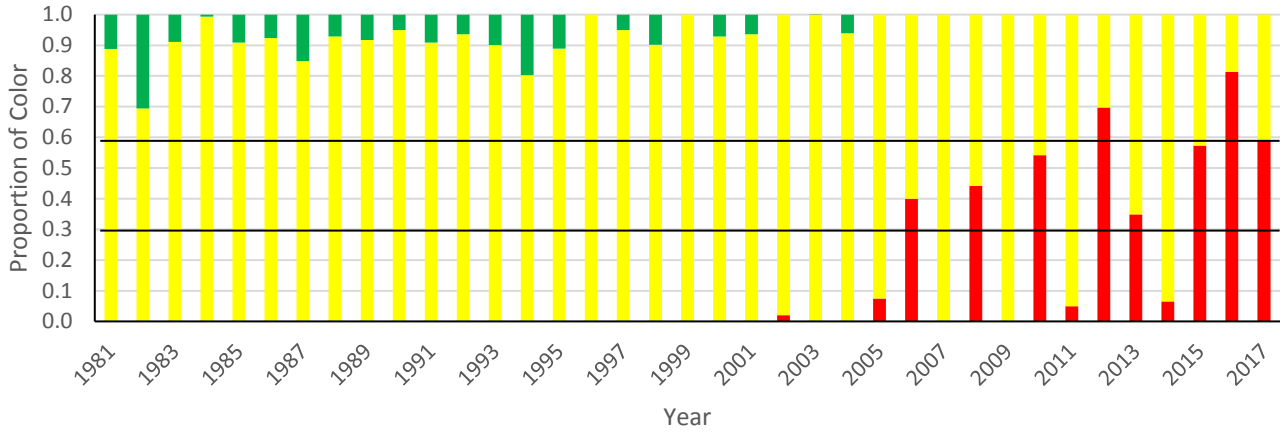
Traffic Light Analysis (Fishery Dependent)

Commercial

- Commercial landings for spot on the Atlantic coast increased 217% in 2017 from 2016. However, landings were still well below the long term mean and the increase in 2017 was up from the time series low which occurred in 2016. Long term, there is still a declining trend in commercial landings that has been occurring since 2003. Total annual landings have declined 90.7% from 2004 to 2016.

- The TLA for commercial landings had relatively stable proportions of green and yellow throughout the 1980s and 1990s but began declining in the early 2000s as evidenced by increasing proportions of red (Fig. 1). The long term mean for the reference time series (1989-2012) was 5,744,635 pounds per year but the average landings since 2010 have dropped to 2,886,785 pounds, with a value of 1,989,804 pounds in 2017.
- The TLA commercial index did trip at the 30% level in 2017.

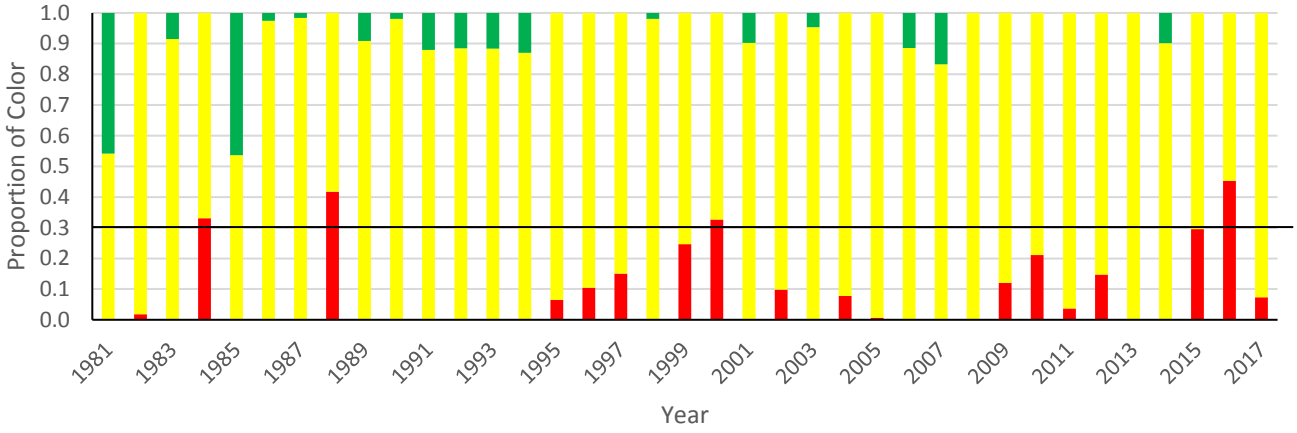
Figure 1. Annual TLA color proportions using 1989-2012 reference period for spot from commercial landings for the Atlantic coast of the US.



Recreational

- The recreational harvest for spot on the Atlantic coast increased 110% from 2016 to 2017, with values of 3,620,388 pounds and 7,636,915 pounds, respectively.
- Annual harvest in the recreational fishery has been below the long term mean (LTM) since 2009 and was still below that threshold in 2017.
- The red proportion of the TLA decreased in 2017 to 7.3%. While the red proportion in 2017 was below the concern threshold, the recreational TLA did trip in 2017 since it was above the 30% threshold for the previous two years (2015-2016).

Figure 2. Atlantic coast TLA for recreational spot harvest on the Atlantic coast of the United States. Note: figure uses revised MRIP estimates (July 2018).

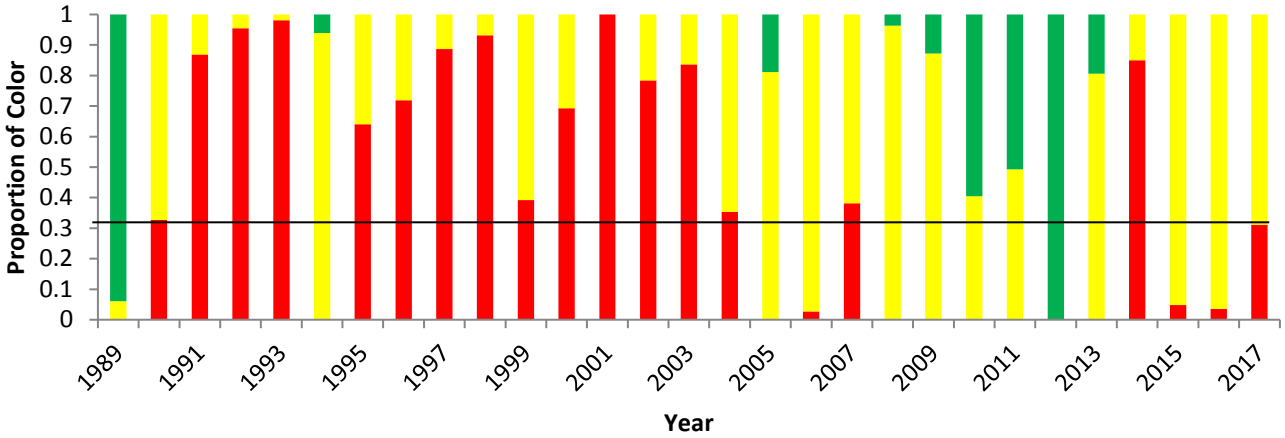


Traffic Light Analysis (Fishery Independent)

NEFSC/NMFS Fall Groundfish Trawl Survey

- The NEFSC/NMFS survey was not carried out in 2017 due to mechanical problems with the RV Bigelow. In the interim, a placeholder index for 2017 was calculated as the mean for the previous three years (2014-2016) (Fig. 3).
- While the red proportion did increase in 2017 using the 3 year placeholder index value, it was still below the 30% threshold.
- The TLA did not trigger in 2017 with the placeholder index

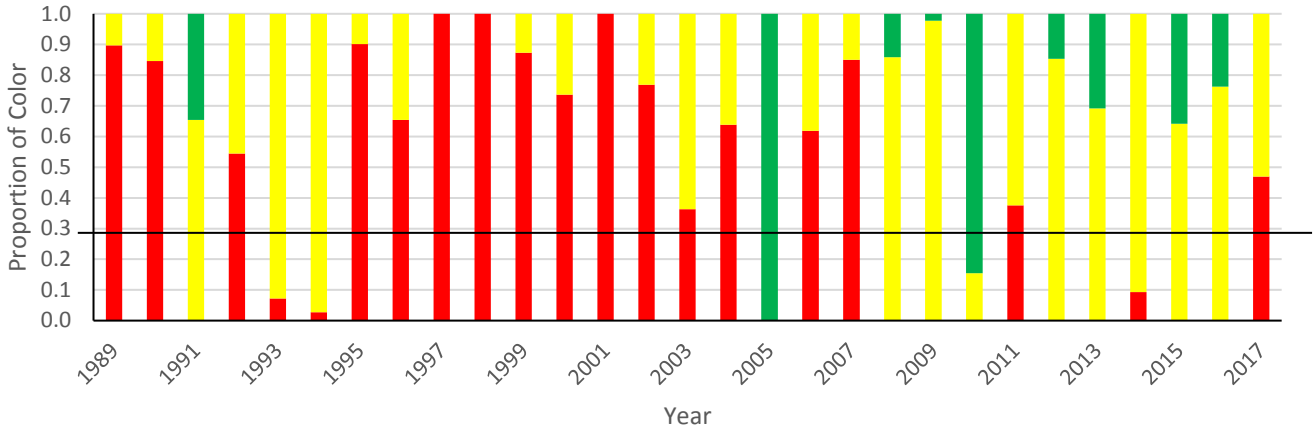
Figure 3. Non-proportioned annual TLA model using 1989-2012 reference time period for Spot from NMFS fall groundfish trawl survey.



SEAMAP Trawl Survey

- The annual CPUE declined 6.9% in 2017 from 2016 and remained above the long term mean (11.3 kg fish per tow).
- The TLA index did not trigger in 2017, and under the current TLA trigger scheme hasn't triggered since 2007.

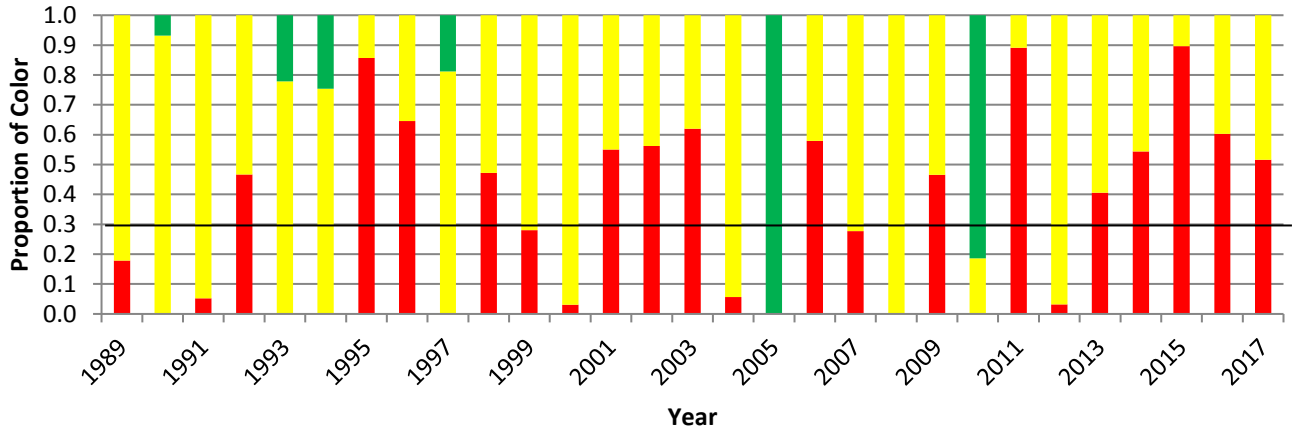
Figure 4. Annual color proportions for spot TLA from the fall SEAMAP survey using a 1989-2012 reference period



Maryland Juvenile Striped Bass Survey

- Since the Maryland survey was the only juvenile index used in the trigger exercise it was used by itself to compare to the other two composite characteristic indices (harvest and abundance).
- The Maryland CPUE increased 24.1% in 2017 from 2016; however the 2015 index value was the lowest in the entire time series and both 2016 and 2017 index values were still quite low (Fig. 5).
- Mean annual CPUE was below the long term mean for the seventh year in a row, indicating annual recruitment and year-class strength remain poor in the Maryland portion of the Chesapeake Bay.
- The TLA trigger did trip in 2017 for the fourth year in a row.
- The index tripping at the 30% level in 2013-2017 indicates cause for concern as the general decline in this index indicates a decline in spot recruitment in Maryland waters has been occurring for the past 20 years.

Figure 5. Annual TLA color proportions for the Maryland seine survey juvenile index using 1989-2012 reference period.

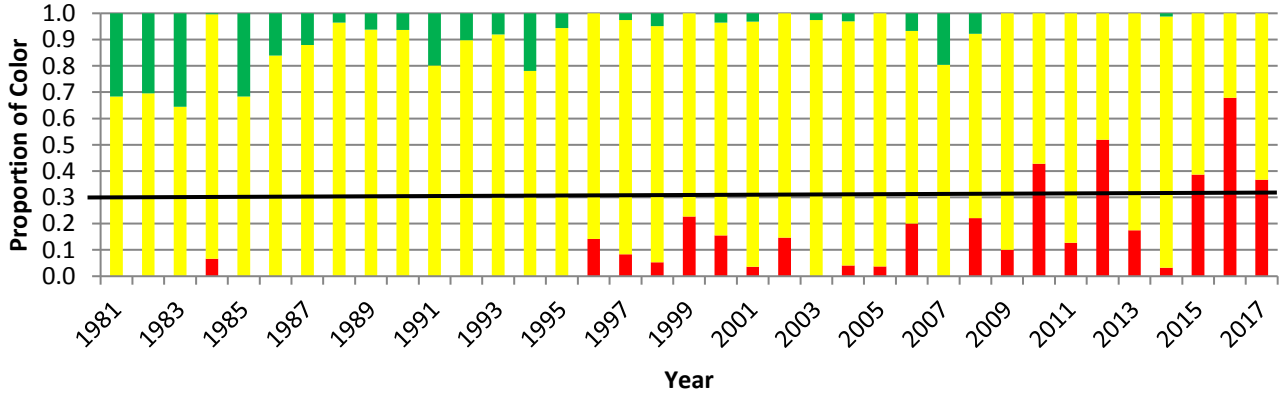


Traffic Light Analysis (Composite Indexes)

Harvest Composite Characteristic Index

- The harvest composite characteristic TLA shows the general decline in landings since 2008, with increasing proportions of red annually (Fig. 6).
- The composite characteristic did trip in 2017 (30% level) with three consecutive years greater than 30%.
- While the red proportion did decline in 2017 it was still above the 30% threshold. This was likely driven more by the decline in commercial landings rather than the recreational harvest.
- The continued declining trend in spot fishery landings was driven primarily by declining landings in the Mid-Atlantic region where the majority of coastwide landings occur.

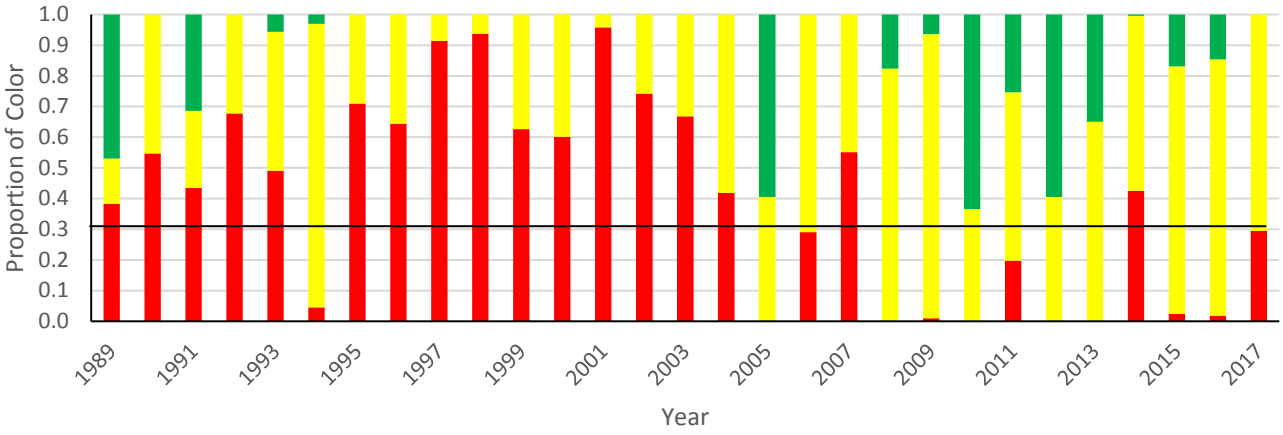
Figure 6. Annual TLA color proportions for harvest composite (commercial and recreational landings) for spot on the Atlantic coast of the US using 1989-2012 reference period.



Abundance Composite Characteristic Index

- The TLA composite characteristic for adult spot (NMFS and SEAMAP surveys) showed a decline from 2016 with a red proportion of 23.3% (Fig. 7).
- The decline in catch levels in the SEAMAP index and the decrease in the NMFS placeholder index would account for this.
- The composite characteristic TLA for the abundance indices did not trigger in 2017.

Figure 7. Annual TLA for spot for composite characteristic of adult fishery independent surveys (NMFS and SEAMAP) using a 1989-2012 reference period.



Summary

The harvest composite characteristic triggered in 2017, mostly due to declines in commercial harvest, while the adult composite index did not and the TLA composite characteristic index for juvenile spot also tripped.

The 2017 Spot Stock Assessment utilized age partitioning in the Catch Survey Analysis model (CSA), separating indices into age 0 and age 1+ (pre-recruits and recruits). The TC suggests considering a similar age partitioning for the TLA as well as a regional approach if it can provide better information on annual changes as well as synchrony between the different indices. The next section of this report outlines the proposed changes to the TLA by the TC for further refinement of the annual trigger exercises.

Proposed Changes to Existing Management Traffic Light Approach for Spot

The current Traffic Light Analysis (TLA) for spot has not triggered management action to date despite declining trends in harvest and indices of abundance to very low values for some areas, particularly since 2014. There has also been discussion about regional differences and the reliability of data sources with contradictory trends for tracking changes in abundance. Data sources considered in the TLA and assessment were explored in attempts to explain differences in trends and identify potential changes in TLA metrics.

Seven recruitment (age-0) indices were evaluated: the SEAMAP trawl index, the NCDMF P195 trawl index, the NMFS trawl index, the ChesMMAP trawl index, the NEAMAP trawl index, the MD seine index, and the VIMS trawl index. Four age-1+ indices were evaluated: the NCDMF P195 trawl index, the NMFS trawl index, the ChesMMAP trawl index, and the NEAMAP trawl index. Nine sources of catch were evaluated: commercial landings, recreational harvest, recreational releases, and recreational total catch, all split between the South Atlantic and Mid-Atlantic (VA-NC border), and South Atlantic shrimp trawl discards.

Four options were developed by the TLA subcommittee (TLA-SC) for the Technical Committee's (TC) review. These options were presented for consideration in February 2018 at the Winter Meeting of the South Atlantic Fisheries Management Board (SAB) of the Atlantic States Marine Fisheries Commission (ASMFC). The four options considered included the following:

1. Status Quo (not recommended)
2. Coastwide TLA with Revised Indices
3. Regional TLA with Revised Indices
4. Relative Exploitation

The SAB requested that the TC further explore Option 3 (Regional TLA with Revised Indices) and present a revised TLA using this option along with the current TLA for the Summer Meeting of the ASMFC (August 2018). As decided during previous meetings, the South Atlantic shrimp trawl discards will be included with all options, but for informational purposes only (i.e., cannot trigger management). In addition, as is done in the current TLA, a recruitment metric is included with all options, not as a direct management trigger but for the TC's consideration during annual TLA updates to better inform management. The TLA recruitment metric includes a composite of VIMS and NC Program 195 indices for the following options, although the NMFS-NEFSC trawl and SEAMAP (ages 0 and 1) indices are available too.

For all options, the PRT has the responsibility of evaluating informational metrics (recruitment, shrimp trawl discards) during annual TLA updates, especially in years when management action is not triggered, to determine other signs of concern with the population. The PRT can recommend management action during years when the adopted option does not trigger management.

Option 3. Regional TLA with Revised Indices

For this option, the TLA-SC revised the abundance indices for spot to split them by age (recruitment indices and age 1+ indices) and region (Mid-Atlantic and South Atlantic) to better

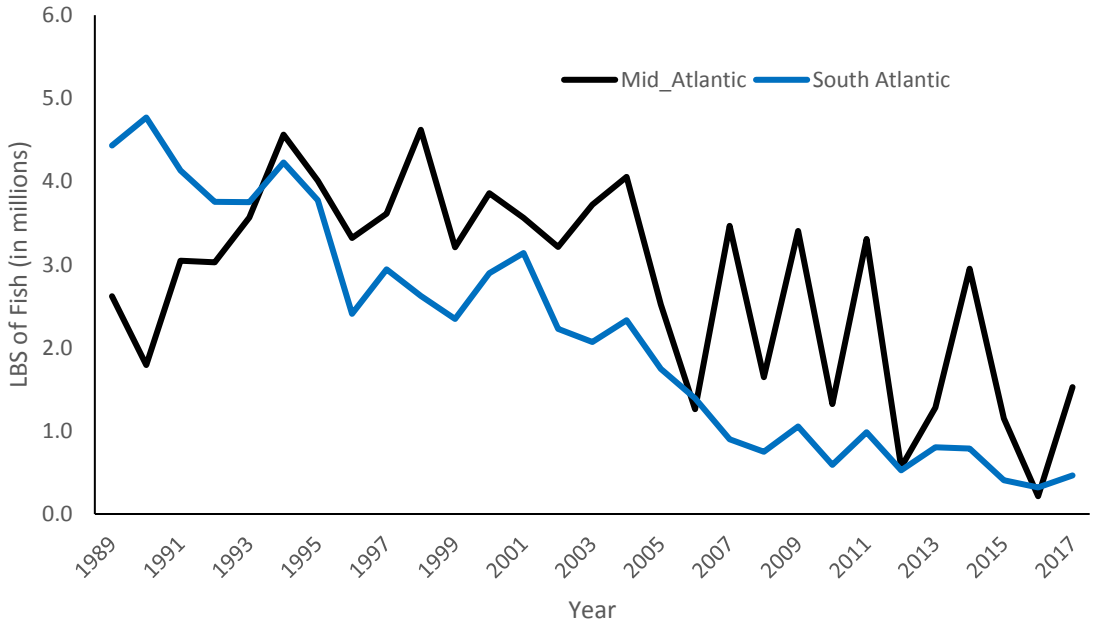
reflect the population. Adult indices for the regional TLA would be NMFS-NEFSC (age-1+, excluding NC strata) and ChesMMAP for the Mid-Atlantic and SEAMAP (age-1+) for the South Atlantic. The juvenile advisory indices used would be the Maryland juvenile fish trawl index and ChesMMAP for the Mid-Atlantic and the NCDMF Program 195 for the South Atlantic

The reference period for the TLA would be based on a 2002-2016 time period since this time frame was covered by all the proposed indices. In addition to an adult index for each region, there would also be regional harvest TLAs for the commercial and recreational fisheries based on annual landings. The TLA-SC suggested a change in the management triggers so that management action should be considered if 2 of the 3 latest years have tripped based on previous guidelines (30% red represents a moderate concern and 60% red represents a significant concern). Again, these would be based on the adult composite index and the harvest metrics, not the recruitment metric.

Harvest Composite Index

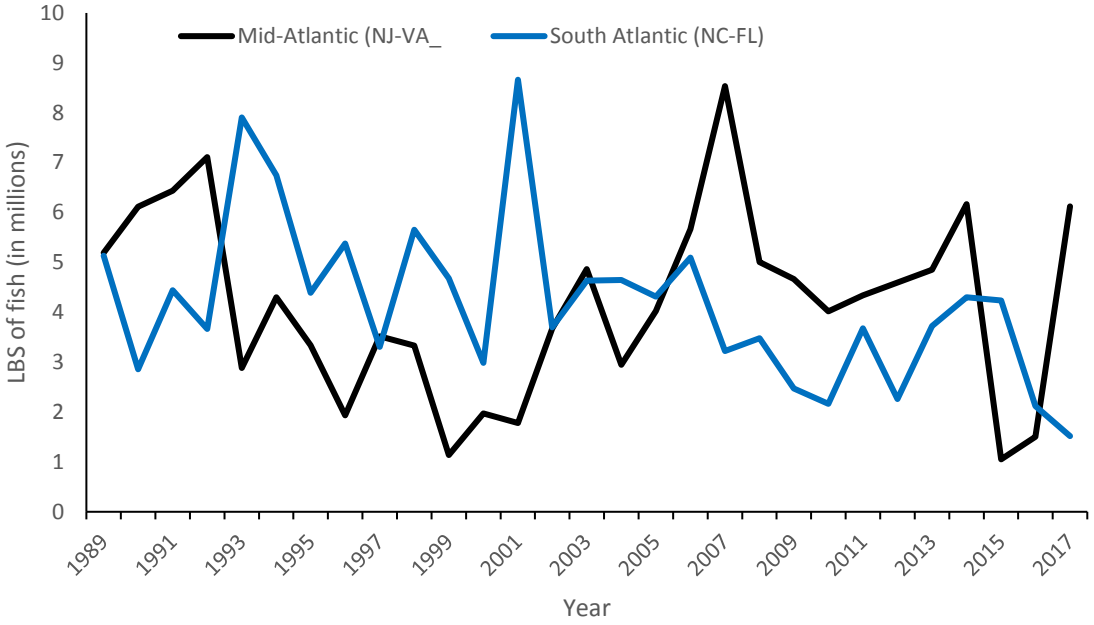
The majority of spot commercial landings occur in the Mid-Atlantic (New Jersey – Virginia), although landings have declined more consistently in the South Atlantic (North Carolina – Florida) (Fig. 8). Landings in the Mid-Atlantic have been highly variable annually over the last ten years with less variation in the South Atlantic.

Figure 8. Annual commercial harvest by region for spot on the Atlantic coast of the United States.



Recreational harvest in the South Atlantic also showed a generally declining trend but nearly as much as the commercial harvest (Fig. 9). Recreational harvest in the Mid-Atlantic showed an increasing trend from 1999 to the series peak in 2007 but has been generally declining since then (Fig. 9).

Figure 9. Annual recreational harvest of spot by region for the Atlantic coast of the United States.



The harvest composite TLA for both regions indicated general decline in harvest in recent years (Figs. 10 and 11). Like the Atlantic coast composite index (Fig. 6) both of the regional composite TLAs would have tripped in both 2016 and 2017 since the red proportions were greater than 30% for two of the three terminal years.

Figure 10. Annual composite TLA color proportions for spot for the Mid-Atlantic (NJ-VA) coast of the United States.

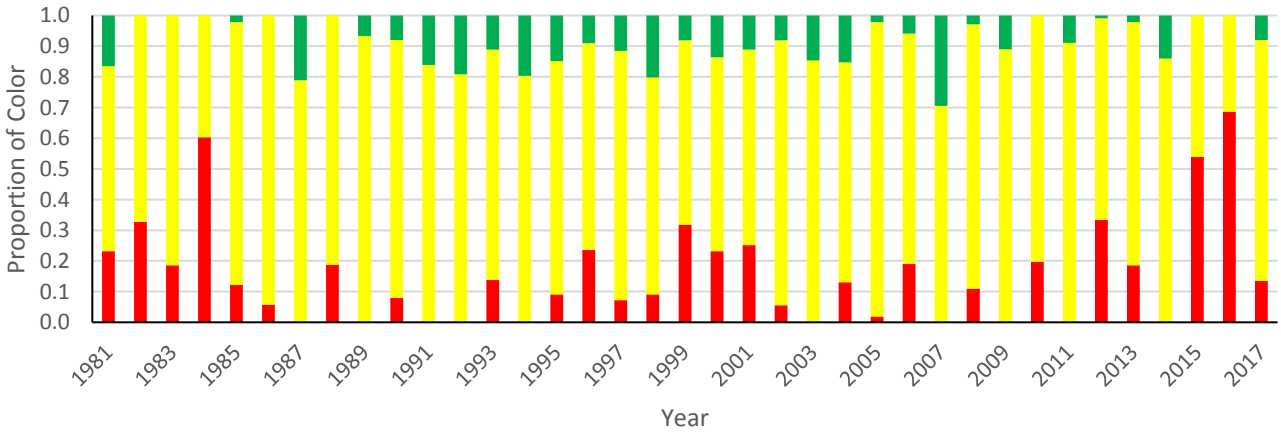
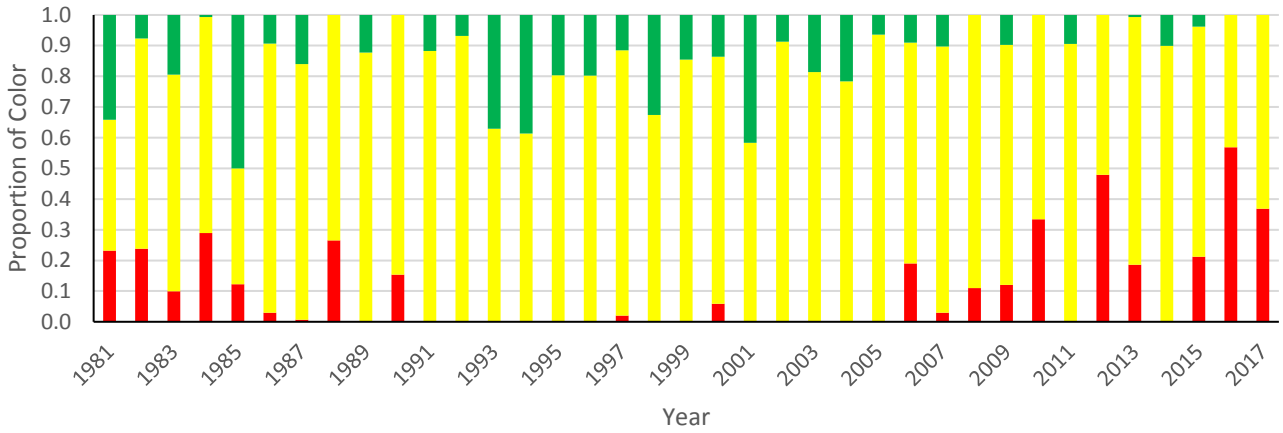


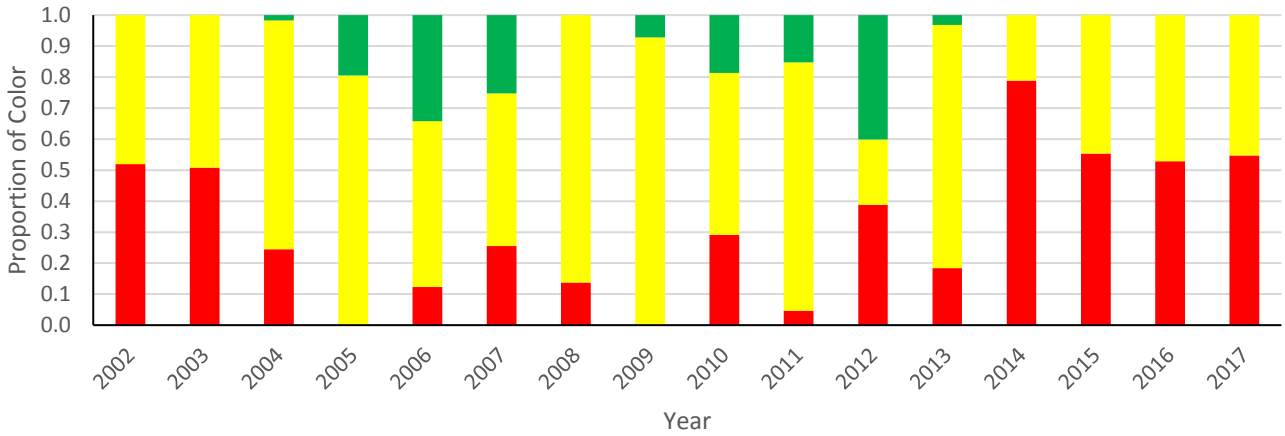
Figure 11. Annual composite TLA color proportions for spot for the South Atlantic (NC-FL) coast of the United States.



Adult Composite Indices

The adult composite index for the Mid-Atlantic used the NMFS and ChesMMAP indices and showed declining abundance since 2009 with the TLA triggering at the 30% level from 2014 through 2017 (Fig. 12). The higher green proportions during mid to late 2000s was due to high green proportions in the NMFS survey where the higher red proportions in the last 6 years was driven by low numbers in the ChesMMAP survey as well as declining catch in the NMFS survey.

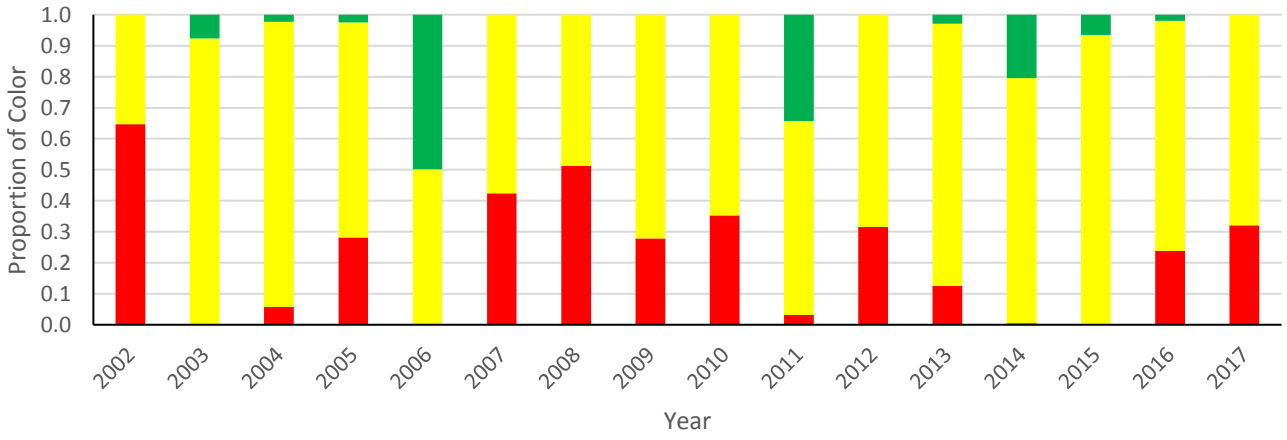
Figure 12. Annual composite TLA color proportions for adult spot for the Mid-Atlantic using 2002-2016 reference



The South Atlantic adult composite (SEAMAP and NC195) showed the highest red proportions during the mid-2000s and values approaching the 30% threshold for 2016-2017 (Fig. 13). The

composite index would not have triggered at the 30% threshold in the South Atlantic and hasn't since 2008-2010.

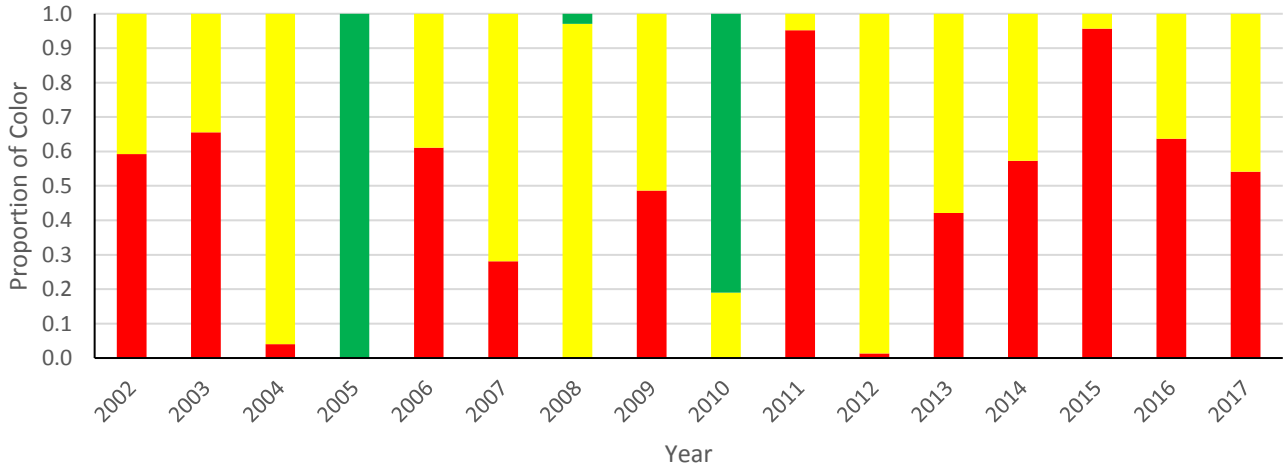
Figure 13. Annual composite TLA color proportions for adult spot for the South Atlantic using 2002-2016 reference period



Juvenile Composite Indices

The Maryland juvenile survey was the only juvenile spot survey available for use with the TLA and there was no juvenile survey available for the South Atlantic. The juvenile TLA showed a similar decline in the last 5-6 years as seen with the adult index with red proportions greater than the 30% threshold. While the juvenile index is not used directly in the trigger exercise, it would have triggered from 2014-2017 at the 30% level and at the 60% level in 2016 and 2017.

Figure 14. Mid-Atlantic (MD Juvenile Survey) TLA using 2002-2016 reference period



South Atlantic Shrimp Trawl Discards

Current estimates of relative spot by-catch from the South Atlantic shrimp fishery are only available through 2016 at the writing of this report. This will be amended when the by-catch index for 2017 become available.

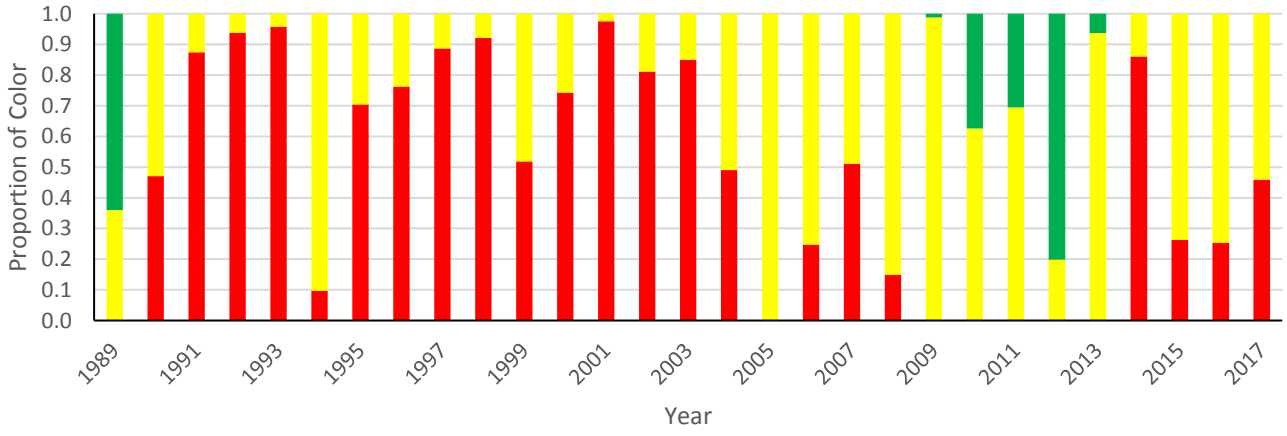
Supplemental Material: Fishery Independent Individual Index TLA's using 2002-2016 reference time period.

NMFS/NEFSC Survey

Since there was no NMFS sampling along the Mid-Atlantic due to mechanical issues on the RV Bigleow, a placeholder index using the three year (2014-2016) was used for the TLA. The TC shall have to decide if the NMFS index should remain in the 2017 index or not be used for this one year. Given the current trends over the last few years with this index, the author suggests using the placeholder proxy for 2017 only as trends have been consistent across the last few years and unless something drastic changes, the index is likely to have a minimal impact on the TLA.

The three-year (2014-2016) mean used for the 2017 placeholder in the NMFS index did exceed the 30% threshold because of the very high red proportion in 2014 and red proportions approaching 30% in 2015-2016.

Figure 15. Annual color proportions for spot TLA from NMFS survey using a 2002-2016 reference period.

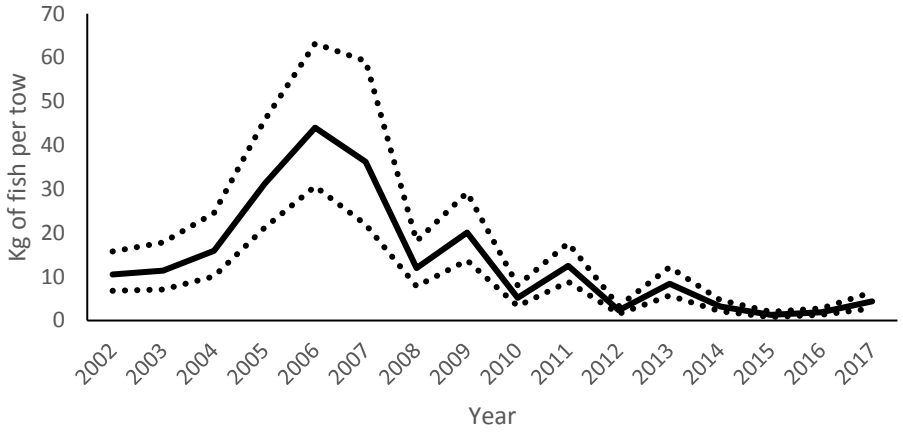


ChesMMAP Survey

The Chesapeake Marine Monitoring Program (ChesMMAP) is a general fish abundance trawl survey run by the Virginia Institute of Marine Science (VIMS) that covers the central portion of the Chesapeake Bay from the mouth up to approximately Aberdeen, MD. Spot are one of most abundant species in the survey. ChesMMAP has been in operation since 2002 with 15 years of currently available data. While not as geographically expansive as some of the other larger regional surveys (NMFS, NEAMAP, and SEAMAP), ChesMMAP does cover the full length of the Chesapeake Bay including both Virginia and Maryland.

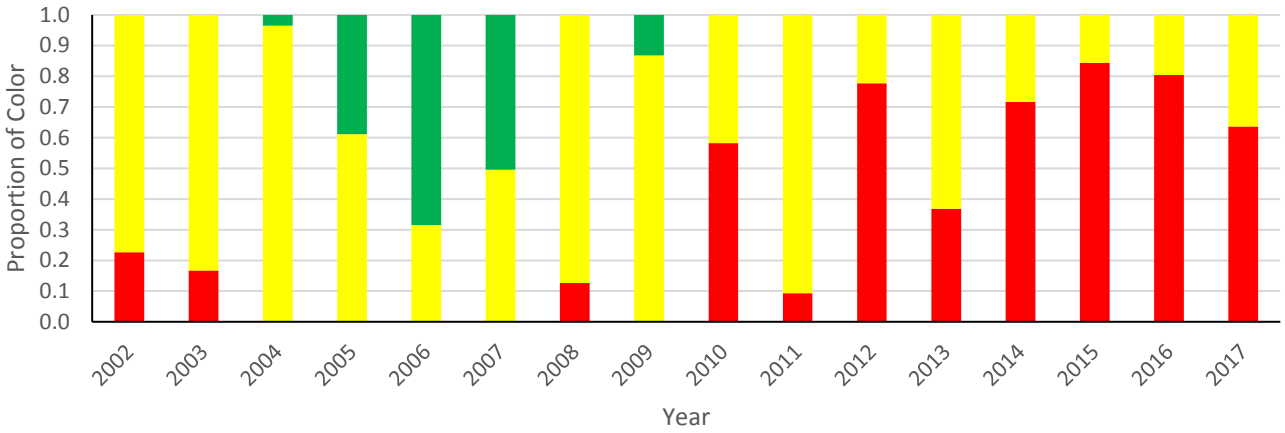
Annual catch levels for spot peaked in 2006 and have declined steadily since then (Fig. 16). Catch level variability was also much higher during the early 2000s versus later years.

Figure 16. Mean annual CPUE for spot from ChesMMAP survey. Dotted lines are 95% CI.



The TLA indicated high red proportions since 2010 when annual CPUE values were lowest (Fig. 17). The TLA would have triggered in 2012 at the 30% threshold and has been above the 60% red threshold since 2014.

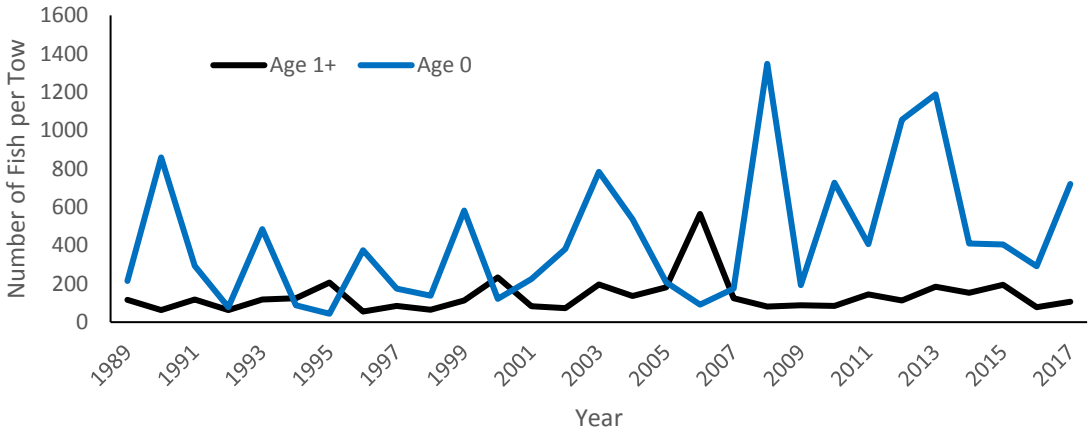
Figure 17. Annual color proportions of TLA for spot from the ChesMMAP survey using a 2002-2016 reference period.



NCDMF Program 195

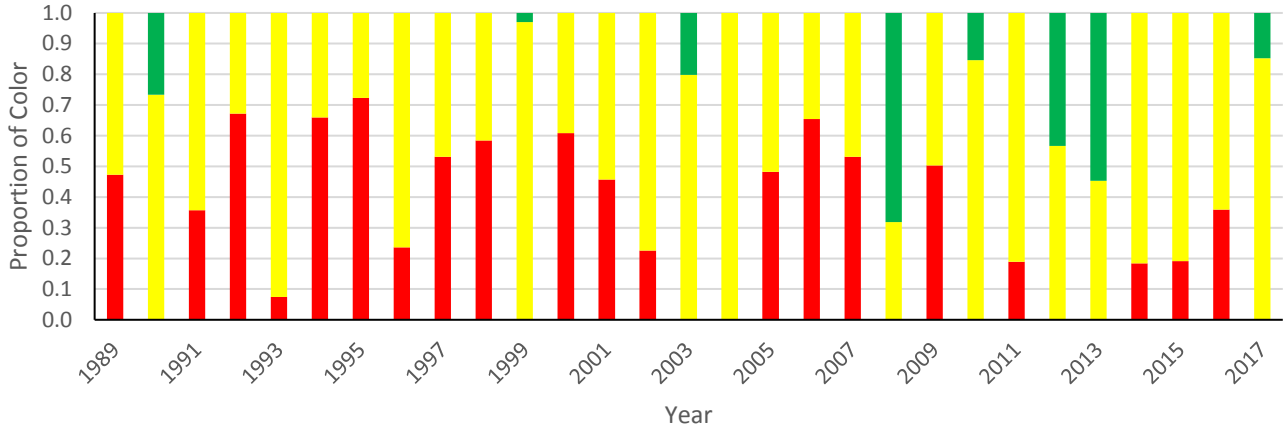
The NC Program 195 index showed a generally increasing trend for age 0 spot over the entire time series but it has declined since 2013 (Fig. 18). Adult spot catch levels remained relatively stable over time with three distinct peaks in 1995, 2000, and 2006.

Figure 18. Stratified mean annual CPUE for spot from NCDMF Program 195 suvey by age group.



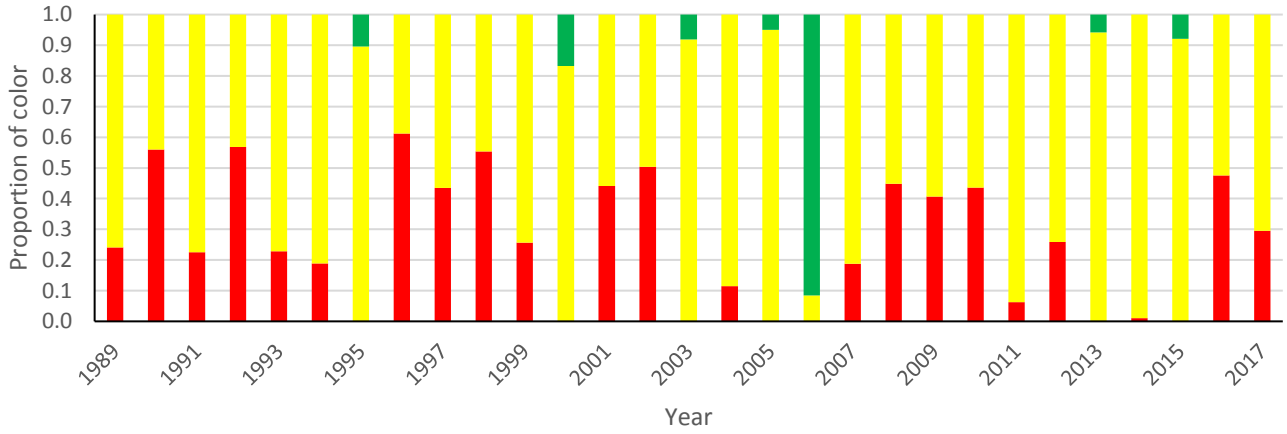
The TLA for juvenile spot (age 0) showed high proportions of red throughout the 1990s and mid 2000s (Fig. 19). Peaks in juvenile abundance occurred in 2008 and 2012-2013 with declines in 2014-2016. The juvenile spot TLA hasn't triggered since 2009.

Figure 19. Annual color proportions for age 0 spot from the NCDMF Program 195 survey using a 2002-2016 reference period.



The TLA for adult spot (age 1+) had only one year with high green proportions (2006) and showed several years (1992, 1997-1998, 2009-2010, and 2017) where the index triggered (Fig. 20).

Figure 20. Annual color proportions for age 1+ spot from the NCDMF Program 195 using a 2002-2016 reference period.



Atlantic States Marine Fisheries Commission

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MEMORANDUM

July 31, 2018

To: **South Atlantic State/Federal Fisheries Management Board**

From: **Atlantic Croaker and Spot Plan Development Team**

Subject: **Recommendations for Management Response to Triggers from Updated Traffic Light Analyses**

At the May 2018 meeting, the South Atlantic State/Federal Fisheries Management Board (Board) tasked the Atlantic Croaker and Spot Plan Development Team (PDT) with exploring potential responses to management triggers that would result from incorporation of TC-recommended updates to the annual Traffic Light Analyses (TLA) for Atlantic croaker and spot. The Board provided guidance on a goal of management measures that would achieve a red level of 35% or less within a two-year timeframe. This goal would only apply to the abundance metric, as the harvest metric would need to be re-evaluated under a new management regime.

The PDT met twice via conference call to address this task. Abundance of Atlantic croaker is strongly associated with environmental variables (Hare and Able 2007, Norcross and Austin 1981), historically expressed through a cyclical pattern in commercial landings. Additionally, the impetus for revision to the TLA was a lack of correlation between current harvest and abundance metrics. Thus, a reduction in harvest would not necessarily be expected to result in a proportional increase in abundance. Atlantic croaker are currently in a low period for commercial harvest, similar to what was previously observed during the early 1980s and followed by an increase into a high period in the late 1990s to early 2000s. Relationships between spot abundance or harvest and environmental variables are not as well-studied as Atlantic croaker, and spot do not exhibit a similar cyclical landings pattern.

Therefore, rather than focusing on a specific numeric goal for percentage red that may not be realistically attainable through management alone, the PDT recommends an alternative goal of initially establishing management measures for both the Atlantic croaker and spot fisheries, which currently have no coastwide management requirements in their respective Fishery Management Plans (FMP). These measures would ideally be suited for long-term management of these species, with the ability for them to be altered in reaction to management triggers from the TLAs. If management action is triggered, as is the case for both species in the Mid-Atlantic region under the updated TLAs, the PDT recommends that measures put in place be re-evaluated as defined in Addendum II to the Atlantic Croaker FMP (after 3 years) and Addendum I to the Spot FMP (after 2 years) to determine if they are eliciting the desired response and evaluate if adjustments should be made. For both Atlantic croaker and spot, the PDT recommends commercial and recreational

management measures in the form of seasons and trip limits (vessel or bag). Given the close association of Atlantic croaker and spot fisheries, management through an aggregate bag or vessel limit could also be considered. State-level minimum size limits are currently used for commercial and recreational Atlantic croaker fisheries in Delaware and Maryland. Size limits can be a more reliable way to restrict harvest than seasons or an aggregate bag limit due to annual variations in migration timing and masked changes in aggregate bag composition. Determination of whether a coastwide minimum size limit would be useful and an appropriate minimum size would require further discussion and evaluation of size selectivity by gears used for Atlantic croaker throughout the management unit relative to biological information on growth and maturity. Minimum size limits have not been applied to spot at the state level, and may be less useful due to the species' fast growth and early maturity.

The PDT also reviewed literature on movement and connectivity of Atlantic croaker and spot between regions specified by the updated TLA as Mid-Atlantic (New Jersey-Virginia) and South Atlantic (North Carolina-Florida). Although movement literature was sparse, genetic and life history studies, as well as commercial landings trends, suggest connectivity across the VA-NC border. The PDT recognizes that Mid- and South Atlantic regions were designated in the TC's recommendations due to the incorporation of regional abundance indices – such as indices from the Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP), the South Carolina Department of Natural Resources Trammel Net Survey, and North Carolina Division of Marine Fisheries Program 195 survey – rather than any stock distinction between these regions. Additionally, the 2010 (ASMFC 2010) and 2017 (unpublished) stock assessments for Atlantic croaker and the 2017 (unpublished) stock assessment for spot were conducted for single, coastwide stocks spanning the entire management units (both New Jersey-Florida). Given the connectivity of fish north and south of the VA-NC border, the PDT recommends that any management response to the updated, regional TLA triggers be executed on a coastwide basis. This could be accomplished through an equal response throughout the management unit, or through a form of apportioned response in which all states take on restricted measures, but states of the triggering region enact stricter measures than those of the non-triggering region. For example, if the whole coast were to implement a 100-pound trip limit and the Mid-Atlantic TLA triggers under that management regime, a response could be an 80-pound trip limit in the Mid-Atlantic and a 90-pound trip limit in the South Atlantic.

To summarize, in response to management triggers from the TC-recommended TLA updates, the PDT recommends that long-term commercial and recreational coastwide management measures be established for each species in the form of seasons and/or trip (vessel or bag/possession) limits. These measures should be re-evaluated in three years for Atlantic croaker and two years for spot to determine if they are eliciting the desired response and evaluate if any adjustments should be made. Use of coastwide or area- or gear-specific minimum size limits for Atlantic croaker could be further evaluated if deemed potentially useful from a management perspective.

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2018 REVIEW OF THE
ATLANTIC STATES MARINE FISHERIES COMMISSION
FISHERY MANAGEMENT PLAN FOR

ATLANTIC CROAKER
(Micropogonias undulatus)

2017 FISHING YEAR

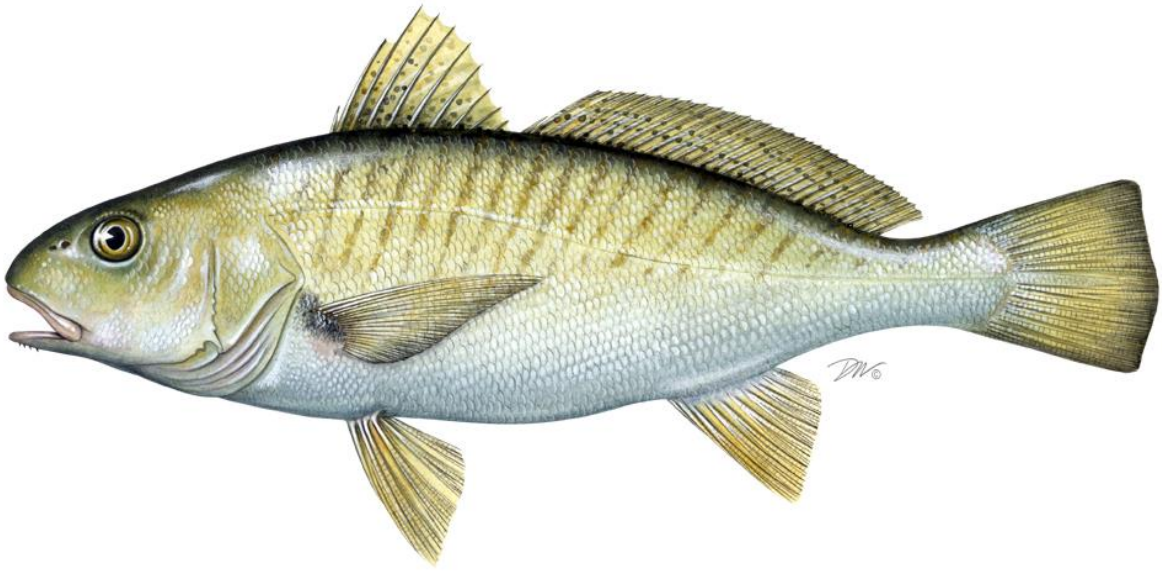

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Table of Contents

I. Status of the Fishery Management Plan

Date of FMP Approval: Original FMP – October 1987

Amendments: Amendment 1 – November 2005 (implemented January 2006)
Addendum I – March 2011
Addendum II – August 2014

Management Areas: The Atlantic coast distribution of the resource from New Jersey through Florida

Active Boards/Committees: 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 X F_{MSY} (estimated to be 0.29); SSB threshold = 0.7 X 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 is an overfished status determination, and an F estimate above the F threshold resulted is 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 recent TC report recommends several updates to the current TLA approach, that the Board is currently considering for incorporation (ASMFC 2018).

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.

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. Therefore, recreational estimates will likely be different from those shown in past FMP Reviews and state compliance reports (due annually on July 1) through 2018. Figure 1 shows coastwide recreational landings including estimates using both the previous Coastal Household Telephone Survey (CHTS) and FES calibration for comparison, but other figures, tables, and text will only show data based on the FES calibration. Data based on either survey can be referenced at: https://www.st.nmfs.noaa.gov/st1/recreational/queries/.

Total Atlantic croaker harvest from New Jersey through the east coast of Florida in 2017 is estimated at 9.0 million pounds (Tables 2 and 3, Figure 2). This represents an 81% decline in total harvest since the peak of 47.4 million pounds in 2003 (85% commercial decline, 74% recreational decline). The commercial and recreational fisheries harvested 46% and 54% of the 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 2). 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 4.1 million pounds in 2017, which registers below the 1950-2017 average of 12.1 million pounds. Within the management unit, the majority of 2017 commercial landings came from Virginia (71%) and North Carolina (24%). The Potomac River Fisheries Commission (PRFC) had the next highest level, with 2.8% of coastwide landings.

In 2018, recreational landings estimates from the Marine Recreational Information Program were updated based on effort estimates calibrated from the mail-based Fishing Effort Survey (Figure 1). From 1981-2017, recreational landings of Atlantic croaker from New Jersey through Florida have varied between 9.2 million fish (3.7 million pounds) and 36.2 million fish (17.4 million pounds; Tables 3 and 4, Figure 3). Landings generally increased until 2003, after which they showed a declining trend through 2017. The 2017 landings are estimated at 10.9 million fish and 4.8 million pounds. Virginia was responsible for 70% of the 2017 recreational landings, in numbers of fish, followed by Florida, South Carolina, and North Carolina (9%, 7%, and 6%, respectively).

The number of recreational releases generally increased over the time series until 2013, after which numbers of releases have decreased in every year through 2017 (Figure 3). However, percentage of released recreational catch has shown a slight increasing trend from the 1990s through 2017. In 2017, anglers released approximately 24 million fish, a decline from the 26 million fish released in 2016. Anglers released an estimated 69% of the croaker catch in 2017 (Figure 3).

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. In order to incorporate these changes, the Board would need to initiate an addendum to the Atlantic Croaker FMP.

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 2017 compliance reports.

<u>Fishery-Dependent Monitoring</u>

- New Jersey: initiated biological monitoring of commercially harvested Atlantic croaker in 2006 in conjunction with ACCSP (2017 n=50 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 (2,037 lengths); seafood dealer sampling (767 lengths and 737 weights)
- PRFC: has a mandatory commercial harvest daily reporting system, with reports due weekly.

- Virginia: commercial fishery biological sampling (6,855 length measurements, 6,849 weight measurements, 313 otolith ages, and 690 sex determinations in 2017)
- North Carolina: commercial fishery biological sampling since 1982 for length (2017 n=6,021), 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 (0 fish in 2017)
- Florida: commercial fishery biological sampling

<u>Fishery-Independent Monitoring</u>

- New Jersey: 3 nearshore ocean (within 12 nm) juvenile trawl surveys (New Jersey Ocean Trawl Survey, 1988-present: 2017 CPUE was well below time-series average but above 2016 value; nearshore Delaware Bay juvenile trawl survey, 1991-present: 2017 survey index was well below time series average; Delaware River juvenile seine survey, 1980-present: 2016 survey index was below time series average)
- Delaware: offshore Delaware Bay adult finfish trawl survey (1990-present; 2017 #/tow = 5.89; 165% increase in relative abundance from 2016 index, below mean for time series); nearshore Delaware Bay juvenile finfish trawl survey (1980-present; 2017 index decreased from 1.17 in 2016 to 0.81; Inland Bays index decreased from 0.43 in 2016 to 0.30 in 2017).
- Maryland: summer gill net survey was initiated in 2013 on lower Choptank (53 fish were captured in 2017); Atlantic coast bays juvenile otter trawl survey (standardized from 1989-present; 2017 GM of 0.38 fish/hectare is the second lowest value of the 29-year time series); Chesapeake Bay juvenile trawl index (standardized from 1989-present; CPUE increased from 0.81 in 2016 to 2.35 in 2017).
- PRFC: Maryland DNR conducts an annual juvenile beach haul seine survey in the Potomac River (1954-present; YOY GM increased from 0.27 in 2016 to 0.35 in 2017).
- Virginia: Virginia Institute of Marine Science (VIMS) Juvenile Finfish and Blue Crab Trawl Survey (1988-present; 2017 index was 15.19, which is down from the 2016 value of 27.41).
- North Carolina: Pamlico Sound juvenile trawl survey (1987-present; 2017 juvenile abundance index (mean number of individuals/tow) was 1,172.3, the second-highest value in the time series)
- South Carolina: estuarine electroshock survey for juveniles (2001-present; 2017 CPUE increased by 80% since 2016, above the long-term mean); SEAMAP shallow water (15-30 ft) trawl survey from Cape Hatteras to Cape Canaveral (1989-present; 2017 CPUE decreased by 36% from 2016; inshore estuarine trammel net survey for adults (May-September, 1991-present; 2017 CPUE increased 178% from 2016); SCECAP estuarine trawl survey (1999-present, primarily targets juveniles, 2017 CPUE decreased from 2016 by 47%).
- Georgia: Marine Sportfish Population Health Survey (trammel and gill net surveys in the Altamaha River Delta and Wassaw estuary, 2002-present; 2017 trammel net index (GM #/standard net set): 0.1, gill net index: 0.4); Ecological Monitoring Survey (trawl, 2003-present; 2017 CPUE (#/tow) decreased from 95.35 in 2016 to 78.8 in 2016).

- Florida: juvenile seine survey (2002-present; 2017 index decreased by 23% from 2016); juvenile trawl survey (2002-present; 2017 index decreased by 9% from 2016); adult haul seine survey (2001-present; 2017 index value increased by 2% from 2016)

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. Catch levels in 2016 decreased 34.6% from 2015 and were above the long term mean. The NEFSC survey was not carried out in 2017 due to mechanical issues with the RV Bigelow. While there will be a survey in 2018, that particular data metric was not available in 2017. In order to maintain the usefulness of the NEFSC index, an initial placeholder value was utilized for 2017 that was calculated as the mean annual catch from the three previous years (2014-2016). The TC has not had a chance to address this specific issue to date and may modify it in the future if a better method or consensus is reached on how to maintain an index value for 2017.

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 2017 shows that this population characteristic tripped for a fifth consecutive year (Figure 4). Recreational harvest was estimated based on MRIP's mail-based Fishing Effort Survey calibration. The mean proportion of red color from 2014-2016 was 69%, exceeding the 60% threshold. The harvest composite index was comprised of commercial and recreational landings. Both commercial and recreational indices would have individually tripped in 2017 at the 30% level. The TLA for commercial landings was above the 60% threshold in 2017, and has exceeded 60% in three consecutive 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 2017 with no red proportion. The NEFSC survey was not conducted in 2017 due to mechanical issues with the RV Bigelow. The 2017 value for this index is estimated in this report as the 3-year average of the 2014-2016 index values. The adult composite TLA characteristic (Figure 5) did not trigger in 2017 with no red proportion and no red in the five previous years. The juvenile composite characteristic index (Figure 6) was fifty percent red and fifty percent green, due to a large decrease in the VIMS index and a large increase 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 2017 since both population characteristics (harvest and adult abundance) were not above the 30% threshold for the 2015-2017 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 2017 are based on 1% of the average coastwide 2015-2017 landings in each fishery: 58,000 pounds for the commercial fishery and 58,400 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 with a three-year average of 279 pounds. The Georgia commercial fishery qualifies for *de minimis* status with a three-year average of zero pounds. The Florida commercial fishery qualifies for *de minimis* status with a three-year average of 46,441 pounds.

Changes to State Regulations
In 2017, 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-24-2017, M-20-2017, M-23-2017, FF-47-2017, M-19-2017, M-18-2017, M-17-2017, M-14-2017, M-13-2017, M-12-2017, M-11-2017, M-10-2017, M-9-2017, M-8-2017, M-7-2017, M-6-2017, M-5-2017, M-4-2017, M-3-2017, M-2-2017, and M-1-2017.

In 2017, the Georgia General Assembly approved the addition of species endorsements to commercial fishing licenses (O.C.G.A 27-2-23 (6) and (11)). Species endorsements regulations were adopted by the Board of Natural Resources in December 2017 and became effective January 2018 (Board of Natural Resources Rule 391-2-4-.17). The endorsements effectively replaced Letters of Authorization.

In Georgia, a new seafood dealer license was also implemented in 2018 through the same 2017 legislation for endorsements (O.C.G.A 27-2-23 (8A)). 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". Georgia requires seafood dealers and commercial fishermen to be properly licensed as described by O.C.G.A Sections 27-4-118, 27-4-136, and Board of Natural Resources Rule 391-2-4-.09. 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 2015

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

VIII. Recommendations

Management and Regulatory Recommendations

- Consider initiation of an addendum to incorporate TC-recommended changes to the annual TLA.
- Encourage the use of circle hooks to minimize recreational discard mortality.
- Consider approval of the *de minimis* requests from Delaware, South Carolina, Georgia, and Florida for their commercial fisheries.
- 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

<u>High Priority</u>

- 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?

<u>Medium Priority</u>

- 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 monito the relative importance of Atlantic croaker. Incorporate biological data collection into the program.

IX. References

Atlantic States Marine Fisheries Commission (ASMFC). 1987. Fishery Management Plan for Atlantic Croaker. Washington (DC): ASMFC. Fishery Management Report No. 10. 90 p.

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Kevin Brown. 2015. Characterization of the commercial shrimp otter trawl fishery in the estuarine and ocean (0-3 miles) waters of North Carolina. Morehead City (NC): NCDEQ, Division of Marine Fisheries. Abstract.

X. Figures

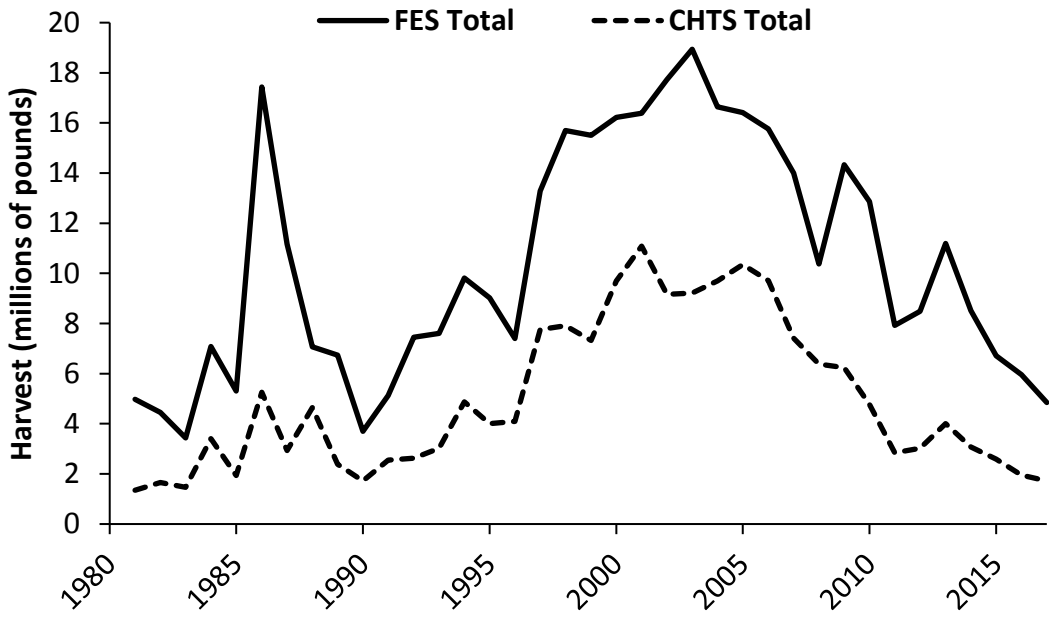


Figure 1. Recreational harvest in pounds, estimated using the Coastal Household Telephone Survey (CHTS) and the mail-based Fishing Effort Survey (FES). (Source: personal communication with NOAA Fisheries, Fisheries Statistics Division. [07/18/2018])

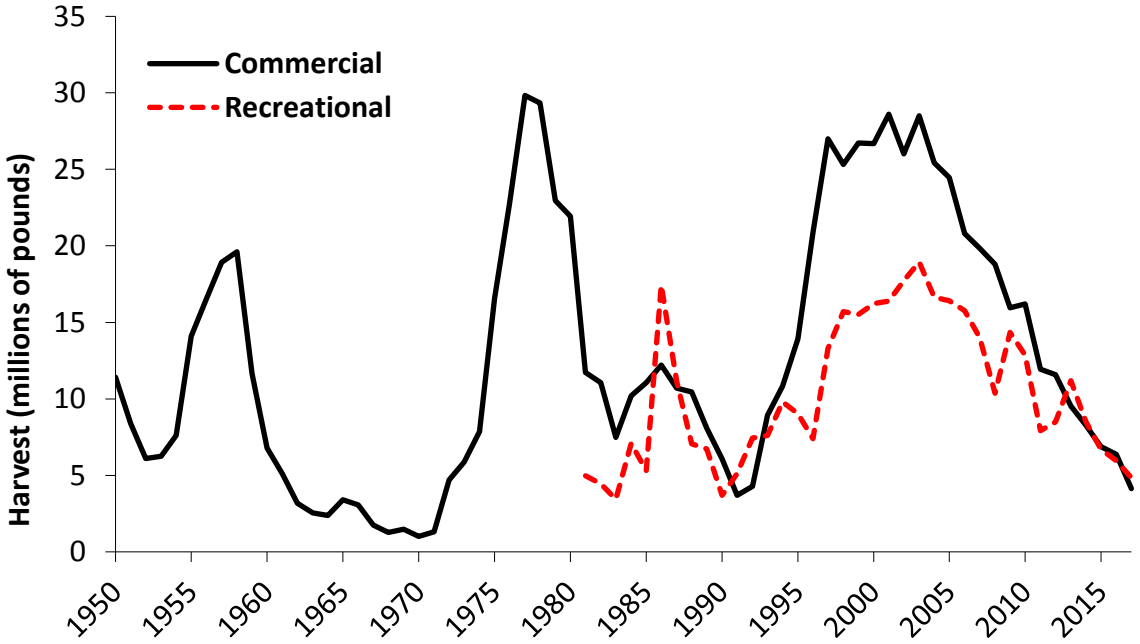


Figure 2. Atlantic croaker commercial and recreational landings (pounds) from 1950-2017. (See Tables 2 and 3 for source information. Commercial landings estimate for 2017 is preliminary. Reliable recreational landings estimates are not available prior to 1981. Recreational landings estimates are based on the mail-based Fishing Effort Survey.)

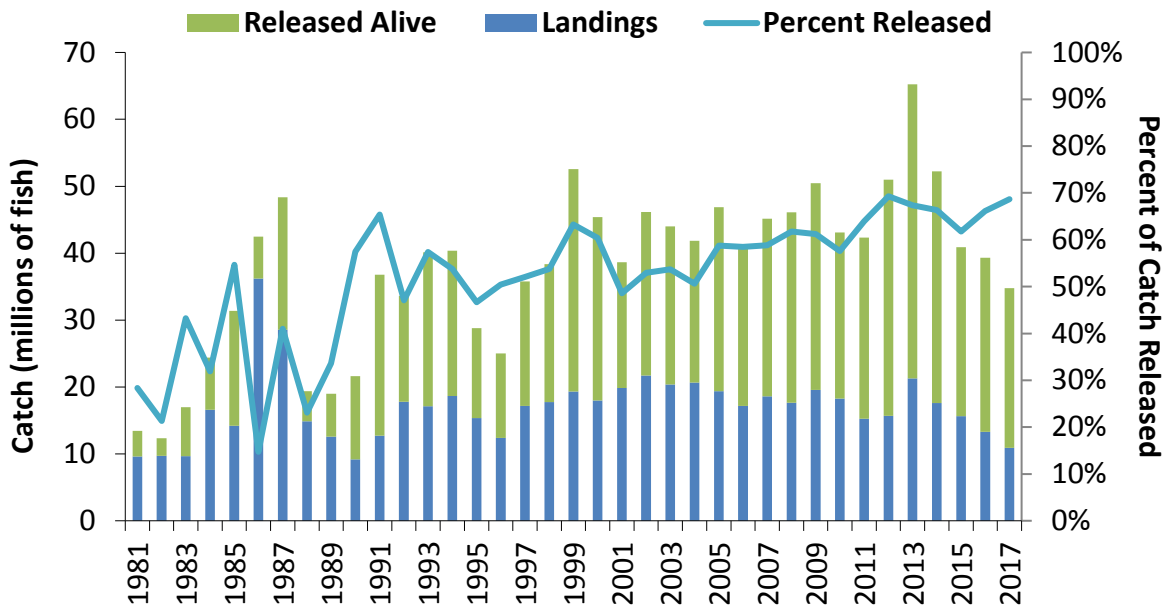


Figure 3. Recreational catch (landings and alive releases, in numbers) and the percent of catch that is released, 1981-2017, based on the mail-based Fishing Effort Survey calibration. (See Tables 4 and 5 for values and source information.)

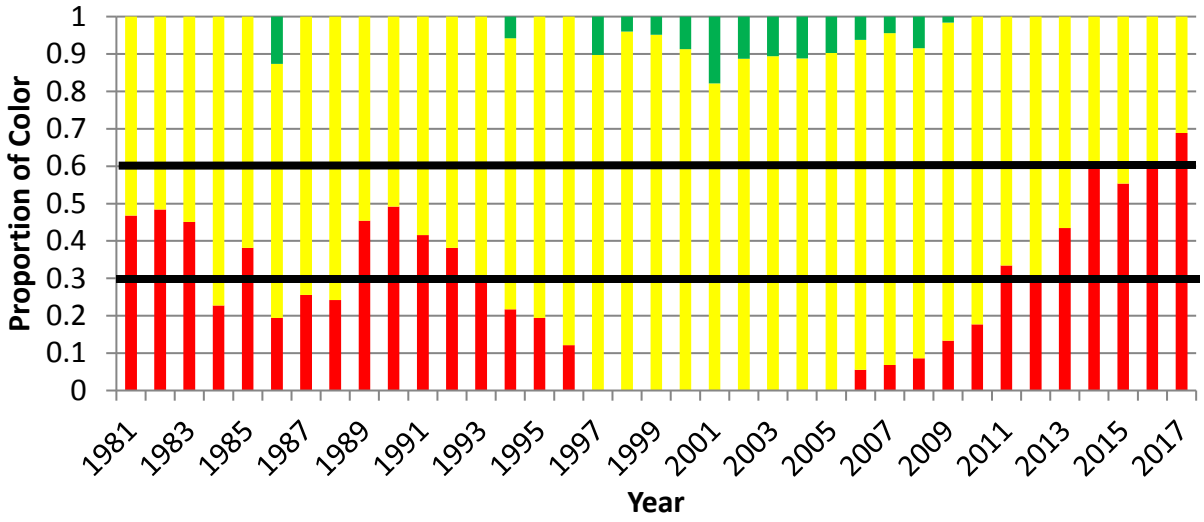


Figure 4. Annual color proportions for the harvest composite TLA of Atlantic croaker recreational and commercial landings.

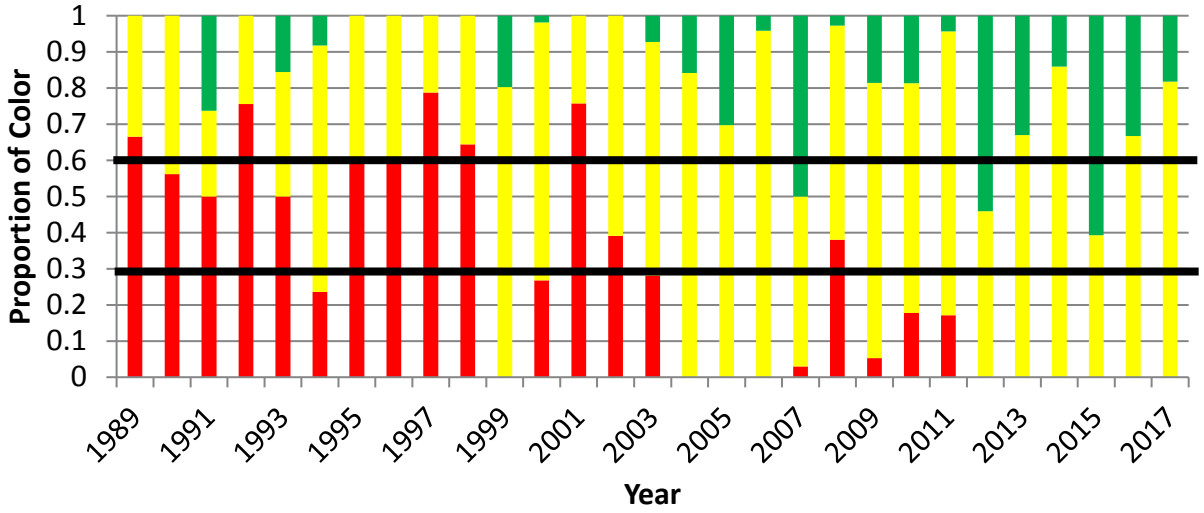


Figure 5. Adult croaker TLA composite characteristic index (NEFSC and SEAMAP surveys). The NEFSC survey was not conducted in 2017 due to mechanical problems with the RV Bigelow. The 3-year average of 2014-2016 values was imputed to estimate the 2017 value for this index.

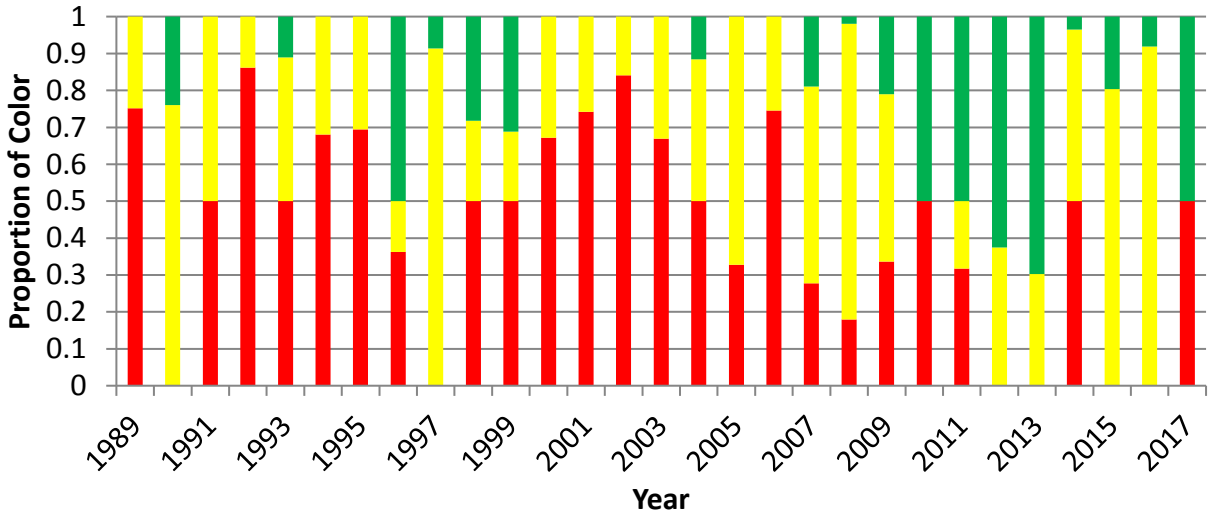


Figure 6. Juvenile croaker TLA composite characteristic index (NC 195 and VIMS surveys).

XI. Tables

Table 1. Summary of state regulations for Atlantic croaker in 2017.

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, 2008-2017.
(Estimates for 2017 are preliminary. Sources: 2018 state compliance reports for 2017 fishing year and for years prior to 2017, personal communication with ACCSP, Arlington, VA [07/18/2018], except PRFC [compliance reports only].)

Year	NJ	DE	MD	PRFC	VA	NC	SC	GA	FL	Total
2008	946,339	10,486	608,859	337,062	11,066,482	5,791,766	116	*	30,407	18,791,517
2009	585,552	*	448,589	234,101	8,489,772	6,135,437	75		32,151	15,925,677
2010	342,116	*	542,233	162,571	7,796,179	7,312,159	*		37,229	16,192,487
2011	458,397	*	714,347	243,196	5,415,432	5,054,186	*		47,649	11,933,205
2012	363,381	*	915,432	273,849	6,842,005	3,106,616	*		74,527	11,575,809
2013	332,813	*	820,777	130,285	6,237,602	1,927,938	*		76,463	9,525,878
2014	265,166	*	443,661	177,777	4,697,381	2,629,908	247		45,587	8,259,726
2015	81,311	*	294,038	118,996	4,508,892	1,819,067	*		39,096	6,861,400
2016	55,210	*	101,949	168,889	3,899,990	2,092,135	302		57,538	6,376,012
2017	1,068	*	41,663	114,319	2,933,080	1,007,963	256		42,689	4,141,038

* confidential data

Table 3. Recreational harvest (pounds) of Atlantic croaker by state, 2008-2017. State values are shown using mail-based Fishing Effort Survey (FES)-calibrated estimates, while coastwide totals are shown for both FES estimates and Coastwide Household Telephone Survey (CHTS) estimates. (Source: personal communication with NOAA Fisheries, Fisheries Statistics Division. [07/18/2018])

Year	NJ	DE	MD	VA	NC
2008	911,380	542,545	825,062	7,244,645	275,052
2009	662,763	615,692	3,012,580	8,282,280	359,703
2010	79,889	106,268	2,472,032	9,295,413	638,817
2011	50,153	123,487	1,188,916	4,584,599	360,390
2012	259,645	147,737	1,980,417	4,664,264	307,338
2013	1,637,516	253,447	1,581,384	6,442,166	453,881
2014	750,580	427,615	1,265,217	4,354,046	758,751
2015	263,749	189,320	871,596	3,514,410	557,735
2016	7,133	10,959	407,010	2,998,022	443,728
2017	0	26,429	238,659	3,383,506	237,160

Year	SC	GA	FL	FES Total	CHTS Total
2008	41,864	24,414	503,549	10,368,511	6,372,427
2009	214,212	69,031	1,120,776	14,337,037	6,233,412
2010	27,184	35,593	209,519	12,864,715	4,768,844
2011	583,280	38,219	995,506	7,924,550	2,837,034
2012	30,149	29,815	1,063,337	8,482,702	3,017,384
2013	84,248	89,781	642,887	11,185,310	4,000,931
2014	104,434	138,423	712,090	8,511,156	3,075,053
2015	181,909	248,431	881,185	6,708,335	2,584,350
2016	81,896	116,313	1,893,203	5,958,264	1,949,944
2017	310,621	100,565	555,389	4,852,329	1,715,421

Table 4. Recreational harvest (numbers) of Atlantic croaker by state, 2008-2017. State values are shown using mail-based Fishing Effort Survey (FES)-calibrated estimates, while coastwide totals are shown for both FES estimates and Coastwide Household Telephone Survey (CHTS) estimates. (Source: personal communication with NOAA Fisheries, Fisheries Statistics Division. [07/18/2018])

Year	NJ	DE	MD	VA	NC
2008	1,025,804	639,436	1,057,946	12,901,813	678,638
2009	1,059,267	983,173	2,586,887	10,789,517	958,128
2010	142,887	207,601	2,994,889	12,961,723	1,280,446
2011	91,014	212,613	1,530,723	8,891,276	873,659
2012	830,891	202,283	2,565,599	8,786,350	848,495
2013	2,707,410	530,236	2,308,987	12,517,286	1,300,804
2014	852,733	806,256	2,197,125	9,533,829	1,935,961
2015	339,021	334,676	1,738,576	8,024,381	1,437,019
2016	8,236	24,546	659,318	7,276,719	1,109,570
2017	0	65,575	425,987	7,637,843	666,930

Year	SC	GA	FL	FES Total	CHTS Total
2008	190,181	72,912	1,055,906	17,622,636	10,849,419
2009	733,845	185,129	2,252,473	19,548,419	8,436,509
2010	88,399	121,252	470,168	18,267,365	6,711,636
2011	949,132	129,941	2,593,963	15,272,321	5,109,533
2012	132,264	104,944	2,190,268	15,661,094	5,732,227
2013	336,140	264,984	1,332,465	21,298,312	7,554,404
2014	600,482	289,781	1,359,207	17,575,374	6,218,185
2015	555,263	790,014	2,429,723	15,648,673	5,663,615
2016	268,470	402,254	3,553,777	13,302,890	4,278,373
2017	765,227	371,301	969,146	10,902,009	3,920,875

Table 5. Recreational releases (number) of Atlantic croaker by state, 2008-2017. State values are shown using mail-based Fishing Effort Survey (FES)-calibrated estimates, while coastwide totals are shown for both FES estimates and Coastwide Household Telephone Survey (CHTS) estimates. (Source: personal communication with NOAA Fisheries, Fisheries Statistics Division. [07/18/2018])

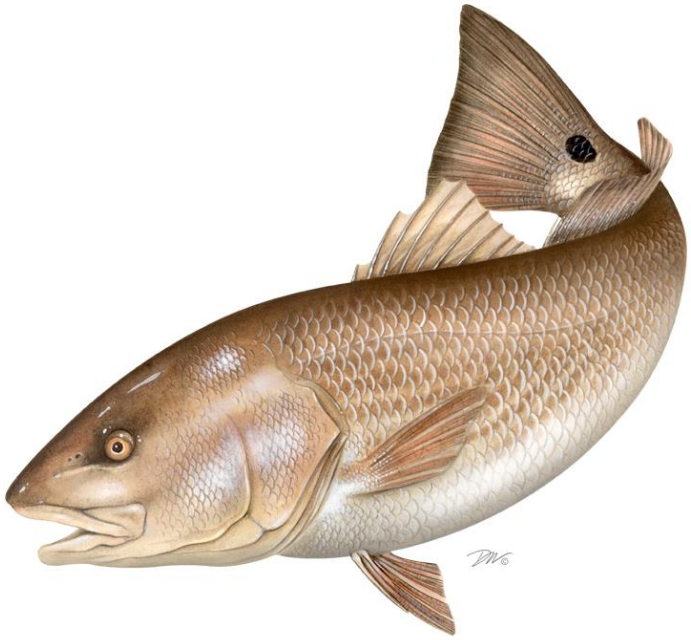
Year	NJ	DE	MD	VA	NC
2008	4,777,481	1,162,992	3,644,105	12,806,082	3,274,873
2009	406,639	1,284,262	2,424,818	16,732,646	5,623,278
2010	380,916	1,056,528	3,060,983	13,470,836	4,571,287
2011	252,419	214,603	937,220	14,160,124	7,005,152
2012	3,336,964	1,036,383	7,090,976	15,140,369	3,878,710
2013	2,980,744	1,811,661	7,557,223	18,480,099	6,729,556
2014	703,031	1,396,970	2,806,693	10,314,405	10,347,332
2015	240,840	309,389	1,236,293	6,815,343	9,632,560
2016	139,085	390,655	726,662	6,993,470	7,254,382
2017	152,540	230,934	2,833,760	8,443,528	4,631,445

Year	SC	GA	FL	FES Total	CHTS Total
2008	531,919	527,977	1,743,548	28,468,977	15,662,602
2009	1,232,519	1,169,782	2,015,296	30,889,240	12,673,959
2010	621,497	651,984	1,014,552	24,828,583	8,469,416
2011	1,187,686	748,696	2,559,976	27,065,876	8,143,558
2012	1,070,703	781,302	2,999,225	35,334,632	10,709,525
2013	3,754,143	1,361,943	1,265,571	43,940,940	13,916,551
2014	4,742,718	2,057,898	2,265,961	34,635,008	9,996,064
2015	3,236,774	1,320,939	2,451,253	25,243,391	7,662,983
2016	5,233,835	1,178,630	4,073,001	25,989,720	6,929,781
2017	4,755,853	1,059,539	1,770,846	23,878,445	6,724,829

2018 REVIEW OF THE ATLANTIC STATES MARINE FISHERIES COMMISSION FISHERY MANAGEMENT PLAN FOR

RED DRUM (*Sciaenops ocellatus*)

2017 FISHING YEAR



The Red Drum Plan Review Team

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I. Status of the Fishery Management Plan

Date of FMP Approval:	Original FMP – October 1984
Amendments:	Amendment 1 – October 1991 Amendment 2 – June 2002 Addendum 1 – August 2013
Management Areas:	The Atlantic coast distribution of the resource from New Jersey through Florida Northern: New Jersey through North Carolina Southern: South Carolina through the east coast of Florida
Active Boards/Committees:	South Atlantic State/Federal Fisheries Management Board, Red Drum Technical Committee, Stock Assessment Subcommittee, Plan Development Team, Plan Review Team, South Atlantic Species Advisory Panel

The Atlantic States Marine Fisheries Commission (ASMFC) adopted an Interstate Fishery Management Plan (FMP) for Red Drum in 1984. The original management unit included the states from Maryland to Florida. In 1988, the Interstate Fisheries Management Program (ISFMP) Policy Board requested that all Atlantic coastal states from Maine to Florida implement the plan's recommended management regulations to prevent development of northern markets for southern fish. The states of New Jersey through Florida are now required to follow the FMP, while Maine through New York (including Pennsylvania) are encouraged to implement consistent provisions to protect the red drum spawning stock.

In 1990, the South Atlantic Fishery Management Council (Council) adopted a FMP for red drum that defined overfishing and optimum yield (OY) consistent with the Magnuson Fishery Conservation and Management Act of 1976. Adoption of this plan prohibited the harvest of red drum in the exclusive economic zone (EEZ), a moratorium that remains in effect today. Recognizing that all harvest would take place in state waters, the Council FMP recommended that states implement measures necessary to achieve the target level of at least 30% escapement.

Consequently, ASMFC initiated Amendment 1 in 1991, which included the goal to attain optimum yield from the fishery over time. Optimum yield was defined as the amount of harvest that could be taken while maintaining the level of spawning stock biomass per recruit (SSBR) at or above 30% of the level which would result if fishing mortality was zero. However, a lack of information on adult stock status resulted in the use of a 30% escapement rate of sub-adult red drum to the off-shore adult spawning stock.

Substantial reductions in fishing mortality were necessary to achieve the escapement rate; however, the lack of data on the status of adult red drum along the Atlantic coast led to the adoption of a phase-in approach with a 10% SSBR goal. In 1991, states implemented or maintained harvest controls necessary to attain the goal.

As hoped, these management measures led to increased escapement rates of juvenile red drum. Escapement estimates for the northern region of New Jersey through North Carolina (18%) and the southern region of South Carolina through Florida (17%) were estimated to be above the 10% phase-in goal, yet still below the ultimate goal of 30% (Vaughan and Carmichael 2000). North Carolina, South Carolina, and Georgia implemented substantive changes to their regulations from 1998-2001 that further restricted harvest.

The Council adopted new definitions of OY and overfishing for red drum in 1998. Optimum yield was redefined as the harvest associated with a 40% static spawning potential ratio (sSPR), overfishing as an sSPR less than 30%, and an overfishing threshold as 10% sSPR. In 1999, the Council recommended that management authority for red drum be transferred to the states through the Commission's Interstate Fishery Management Program (ISFMP) process. This was recommended, in part, due to the inability to accurately determine an overfished status, and therefore stock rebuilding targets and schedules, as required under the revised Sustainable Fisheries Act of 1996. The transfer necessitated the development of an amendment to the interstate FMP in order to include the provisions of the Atlantic Coastal Fisheries Cooperative Management Act.

ASFMC adopted Amendment 2 to the Red Drum FMP in June 2002 (ASMFC 2002), which serves as the current management plan. The goal of Amendment 2 is to achieve and maintain the OY for the Atlantic coast red drum fishery as the amount of harvest that can be taken by U.S. fishermen while maintaining the sSPR at or above 40%. There are four plan objectives:

- Achieve and maintain an escapement rate sufficient to prevent recruitment failure and achieve an sSPR at or above 40%.
- Provide a flexible management system to address incompatibility and inconsistency among state and federal regulations which minimizes regulatory delay while retaining substantial ASMFC, Council, and public input into management decisions; and which can adapt to changes in resource abundance, new scientific information, and changes in fishing patterns among user groups or by area.
- Promote cooperative collection of biological, economic, and sociological data required to effectively monitor and assess the status of the red drum resource and evaluate management efforts.
- Restore the age and size structure of the Atlantic coast red drum population.

The management area extends from New Jersey through the east coast of Florida, and is separated into a northern and southern region at the North Carolina/South Carolina border. The sSPR of 40% is considered a target; an sSPR below 30% (threshold level) results in an overfishing determination for red drum. Amendment 2 required all states within the management unit to implement appropriate recreational bag and size limit combinations needed to attain the target sSPR, and to maintain current, or implement more restrictive, commercial fishery regulations. All states were in compliance by January 1, 2003. See Table 1 for state commercial and recreational regulations in 2017.

Following the approval of Amendment 2 in 2002, the process to transfer management authority to ASMFC began, including an Environmental Assessment and public comment period. The final rule became effective November 5, 2008. It repeals the federal Atlantic Coast Red Drum Fishery Management Plan and transfers management authority of Atlantic red drum in the exclusive economic zone from the South Atlantic Fishery Management Council to the Atlantic States Marine Fisheries Commission.

The Board approved Addendum I to Amendment 2 in August 2013. The Addendum revised the habitat section of Amendment 2 to include current information on red drum spawning habitat and life-stages (egg, larval, juvenile, sub-adult, and adult). It also identified and described the distribution of key habitats and habitats of concern.

II. Status of the Stocks

The 2017 Red Drum Stock Assessment and Peer Review Report indicate overfishing is not occurring for either the northern or southern stock of red drum (ASMFC 2017). The assessment was unable to determine an overfished/not overfished status because population abundance could not be reliably estimated due to limited data for the older fish (ages 4+).

Northern Region (NJ-NC)

Recruitment (age 1 abundance) has varied annually with a large peak occurring in 2012 (Figure 1). The trend in the three-year average sSPR indicates low sSPR early in the time series with increases during 1991 – 1997 and fluctuations thereafter (Figure 2). The average sSPR has been above the overfishing threshold ($F_{30\%}$) since 1994, and at or above the target ($F_{40\%}$) since 1996, except during one year (2002). Fishing pressure and mortality appear to be stabilized near the target fishing mortality. The average sSPR is also likely above the target benchmark.

Southern Region (SC-FL)

Recruitment (age 1 abundance) has fluctuated without apparent trend since 1991 (Figure 1). A high level of uncertainty exists around the three-year average sSPR estimates for the southern region. While the 3-year average sSPR estimate in 2013 was above both the target ($F_{40\%}$) and the overfishing threshold ($F_{30\%}$), indicating that overfishing is not occurring, the high level of uncertainty around this estimate indicates that this conclusion should be considered with extreme caution (Figure 2).

III. Status of the Fishery

In July, 2018, the Marine Recreational Information Program (MRIP) updated recreational catch estimates based on the mail-based Fishing Effort Survey (FES). Previous estimates were made based on the Coastal Household Telephone Survey (CHTS). As current management is based on the most recent stock assessment (2017), which used CHTS-based estimates, these estimates will continue to be used until another stock assessment is conducted. Figure 7 shows coastwide recreational landings including estimates using both the previous CHTS and FES calibrations for comparison, but other figures, tables, and text will only show data based

on the CHTS calibration. Data based on either survey can be referenced at: https://www.st.nmfs.noaa.gov/st1/recreational/queries/.

Total red drum landings from New Jersey through the east coast of Florida in 2017 are estimated at 2.15 million pounds (Tables 2 and 3, Figure 3). This is roughly 100,000 pounds less than was landed in 2016. 2017 total landings are above the previous ten-year (2008-2017) average of 2.01 million pounds. The commercial and recreational fisheries harvested 9% and 91% of the total, respectively. The southern region includes South Carolina through Florida's east coast, while the northern region includes New Jersey through North Carolina. In 2017, 56% of the total landings came from the southern region where the fishery is exclusively recreational, and 44% from the northern region (Figure 4).

Coastwide commercial landings increased significantly this year, but show no long-term temporal trends. In the last 50 years, landings have ranged from approximately 54,000 pounds (in 1997) to 440,000 pounds (in 1980, Figure 3). In 2017, red drum were commercially landed only in Maryland, Virginia, and North Carolina (Table 2). Coastwide commercial harvest increased from 78,785 pounds in 2016 to 194,449 pounds in 2017, with 96% harvested by North Carolina. Historically, North Carolina and Florida shared the majority of commercial harvest, but commercial harvest has been prohibited in Florida under state regulation since January 1988. South Carolina also banned commercial harvest and sale of native caught red drum beginning in 1987, and in 2013 Georgia designated Red Drum Gamefish status, eliminating commercial harvest and sale.

In North Carolina, a daily commercial trip limit and an annual cap of 250,000 pounds with payback of any overage constrain the commercial harvest. Unique to this state, the red drum fishing year extends from September 1 to August 31. In 2008, the Board approved use of this 2008 fishing year to monitor the cap. During the 2009/2010 and the 2013/2014 fishing years, North Carolina had overages of 25,858 pounds and 12,753 pounds, respectively. The commercial harvest for each following fishing year remained well below the adjusted cap allowance, providing sufficient payback.

Recreational harvest of red drum peaked in 1984 at 1.05 million fish (or 2.6 million pounds; Tables 3 and 4). Since 1988, the number has fluctuated without trend between 250,000 and 760,000 fish (800,000 to 2.7 million pounds; Figures 3 and 5). Recreational harvest decreased from 591,333 fish (2.2 million pounds) in 2016 to 541,670 fish (2.0 million pounds) in 2017. The 2017 harvest is greater than the 10-year average (2008-2017) for recreational harvest in numbers (538,441) and pounds (1.8 million). Florida anglers landed the largest share of the coastwide recreational harvest in numbers (40%), followed by North Carolina (21%), Virginia (18%), and South Carolina (14%).

Anglers release far more red drum than they keep; the percent of the catch released has been over 80% during the last decade (Figure 5). Recreational releases show an increasing trend over the time series that has plateaued from around the early 2000s to the present. The proportion of releases in 2017 was 85% (versus 81% in 2016), and the overall number of fish released was

3.0 million in 2017 (Figure 5, Table 5). It is estimated that 8% of released fish die as a result of being caught, resulting in an estimated 241,665 dead discarded fish in 2017 (Table 5). Recreational removals from the fishery are thus estimated to be 783,335 fish in 2017 (Figure 6).

IV. Status of Assessment Advice

Current stock status information comes from the 2017 stock assessment (ASMFC 2017) completed by the ASMFC Red Drum Stock Assessment Subcommittee (SAS) and Technical Committee (TC), peer reviewed by an independent panel of experts through ASMFC's desk review process, and approved by the South Atlantic State-Federal Fisheries Management Board for use in management decisions. Previous interstate management decisions were based on the last coastwide assessment, SEDAR 18 (SAFMC 2009), and prior to 2009, decisions were based on regional assessments conducted by Vaughan and Helser (1990), Vaughan (1992, 1993, 1996), and Vaughan and Carmichael (2000) that reflected the current stock structure, two stocks divided at the North Carolina-South Carolina border. Several states have also conducted state-specific assessments (e.g., Murphy and Munyandorero 2009; Takade and Paramore 2007 [update of Vaughan and Carmichael 2000]).

The 2017 stock assessment uses a statistical catch at age (SCA) model with age-specific data for red drum ages 1 through 7+. This model is similar to that used in the 2009 assessment, with data updated through 2013. Data from 1989-2013 were included from the following sources: commercial and recreational harvest and discard data, fishery-dependent and -independent biological sampling data, tagging data, and fishery-independent survey abundance data.

The Peer Review Panel considered the use of an SCA model appropriate given the types of data available for red drum. For the northern region, the Review Panel agreed that the model was informative of age 1-3 abundance and exploitation rates, but not for older age groups. The model was also found to be informative of annual trends in sSPR and the 2011-2013 average sSPR. For the southern region, the Review Panel agreed that estimates of age 7+ fish seemed to be more consistent with the population biology, leading to a large fraction of biomass being unavailable to exploitation. For both regions, most of the sSPR is contained within the larger, fully mature, age 7+ fish, thus even a small increase in fishing mortality on older red drum (due to harvest or other factors) could quickly lead to a decrease in sSPR and overfishing.

V. Status of Research and Monitoring

No monitoring or research programs are annually required of the states except for the submission of a compliance report. The following fishery-dependent (other than catch and effort data) and fishery-independent monitoring programs were reported in the 2017 reports.

<u>Fishery Dependent Monitoring</u>

- Delaware DFW – Commercial monitoring through mandatory logbook reports.
- Maryland DNR – Commercial pound nets sampled bi-weekly in the Chesapeake Bay from late spring through summer (2017 n=19). Only three of the 24 years of sampling exceeded 20 fish, and no red drum were encountered in ten of the survey years. Seafood dealer

sampling was conducted (2017 n=2). Licensed charter boat captain logbooks are monitored for red drum captures (2017: 48 caught, 17 harvested).

- PRFC – Red drum are harvested incidentally in the commercial pound net and haul seine fisheries. The mandatory commercial harvest daily reporting system, which collects harvest and discards/releases, reported zero red drum released in 2017.
- Virginia MRC – Volunteer anglers have participated since 1995 in the Virginia Game Fish Tagging Program (2017: 1,436 fish tagged, 125 reported recaptures). Carcasses collected through the Marine Sportfish Collection Project since 2007 (2017 n=37).
- North Carolina DMF – Commercial cap monitored through trip ticket program; commercially-landed red drum sampled through biological monitoring program since 1982 (2017: 673 fish measured, primarily gill net).
- South Carolina DNR – State finfish survey conducted in January and February (2017 n=198 caught and 49 harvested, mean catch rate: 1.92 red drum/targeted angler hour). Charter Vessel Trip Reporting (2017 caught: 55,712; release rate: 93.5%). SC Marine Game Fish Tagging Program studies movement patterns, growth rates, and release-mortality rates (in 2017 fish tagged: 4,564; recaptured: 660). SCDNR Sub-Adult Red Drum Tagging Program tags fish caught by the SCDNR electrofishing and trammel net fishery-independent surveys and other fishery-independent sampling efforts (in 2017 fish tagged: 1,191; recaptured: 348). SCDNR Adult Red Drum Tagging Program tags fish caught by the SCDNR inshore fisheries research section longline fishery-independent survey (in 2017 tagged: 409; recaptured: 22). Tournament and freezer fish programs (2017 n=26).
- Georgia CRD – Age, length, and sex data collected through the Marine Sportfish Carcass Recovery Project (2017 n=644 red drum).
- Florida FWC – 7,817 trip interviews in 2017 collected data on total-catch rates and sizes (through MRIP).
- NMFS – Length measurements and recreational catch, harvest, release, and effort data are collected via the Marine Recreational Information Program.

<u>Fishery Independent Monitoring</u>

- New Jersey DFW – Five annual nearshore trawl surveys conducted since 1988, in January/February, April, June, August, and October. Length and weight data, and catch per unit effort (CPUE) in number of fish per tow and biomass per tow recorded for all species. Only two red drum were caught in entire time series (single tow, 2013).
- North Carolina DMF – Seine survey since 1991 produces age-0 abundance index (2016 n=326; CPUE of 2.72, decrease from 2016 CPUE of 5.93). Gill net survey in Pamlico Sound since 2001 characterizes size and age distribution, produces abundance index, improves bycatch estimates, and studies habitat usage (2017 CPUE of 4.12, above long-term average). Longline survey since 2007 produces adult index of abundance and tags fish (2017 n=337; CPUE slightly below long-term average at 4.68 fish per set).
- South Carolina DNR – Estuarine trammel net survey for subadults (2017 CPUE below 10-year average). Electrofishing survey in low salinity estuarine areas for juveniles/subadults (2017 CPUE above 10-year average). Inshore bottom longline survey

for biological data and adult abundance index (409 tagged, 84 sampled for age in 2017). Genetic sub-sampling and tagging conducted during these three surveys.

- Georgia CRD – Estuarine trammel net survey for subadult biological data and abundance index (2017, both areas n=146). Estuarine gill net survey for young-of-year (YOY) biological data and abundance index (2017 both areas n=600). Bottom longline survey for adult biological data and abundance index (2017 n=119 in GA, 9 in NE FL).
- Florida FWC-FWRI – Two seine surveys in northern Indian River Lagoon (IRL) and lower St. Johns River (SJR) for YOY (< 40 mm SL) abundance indices (2017 CPUE higher than 2016). Haul seine survey in these areas and southern IRL for subadult index (2017 CPUE lower than 2016). Age and length data collected during surveys.

VI. Status of Management Measures and Issues

Fishery Management Plan

Amendment 2 was fully implemented by January 1, 2003, providing the management requirements for 2010. Requirements include: recreational regulations designed to achieve at least 40% sSPR, a maximum size limit of 27 inches or less, and current or more stringent commercial regulations. States are also required to have in place law enforcement capabilities adequate to successfully implement their red drum regulations. In August 2013, the Board approved Addendum I to Amendment 2 of the Red Drum FMP. The Addendum revises the habitat section of Amendment 2 to include the most current information on red drum spawning habitat for each life stage (egg, larval, juvenile, sub-adult, and adult). It also identifies the distribution of key habitats and habitats of concern, including potential threats and bottlenecks.

De Minimis Requests

New Jersey and Delaware requested *de minimis* status through the annual reporting process. While Amendment 2 does not include a specific method to determine whether a state qualifies for *de minimis*, the PRT chose to evaluate an individual state's contribution to the fishery by comparing the two-year average of total landings of the state to that of the management unit. New Jersey and Delaware each harvested zero percent of the two-year average total landings. *De minimis* status does not exempt either state from any requirement; it may exempt them from future management measures implemented through addenda to Amendment 2, as determined by the Board.

VII. Implementation of FMP Compliance Requirements for 2017

The PRT finds that all states have implemented the requirements of Amendment 2.

VIII. Recommendations of the Plan Review Team

<u>Management and Regulatory Recommendations</u>

< Consider approval of the *de minimis* requests by New Jersey and Delaware.

< Support a continued moratorium of red drum fishing in the exclusive economic zone.

< Populate the SAS to address assessment recommendations from the Peer Reviewers of the last assessment and the Red Drum TC.

Prioritized Research and Monitoring Recommendations (H) = High, (M) = Medium, (L) = Low

Stock Assessment and Population Dynamics

- Implement surveys (e.g. logbooks, electronic methods, etc.) in each state throughout the management unit to determine the length composition (and age data, if possible) of recreational discards (B2) of red drum. This information has been highlighted as the single largest data gap in previous assessments. (H)
- Further study is needed to determine discard mortality estimates for the Atlantic coast, both for recreational and commercial gears. Additionally, discard estimates should examine the impact of slot-size limit management and explore regulatory discard impacts due to high-grading. Investigate covariates affecting discard mortality (e.g., depth, size, seasonality), and explore methods of determining *in situ* mortality (as opposed to tank studies) and mitigating mortality (e.g. gear types, handling methods, use of descending devices on adults). (H)
- Improve catch/effort estimates and biological sampling from recreational and commercial fisheries for red drum, including increased intercepts of night fisheries for red drum. (H)
- Expand biological sampling based on a statistical analysis to adequately characterize the age/size composition of removals by all statistical strata (gears, states, etc.). (H)
- Each state should develop an on-going red drum tagging program that can be used to estimate both fishing and natural mortality and movements. This should include concurrent evaluations of tag retention, tagging mortality, and angler tag reporting rates. The importance of each state's tagging data to the assessment should be evaluated, including analysis of historical tagging data to determine if existing and historic recreational data sources (e.g., tagging) can be used to evaluate better B2 selectivities. (H)
- Establish programs to provide ongoing estimates of commercial and recreational discard mortality using appropriate statistical methods. Discard estimates should examine the impact of slot-size limit management and explore regulatory discard impacts due to high-grading. (M)
- Evaluate the broader survey needs to identify gaps in current activities and provide for potential expansion and/or standardization between/among current surveys. (M)
- Review all available stock structure data (genetics, tagging, etc.) to determine stock structure and most appropriate management boundaries. (M)

Biological

- Explore methods to effectively sample the adult population in estuarine, nearshore, and open ocean waters, such as in the ongoing red drum long line survey, and to determine the size, age and sex composition of the adults. (H)
- Continue genetic analyses (i.e., SC DNR analyses) to evaluate stock structure and mixing and temporal changes in genetic composition of the red drum population and other applications. (H)
- Refine maturity schedules on a geographic basis. Thoroughly examine the influence of size and age on reproductive function. Investigate the possibility of senescence in female red drum. Archive histological specimens across sizes to look for shifts in maturity schedules and make regional comparisons. Standardize histology reading methods of slides across states conducting such studies. (For reference, see SEDAR 44-DW02). (H)

- Determine habitat preferences, environmental conditions, growth rates, and food habits of larval and juvenile red drum throughout the species range along the Atlantic coast. Assess the effects of environmental factors on stock density/year class strength. Determine whether natural environmental perturbations affect recruitment and modify relationships with spawning stock size. (H)
- Continue tagging studies to determine stock identity, inshore/offshore migration patterns of all life stages (i.e. basic life history research). Specific effort should be given to developing a large-scale program for tagging adult red drum. (M)
- Fully evaluate the effects and effectiveness of using cultured red drum to facilitate higher catch rates along the Atlantic coast. (M)
- Conduct a tagging study using emerging technologies (i.e., acoustic tagging, satellite tagging, genetic tags) to evaluate stock mixing and identify movement of sub-adult fish transitioning to maturity. (M-L)
- Otolith microchemistry analysis should be considered for exploring links between sub-adult estuarine habitats and adult stock structure. (L)

Social (Unless otherwise indicated, the collection of sociological and/or economic data, also sometimes collectively described as "socioeconomic data," would be based on Atlantic Coastal Cooperative Statistics Program [ACCSP] standards.)

- Encourage the NMFS to fund socioeconomic add-on questions to the recreational fisheries survey that are specifically oriented to red drum recreational fishing. (H)
- States with significant fisheries (over 5,000 pounds) should periodically (e.g. every five years) collect socioeconomic data on red drum fisheries through add-ons to the recreational fisheries survey or by other means. (H)
- Using a human dimension analysis perspective, explore Atlantic red drum historical catch-release trends and explanatory factors such as the possible impacts of changes in recreational fishing technology and/or angler behavior on red drum catchability and selectivity over time. (H)
- Conduct applied research to evaluate the various projected (forecasted) social impacts on red drum fishery stakeholders of possible regulatory options (e.g. changing minimum sizes, etc.). (M)

Economic

- Using available secondary data and other information, develop models to estimate the local (community), state and regional level economic impacts (e.g. sales, jobs, income, etc.) of recreational red drum fisheries-related activities including the for-hire sector component (e.g. fishing guides). (H)
- Where appropriate, encourage individual member states to conduct studies to project and evaluate the estimated comparable net economic values associated with current and possible future regulatory regimes that could impact red drum recreational anglers, including those preferring catch and release fishing. (M)
- Using risk adjusted benefit-cost analysis protocols, project the estimated public sector-oriented net economic values over a time for various cultured red drum stocking scenarios compared to possible changes in other fishery management alternatives. (M)

< Encourage NOAA Fisheries to periodically conduct special surveys and related data analysis to determine the economic and operational characteristics of the recreational fishing for-hire component targeting red drum, especially fishing guide-oriented businesses in the South Atlantic states. (M)

Habitat

< Identify spawning areas of red drum in each state from North Carolina to Florida so these areas may be protected from degradation and/or destruction. Explore relationships between spawning activity (e.g. spawning sounds) and environmental parameters (e.g. temperature). (H)
< Identify changes in freshwater inflow on red drum nursery habitats. Quantify the relationship between freshwater inflows and red drum nursery/sub-adult habitats. (H)
< Determine the impacts of dredging and beach re-nourishment on red drum spawning and early life history stages. (M)
< Investigate the concept of estuarine reserves to increase the escapement rate of red drum along the Atlantic coast. (M)
< Identify impacts of water quality, environmental, and ecosystem changes on red drum stock dynamics for potential incorporation into stock assessment models. (M)
< Quantify relationships between red drum production and habitat and implications for future management planning. (L)
< Determine methods for restoring red drum habitat and/or improving existing environmental conditions that adversely affect red drum production. (L)

IX. References

Atlantic States Marine Fisheries Commission (ASMFC). 2002. Amendment 2 to the Interstate Fishery Management Plan for Red Drum. ASMFC, Washington, DC, Fishery Management Report No. 38, 141 p.

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X. Figures

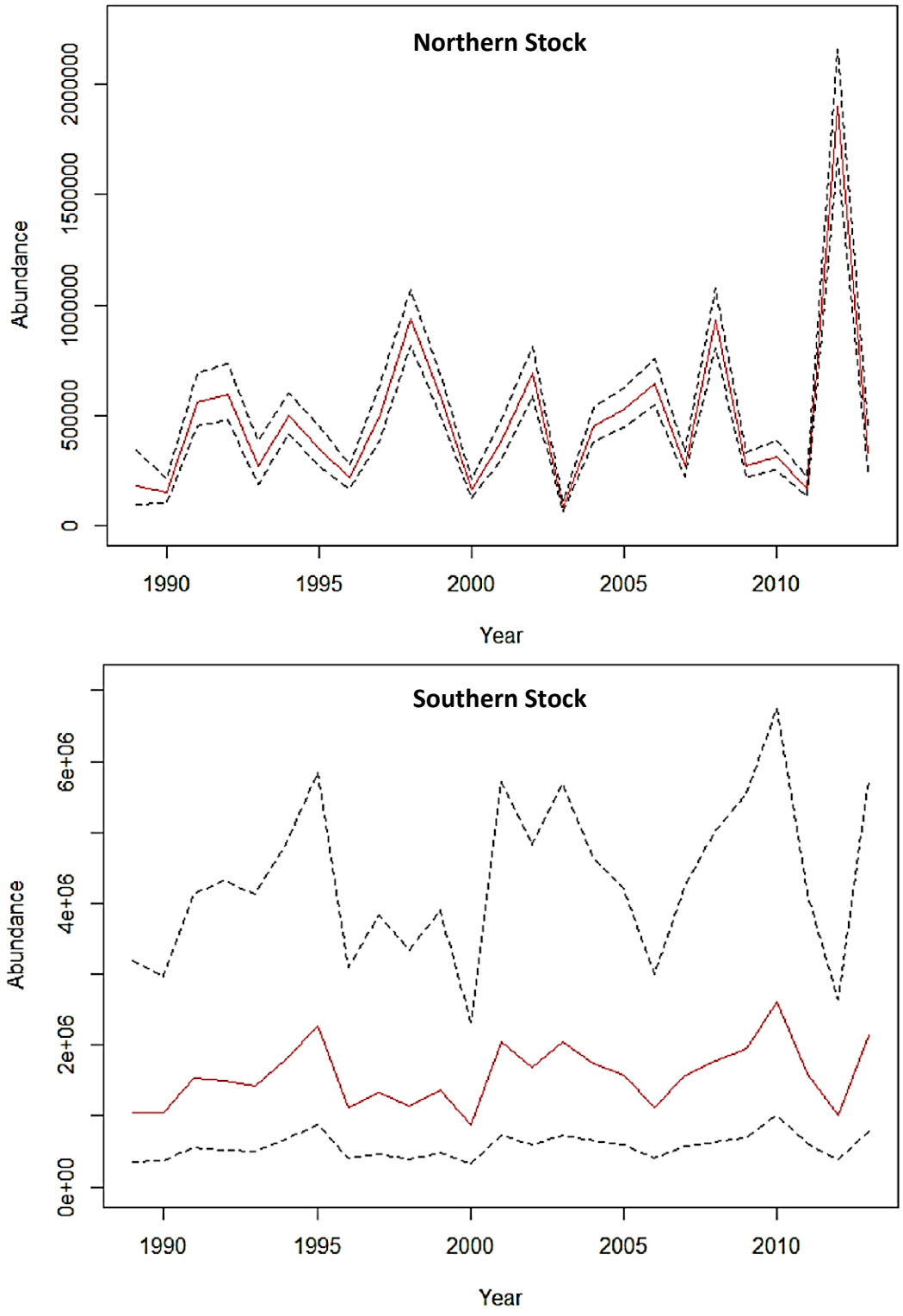

Figure 1. Predicted recruitment (age-1 abundance, red lines) with 95% confidence intervals (dashed black lines) for the northern (top) and southern (bottom) regions (Source: ASMFC 2017).

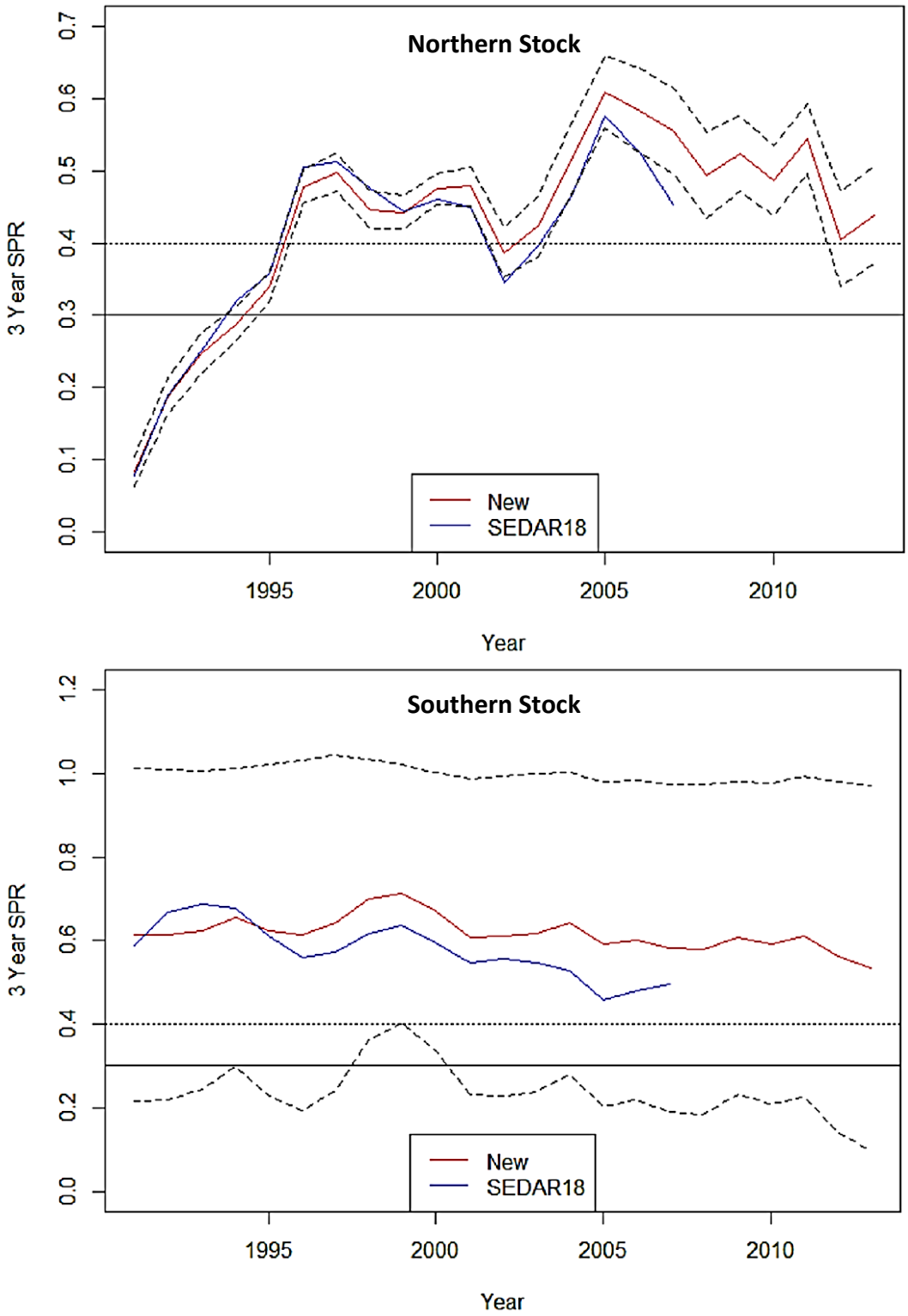

Figure 2. Three year average sSPR (red lines) for the northern (top) and southern (bottom) stocks with 95% confidence intervals (dashed black lines). Point estimates from the previous benchmark assessment (SEDAR18) are included for comparison. The target sSPR (dotted black line) is 40% and the threshold sSPR (solid black line) is 30% (Source: ASMFC 2017)**.**

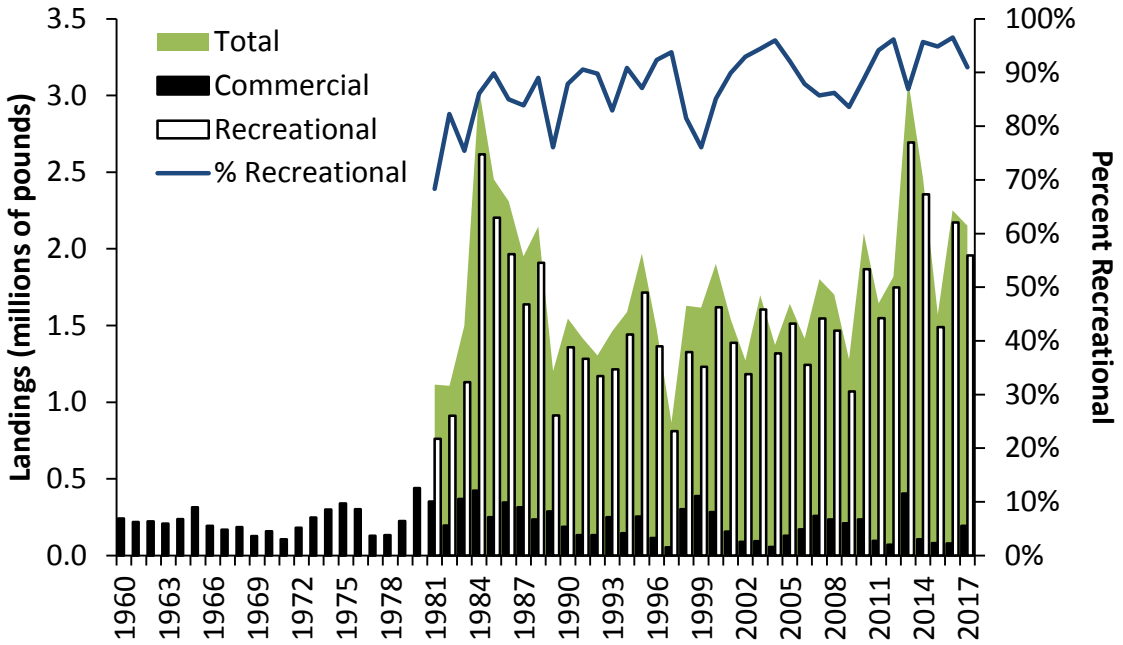

Figure 3. Commercial and recreational landings (pounds) of red drum. Recreational data not available prior to 1981. See Tables 2 and 3 for values and data sources.

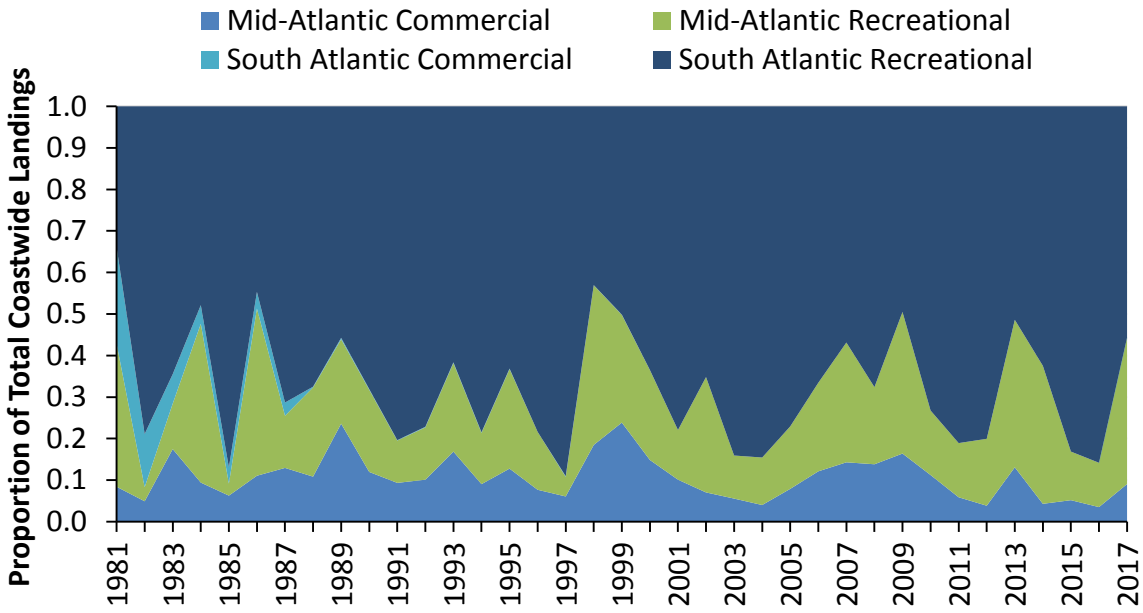

Figure 4. Proportion of regional, sector-specific landings to total coastwide landings (pounds). See Tables 2 and 3 for data sources.

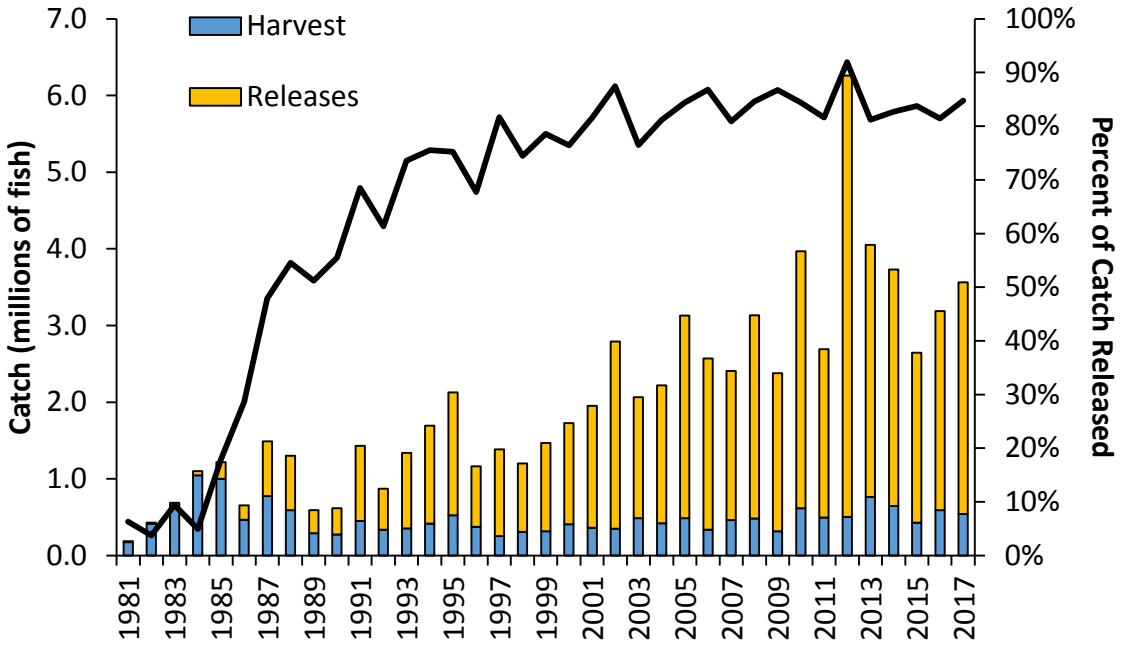

Figure 5. Recreational catch (harvest and alive releases) of red drum (numbers) and the proportion of catch that is released. See Tables 4 and 5 for values and data sources.

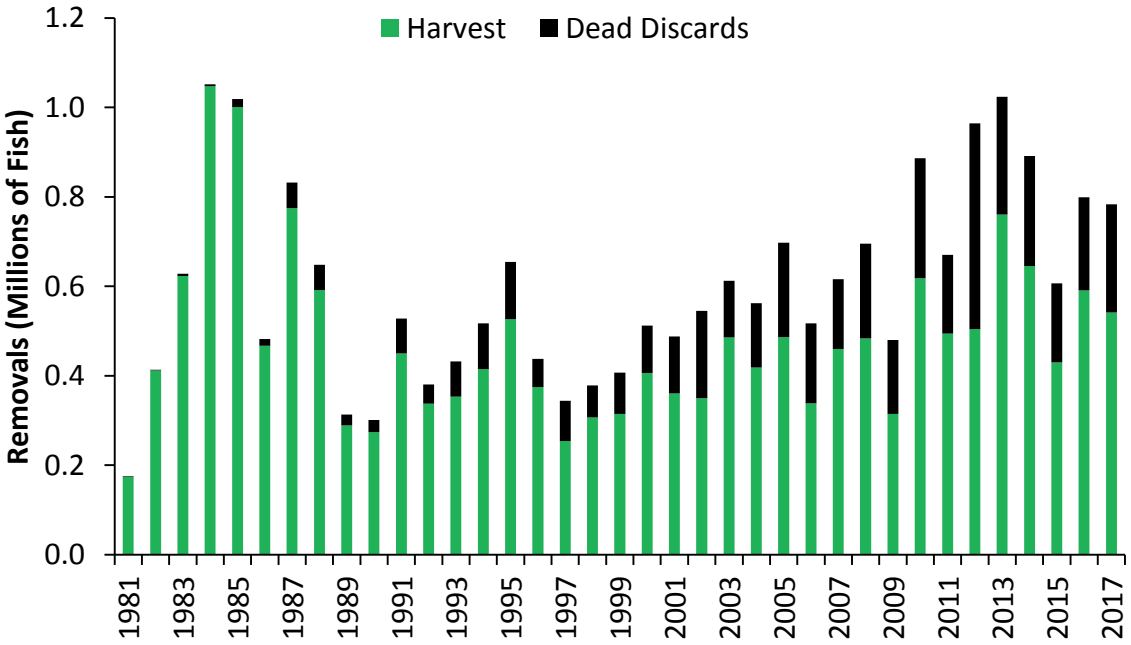

Figure 6. Recreational removals (harvest and dead discards) of red drum (numbers). Dead discards are estimated by applying an 8% discard mortality rate to alive releases. See Tables 4 & 5 for values and data sources.

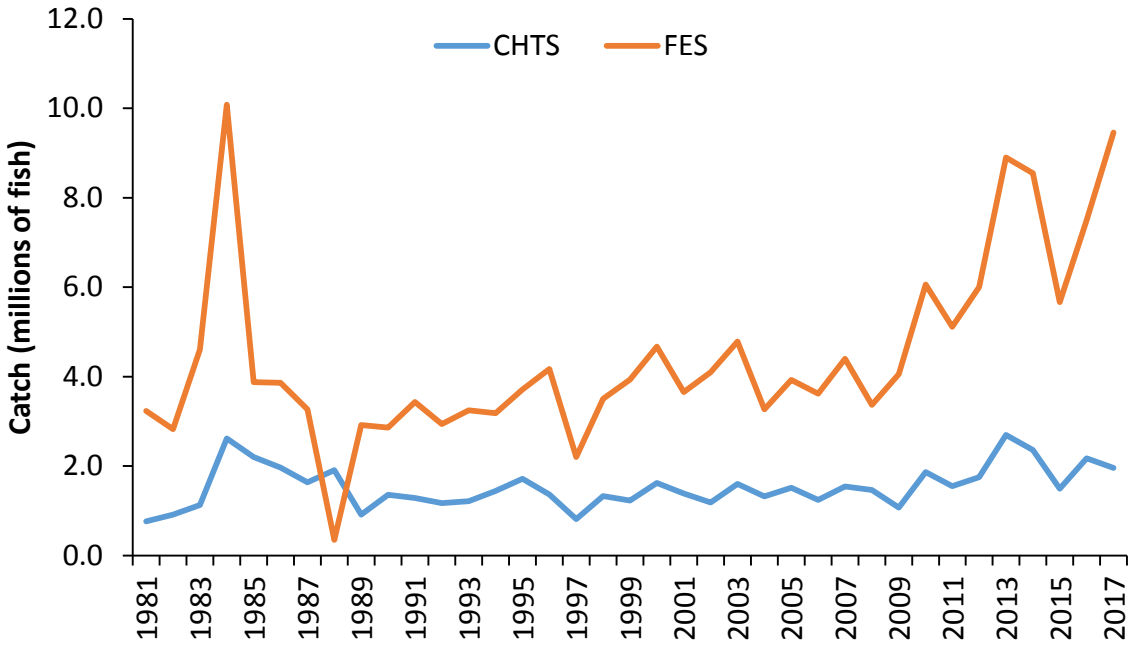

Figure 7. Coastwide comparison of MRIP recreational landings estimates for red drum based on the Coastal Household Telephone Survey (CHTS) and the mail-based Fishing Effort Survey (FES), 1981-2017. FES-calibrated estimates will be used for red drum management once a new stock assessment that incorporates the estimates is completed. (Source: personal communication with MRIP, 2018).

XI. Tables

Table 1. Red drum regulations for 2017. The states of New Jersey through Florida are required to meet the requirements in the FMP; states north of New Jersey are encouraged to follow the regulations. All size limits are total length.

State	Recreational	Commercial
NJ	18" - 27", 1 fish	18" - 27", 1 fish
DE	20" - 27", 5 fish	20" - 27", 5 fish
MD	18" - 27", 1 fish	18" - 25", 5 fish
PRFC	18" - 25", 5 fish	18" - 25", 5 fish
VA	18" - 26", 3 fish	18" - 25", 5 fish
NC	18" - 27", 1 fish	18" - 27"; 250,000 lb harvest cap with overage payback (150,000 lbs Sept 1- April 30; 100,000 lbs May 1-Aug 31); harvest of red drum allowed with 7 fish daily trip limit; red drum must be less than 50% of catch (lbs); small mesh (<5" stretched mesh) gill nets attendance requirement May 1 - November 30. Fishing year: September 1 – August 31.
SC	15" - 23", 3 fish. Gigging allowed March-November	Gamefish Only
GA	14" - 23", 5 fish	Gamefish Only
FL	18" - 27", Northern Region- 2 fish; Southern Region- 1 fish	Sale of native fish prohibited

Table 2. Commercial landings (pounds) of red drum by state, 2008-2017. (Source: personal communication with ACCSP, Arlington, VA, for years prior to 2017 and state compliance reports for 2017, except as noted below.)

Year	NJ	DE	MD	PRFC	VA	NC	SC	GA	FL	Total
2008			*	69	5,138	229,809		*		235,016
2009	*		*	157	9,296	200,296		*		209,749
2010			*	22	3,966	231,828		*		235,816
2011				3	4,397	91,980		*		96,380
2012	*		334	81	2,786	66,519				69,720
2013	*	0	2,752	268	30,137	371,949				405,106
2014	*	0	298	3	14,733	90,647				105,681
2015	0	0	*	0	761	80,282				81,043
2016	0	0	*	0	1,898	76,977	0	0	0	78,875
2017	*	0	1,015	0	6,971	186,463	*	0	0	194,449

Notes: PRFC landings from agency reporting program; * indicates confidential landings.

Table 3. Recreational landings (pounds) of red drum by state, 2008-2017. (Source: personal communication with MRIP for years prior to 2017 and state compliance reports for 2017)

Year	NJ	DE	MD	VA	NC	SC	GA	FL	Total
2008				84,491	231,551	251,930	247,442	651,672	1,467,086
2009				147,444	288,958	165,892	126,196	341,384	1,069,874
2010				43,126	283,286	447,895	318,264	773,783	1,866,354
2011	2,421				212,245	441,834	229,214	662,811	1,548,524
2012		396	26,788	27,446	238,312	369,333	107,368	978,727	1,748,369
2013		7,153	6,205	410,917	676,050	236,887	129,279	1,226,481	2,692,970
2014				221,685	596,447	242,371	154,332	1,141,154	2,355,988
2015				29,339	154,496	269,787	97,690	939,007	1,490,319
2016				9,682	230,473	144,859	153,368	1,634,141	2,172,523
2017	0	0	1,887	354,719	402,390	278,006	128,973	790,449	1,956,423

Table 4. Recreational landings (numbers) of red drum by state, 2008-2017. (Source: personal communication with MRIP for years prior to 2017 and state compliance reports for 2017)

Year	NJ	DE	MD	VA	NC	SC	GA	FL	Total
2008				20,847	50,809	119,471	133,107	159,246	483,480
2009				38,670	57,543	70,326	68,857	79,635	315,031
2010				11,076	64,024	172,708	194,826	175,828	618,462
2011	955				45,143	161,503	106,962	180,001	494,564
2012		296	17,869	28,159	52,948	121,068	45,766	238,191	504,297
2013		1,686	2,083	124,088	164,218	97,386	73,827	297,527	760,815
2014				53,672	116,601	103,892	92,869	278,037	645,071
2015				7,792	36,704	106,620	48,172	230,397	429,685
2016				3,510	62,105	62,816	74,702	388,200	591,333
2017			634	70,725	101,473	115,132	66,987	289,056	541,670

Table 5. Recreational alive releases and dead discards (numbers) of red drum by state, 2008-2017. Dead discards are estimated based on an 8% release mortality rate. (Source: personal communication with MRIP for years prior to 2017 and state compliance reports for 2017)

Year	NJ	DE	MD	VA	NC	SC	GA	FL	Total	Dead Discards
2008		75	217	236,787	658,887	552,217	313,743	889,550	2,651,476	212,118
2009			14,754	178,396	429,776	751,123	167,704	521,659	2,063,412	165,073
2010			2,182	28,580	635,876	786,452	483,650	1,414,115	3,350,855	268,068
2011				61,330	207,697	664,291	213,781	1,051,143	2,198,242	175,859
2012		5,876	280,171	2,503,456	1,533,010	543,618	90,237	799,428	5,755,796	460,464
2013		407	2,207	220,305	654,030	673,377	198,722	1,541,541	3,290,589	263,247
2014		41	273	116,215	382,663	635,836	290,101	1,659,671	3,084,800	246,784
2015			779	25,835	334,510	571,433	168,338	1,114,355	2,215,250	177,220
2016		968	15,414	49,819	825,046	337,852	160,031	1,207,481	2,596,611	207,729
2017			6,066	266,236	643,418	581,270	240,613	1,283,206	3,020,809	241,665

South Atlantic Board

Activity level: Moderate

Committee Overlap Score: Moderate (American Eel TC, Horseshoe Crab TC, Shad and River Herring TC, Sturgeon TC, Weakfish TC)

Committee Task List

- Atlantic Croaker and Spot PDT ≈ August: Provide recommendations on management response to triggers from Traffic Light Analyses changes
- Black Drum TC – Summer: Review 2014 benchmark stock assessment research recommendations and make recommendation for 2019 stock assessment
- Cobia PDT ≈ August 2019: Draft Amendment 1 process; current step: develop Draft Public Information Document for Public Comment
- Cobia TC ≈ August: Provide recommendations on how recreational landings should be evaluated
- Cobia TC ≈ August 2018-October 2019: SEDAR 58 stock assessment
- Red Drum SAS - Summer: Develop assessment roadmap and update ASC on progress
- Atlantic Croaker TC - July 1: Compliance Reports Due
- Red Drum TC – July 1: Compliance Reports Due
- Cobia TC – July 1: Compliance Reports Due
- Atlantic Croaker PRT – August 1: Update Traffic Light Analysis
- Spot PRT – August 1: Update Traffic Light Analysis
- Black Drum TC – August 1: Compliance Reports Due
- Spotted Seatrout PRT – September 1: Compliance Reports Due
- Spanish Mackerel PRT – October 1: Compliance Reports Due
- Spot PRT – November 1: Compliance Reports Due

TC Members:

Atlantic Croaker: Chris Mcdonough (SC, Chair), Kristen Anstead (ASMFC), Michael Schmidtke (ASMFC), Tim Daniels (NJ), Michael Greco (DE), Harry Rickabaugh (MD), Ryan Jiorle (VA), Jason Rock (NC), Dan Zapf (NC), Dawn Franco (GA), Joseph Munyandorero (FL), Wilson Laney (USFWS)

Black Drum: Harry Rickabaugh (MD, Chair), Jeff Kipp (ASMFC), Michael Schmidtke (ASMFC), Jordan Zimmerman (DE), Ryan Jiorle (VA), Chris Stewart (NC), Chris McDonough (SC), Ryan Harrell (GA), Dustin Addis (FL)

Cobia: Ryan Jiorle (VA, Vice Chair), Michael Schmidtke (ASMFC), Angela Giuliano (MD), Anne Markwith (NC), Mike Denson (SC), Chris Kalinowsky (GA), Christina Wiegand (SAMFC), Michael Larkin (SERO)
Red Drum: Ryan Jiorle (VA, Chair), Jeff Kipp (ASMFC), Michael Schmidtke (ASMFC), Tim Daniels (NJ), Michael Greco (DE), Genine McClair (MD), Lee Paramore (NC), Joey Ballenger (SC), Chris Kalinowsky (GA), Behzad Mahmoudi (FL), Wilson Laney (USFWS), Roger Pugliese (SAFMC)
Spanish Mackerel (PRT): Michael Schmidtke (ASMFC), Randy Gregory (NC), BJ Hilton (GA), Dustin Addis (FL), Christina Wiegand (SAFMC), John Hadley (SAFMC)
Spot (PRT): Michael Schmidtke (ASMFC), Harry Rickabaugh (MD), Ryan Jiorle (VA), Adam Kenyon (VA), Dan Zapf (NC), Chris McDonough (SC), Dawn Franco (GA)
Spotted Seatrout (PRT): Michael Schmidtke (ASMFC), Douglas Lipton (MD), Steve Poland (NC), Joey Ballenger (SC), Chris Kalinowsky (GA)

SAS Members: