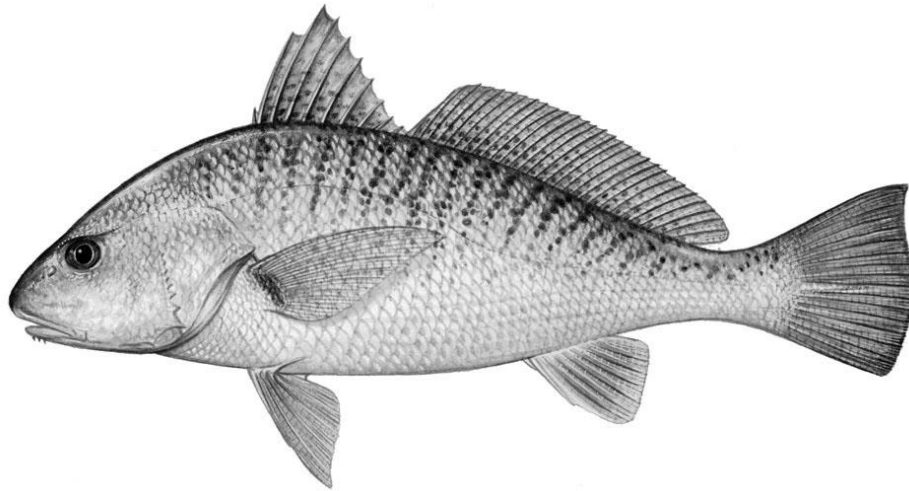


**Traffic Light Analysis of Atlantic Croaker (*Micropogonias undulatus*) for the  
Atlantic States Marine Fisheries Commission Fishery Management Plan  
Review.**

**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, it 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.

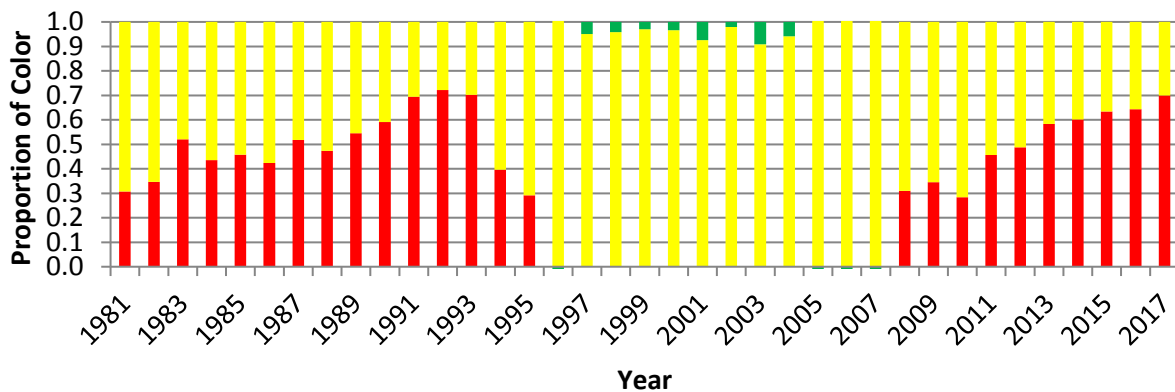
The indices used for the TLA include both commercial and recreational harvest (fishery dependent) and four fishery-independent monitoring surveys that occur in different areas of the Atlantic coast of the United States. The fishery-independent surveys include the Northeast Fisheries Science Center (NMFS) 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 11<sup>th</sup> 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 7<sup>th</sup> 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.

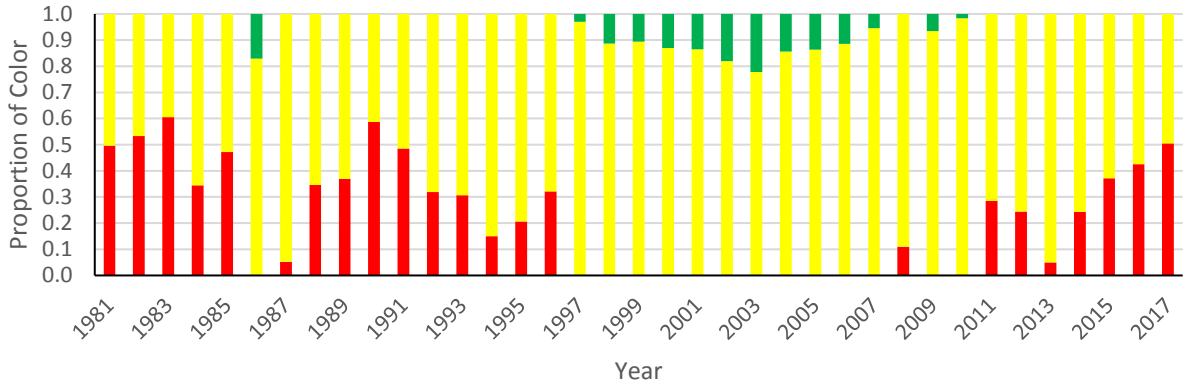
**Figure 1. Annual TLA color proportions for Atlantic croaker commercial landings for the Atlantic coast of the US.**



### *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.**

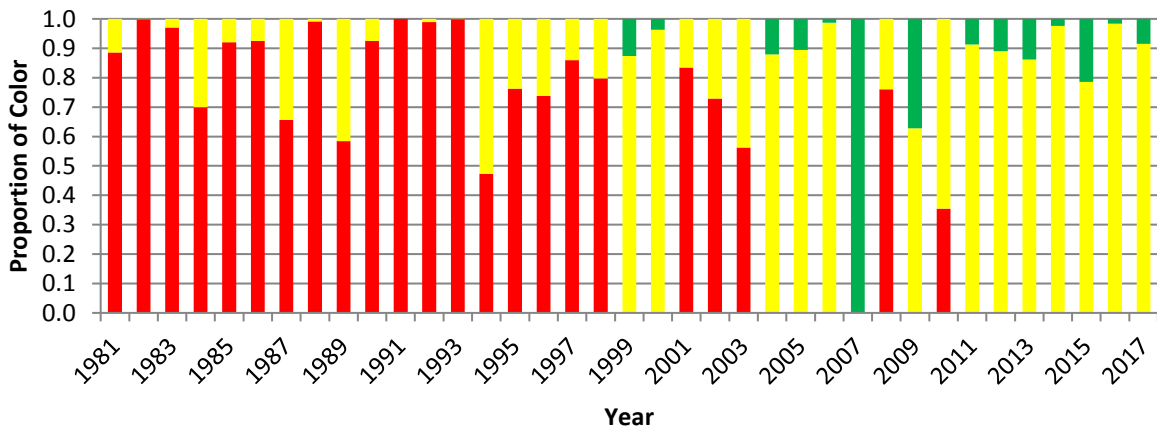


**Traffic Light Analysis (Fishery-independent Surveys)**

*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.

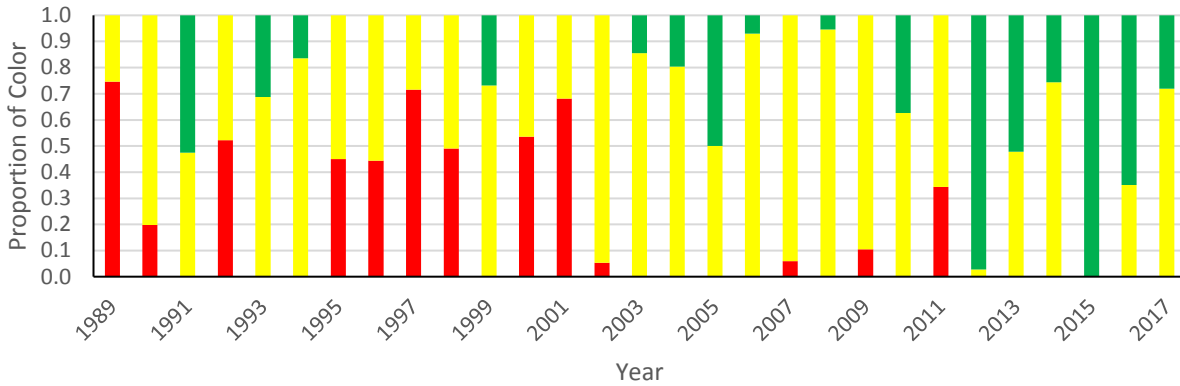
**Figure 5. Annual TLA color proportions for Atlantic croaker from NMFS ground-fish trawl survey based on 1996-2008 reference period.**



*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.

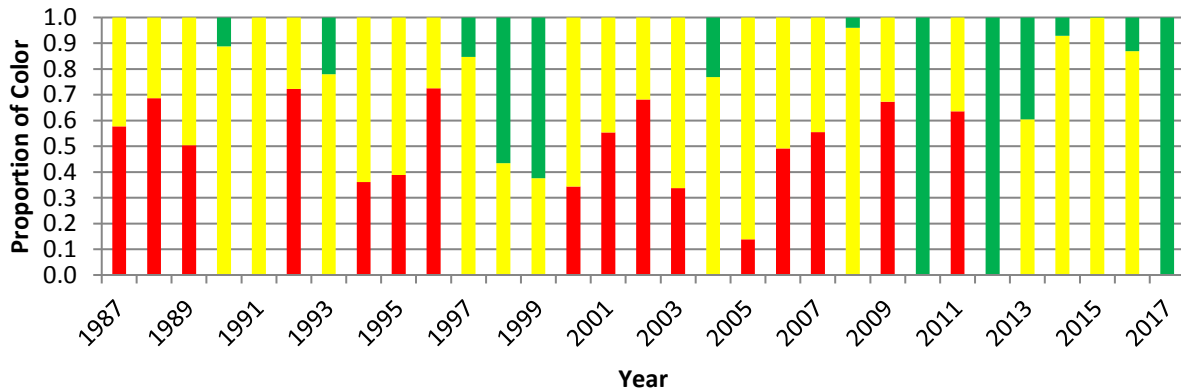
**Figure 4. Traffic Light Model for SEAMAP catch data by weight using a 1996-2008 reference period.**



*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.

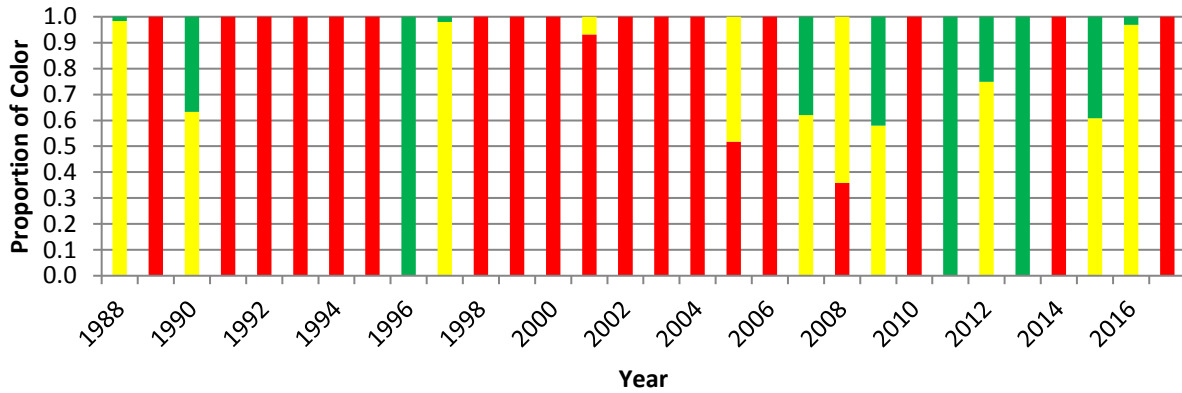
**Figure 5. NCDMF Program 195 TLA color proportions for Atlantic croaker using 1996-2008 reference period.**



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.**

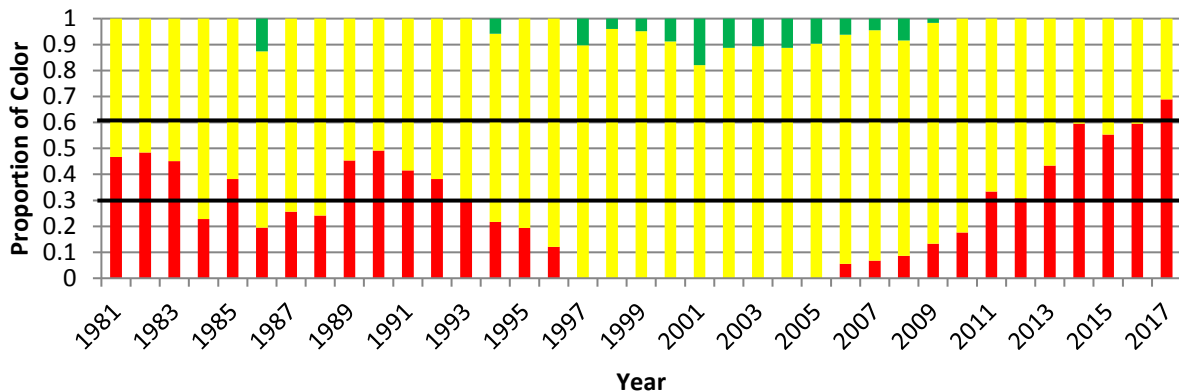


## **Traffic Light Analysis (Composite Indexes)**

### *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**



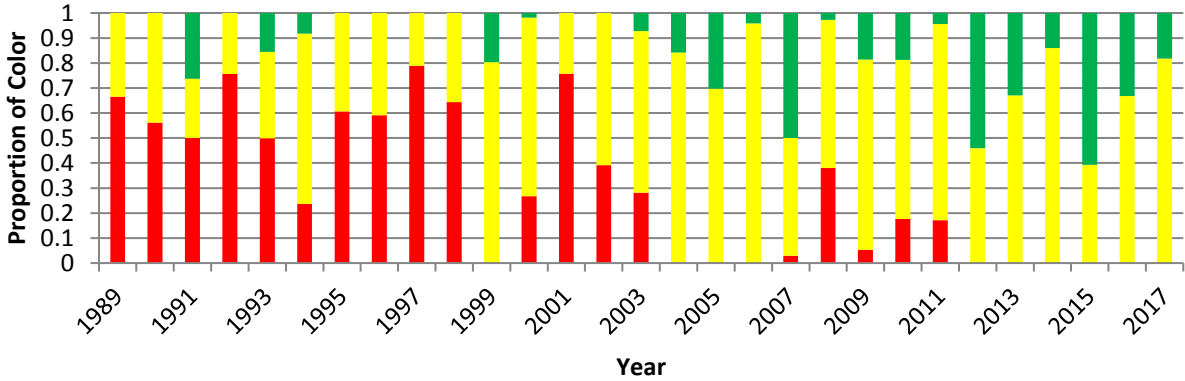
### *Abundance Composite Characteristic Indexes*

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.

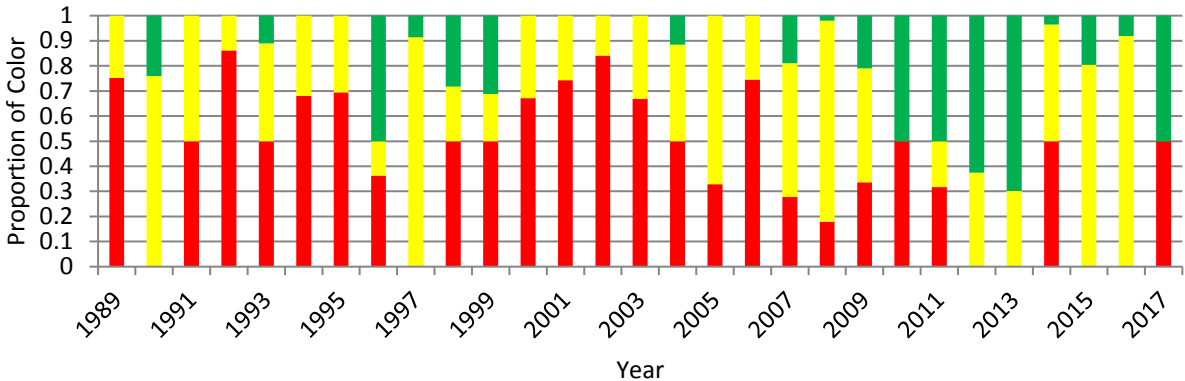
- Three of the four abundance indexes showed increases in 2017.
- The adult composite TLA characteristic (Fig. 8) showed a trend of declining green proportions over the last three years.

- 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**

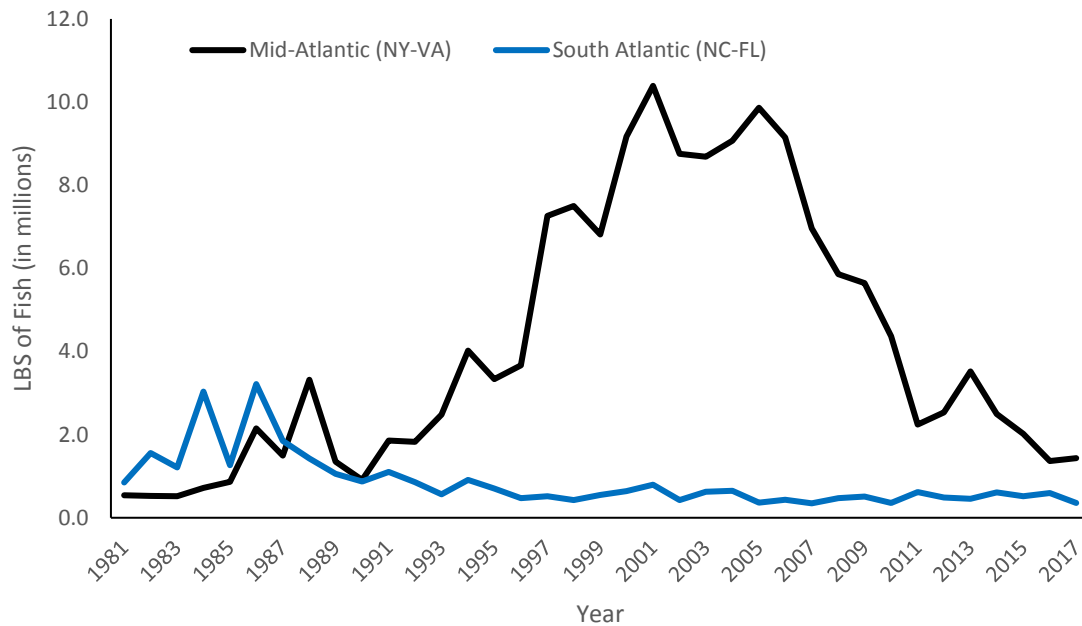
For this option, the TLA-SC revised the abundance indices for Atlantic croaker to split them by age (recruitment indices and age 2+ indices) and region (Mid-Atlantic and South Atlantic) to better reflect the population. Adult indices for the regional TLA would be NMFS-NEFSC (age-2+, excluding NC strata)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

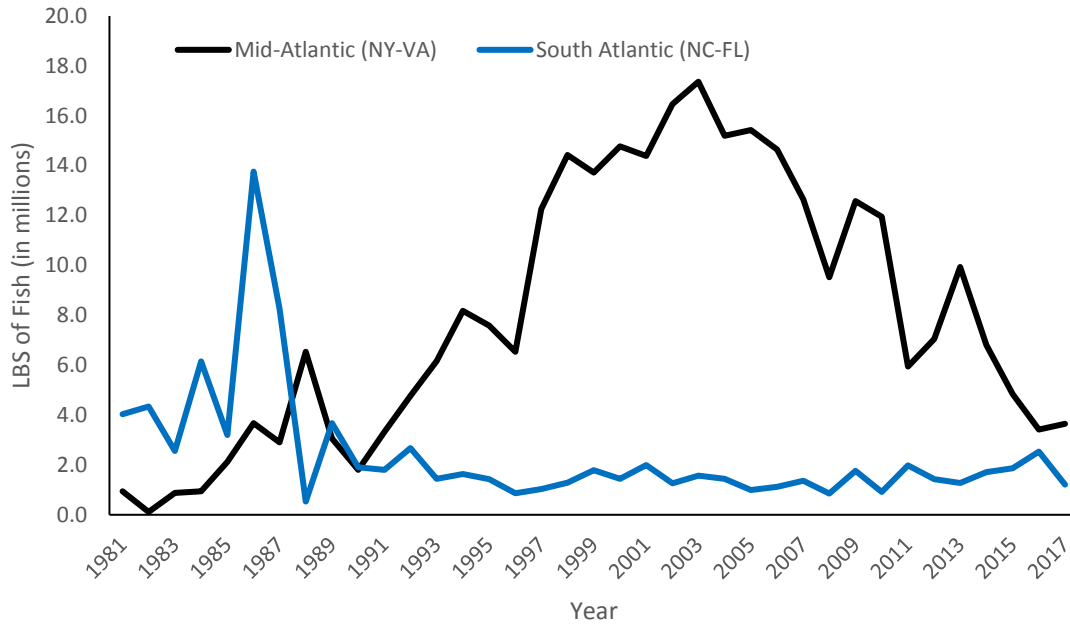
The bulk of coastal commercial landings for Atlantic croaker are driven by trends in the mid-Atlantic (NY-VA) versus relative landings in the South Atlantic region (NC-FL) (Fig. 10). However, the general trend in the south Atlantic has been one of long term decline for Atlantic croaker with the highest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

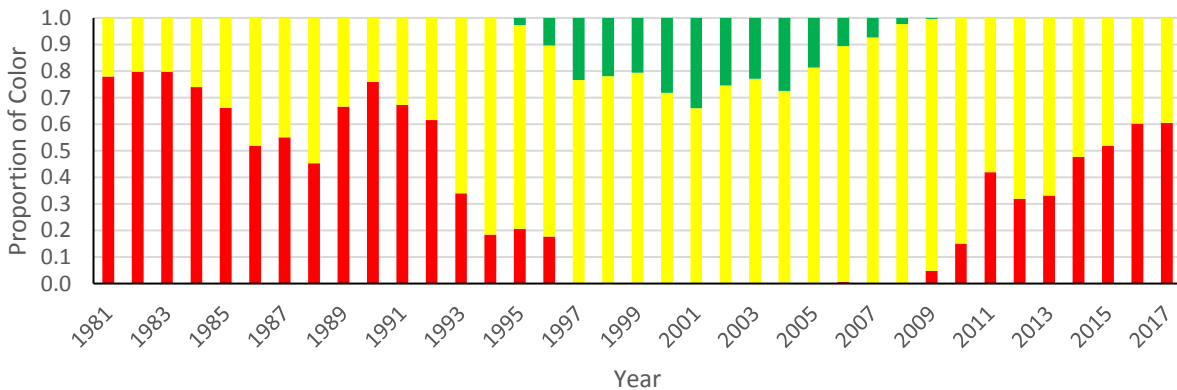
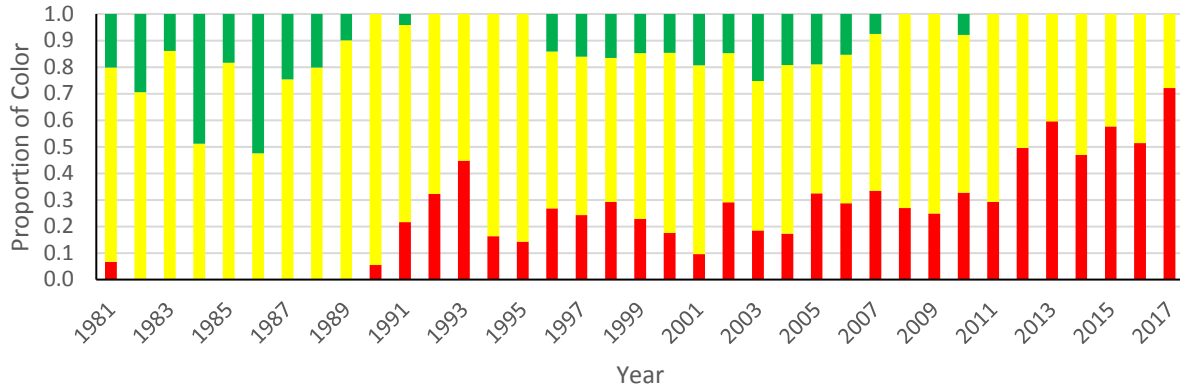


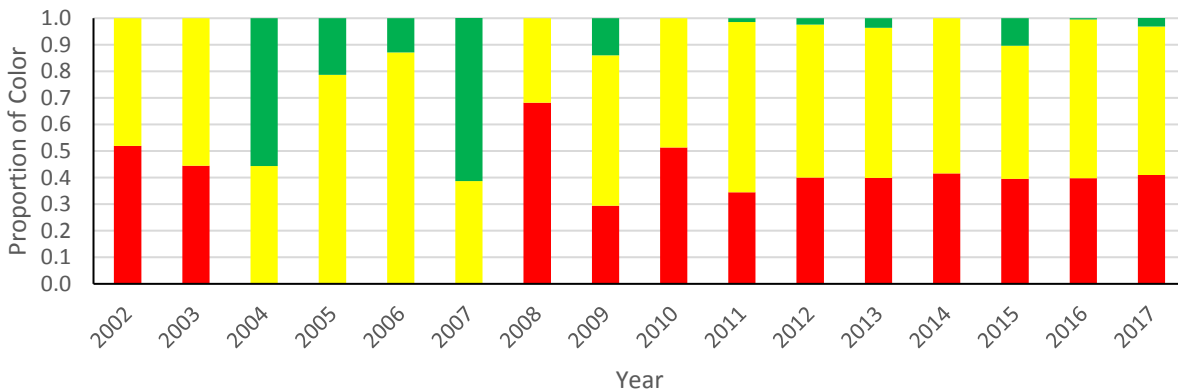
Figure 13. Harvest composite TLA for Atlantic croaker from the south Atlantic (NC-FL) using a 2002-2016 reference period.



*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 ChesMMAAP 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.

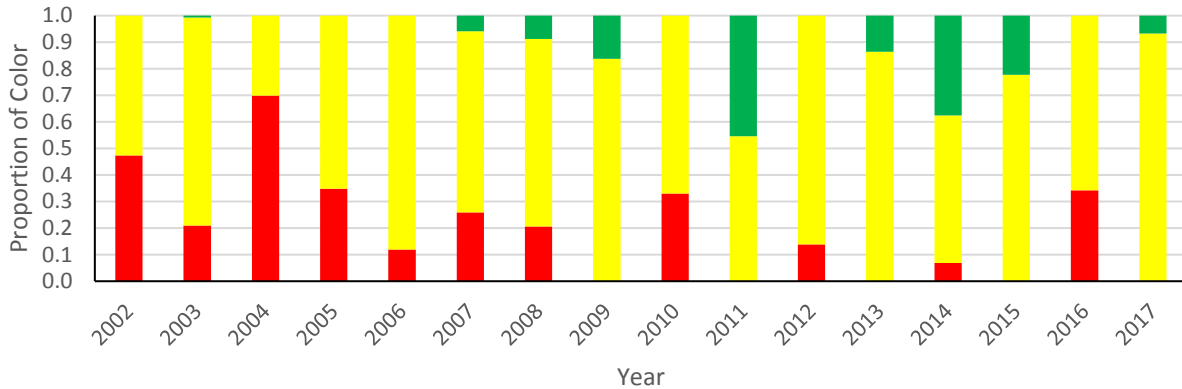
Figure 14. Mid-Atlantic adult composite TLA for Atlantic croaker using a 2002-2016 reference period. Indexes included NMFS and ChesMMAAP.



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.



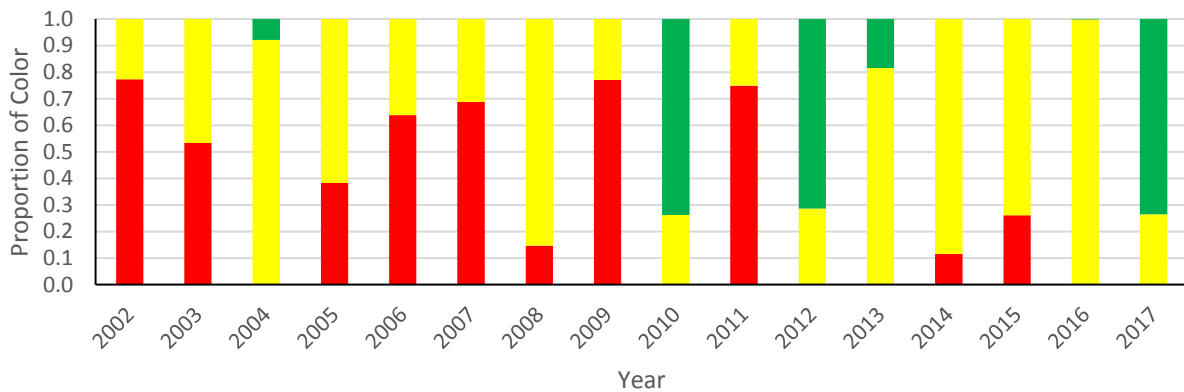
*Regional Advisory Indices*

*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 juvenile 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.

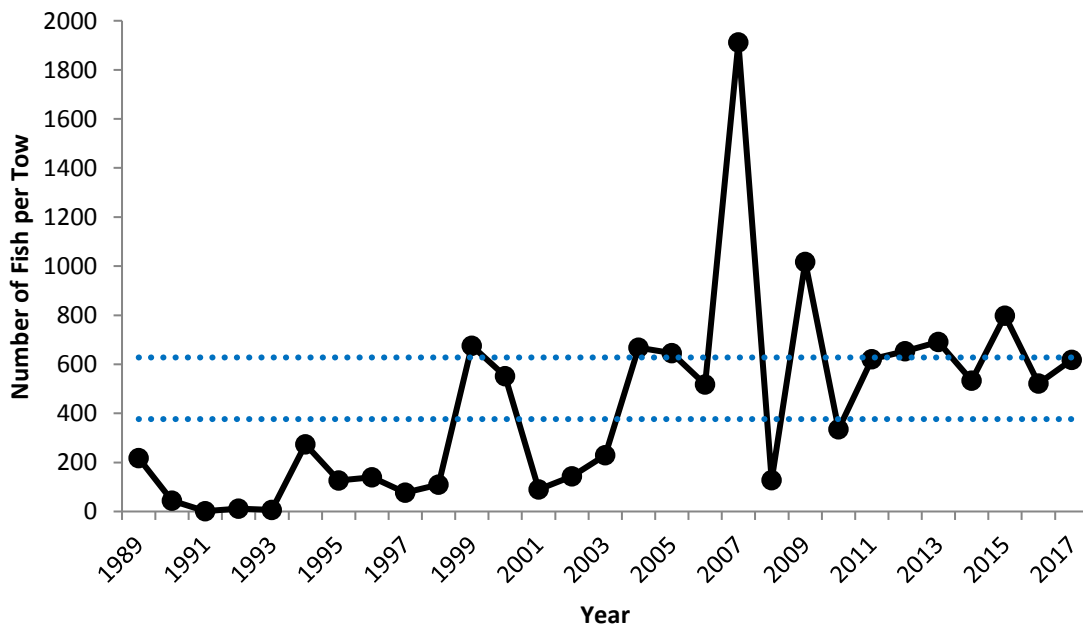
**Supplemental Material: Fishery-independent Individual Index TLA’s**

*NMFS*

- ❖ Since there was no NMFS sampling along the mid-Atlantic due to mechanical issues on the RV Bigelow, 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.

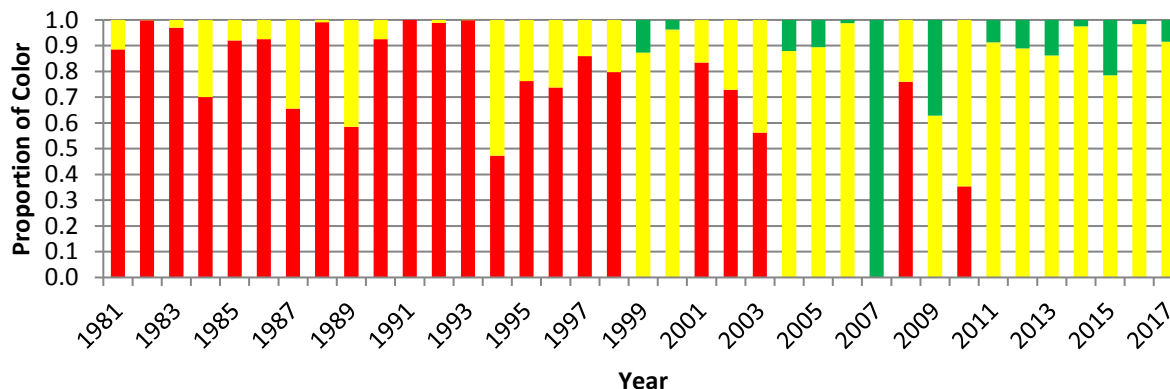
Mean annual CPUE has declined since the peak in 2007 but has remained at or about the long term mean (top blue line on Fig. 18) since 2011 indicating some relative stability in abundance.

**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*

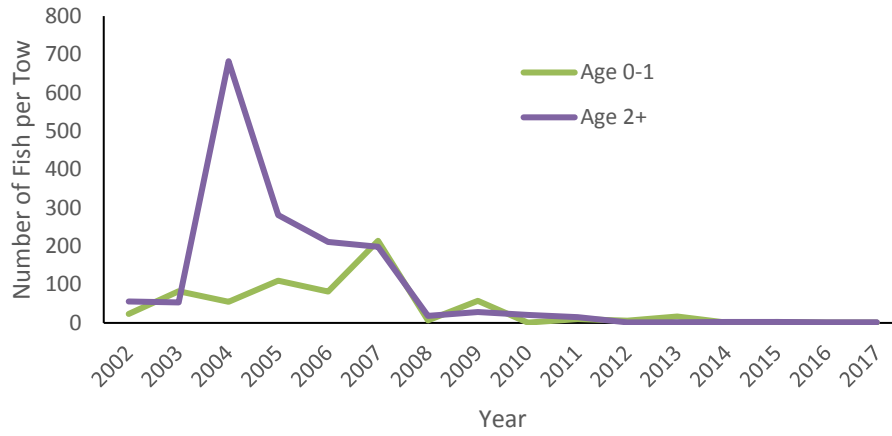
The Chesapeake Marine Monitoring Program (ChesMMAP) is a general fish abundance trawl survey run by the Virginia Institute of Marine Science (VIMS) that covers the central portion of the Chesapeake Bay from the mouth up to approximately Aberdeen, MD. Atlantic croaker are one of most abundant species 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.

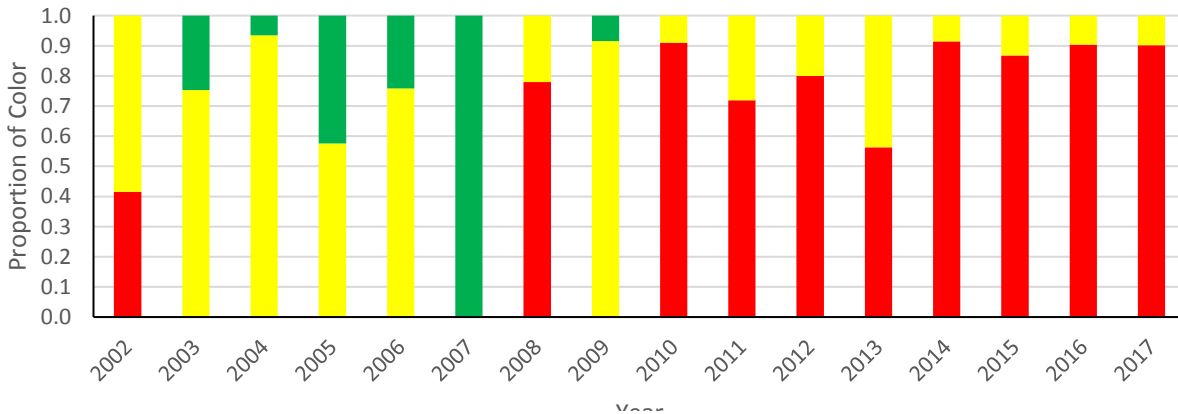
The TLA reflected these trends with high proportions of red since 2008 (Figs. 21 & 22). Proportionately, the decline was slightly greater for juveniles than for adults in recent years.



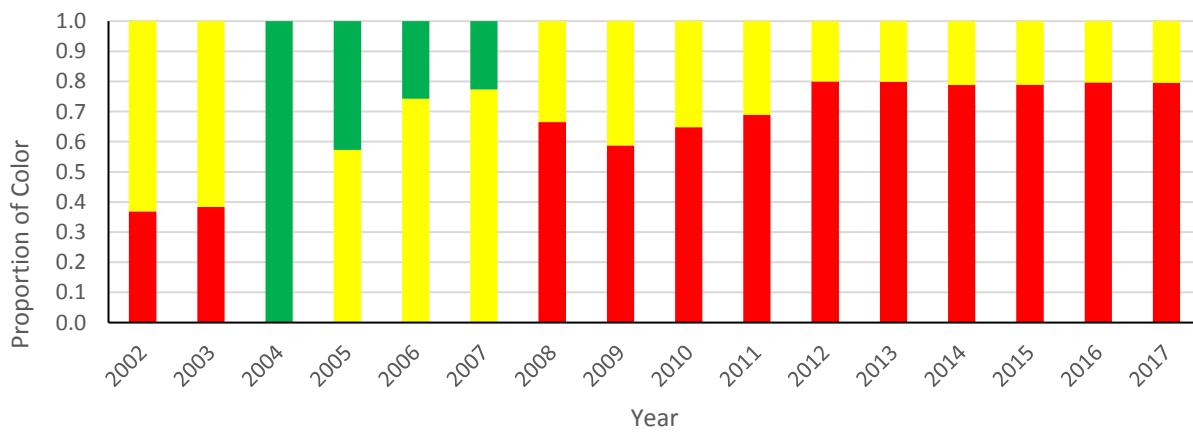
**Figure 20. Stratified mean annual CPUE for Atlantic croaker by age group for ChesMMAP.**



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



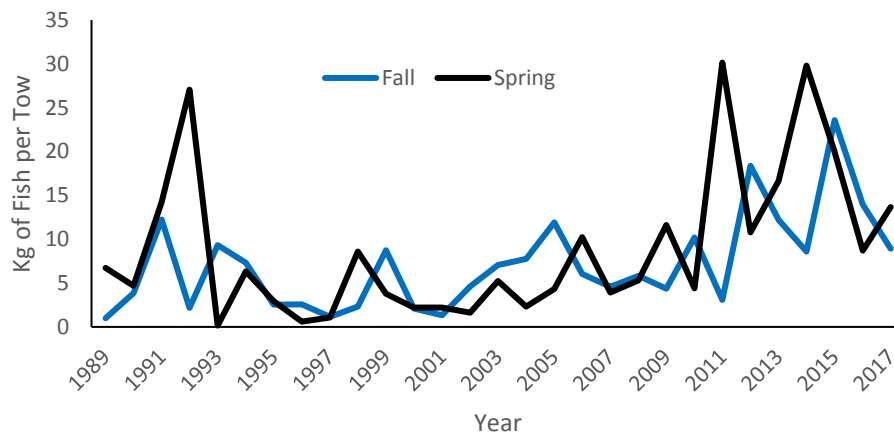
**Figure 22. Annual TLA for Atlantic croaker from ChesMMAP for ages 2+**



## SEAMAP

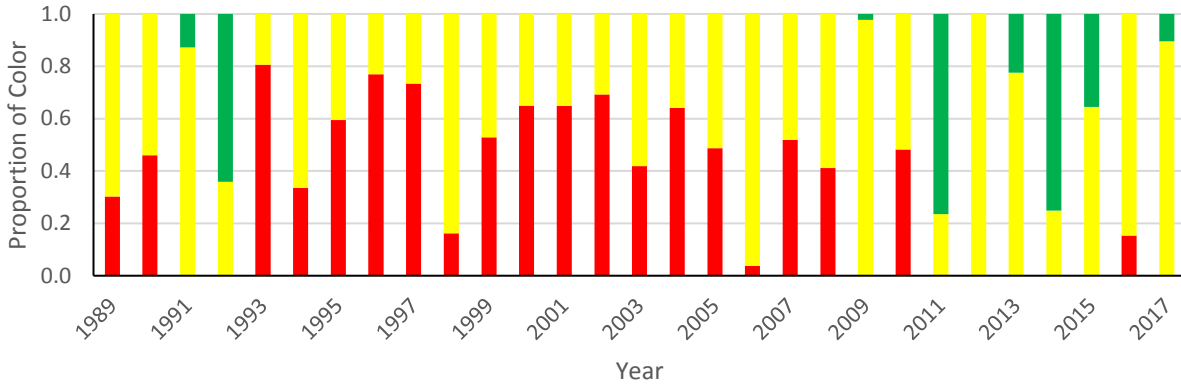
The SEAMAP survey samples during three seasons of the year (spring, summer, and fall) and historically the index used for Atlantic croaker for the trigger management exercises has always been the fall index. The reasons for this were several having to do with the co-occurrence in time frame with other 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).

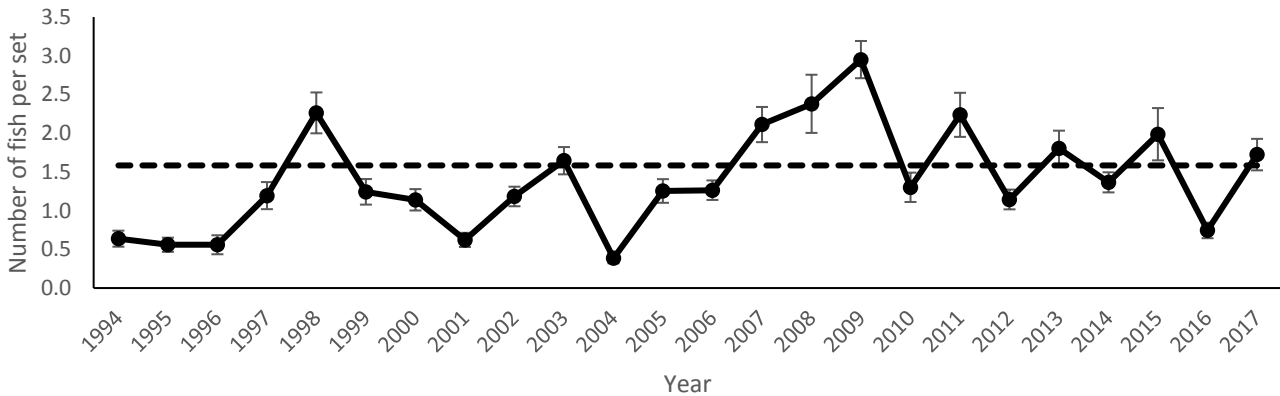
Figure 24. Annual TLA color proportions for adult Atlantic croaker from SEAMAP survey for the spring



*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

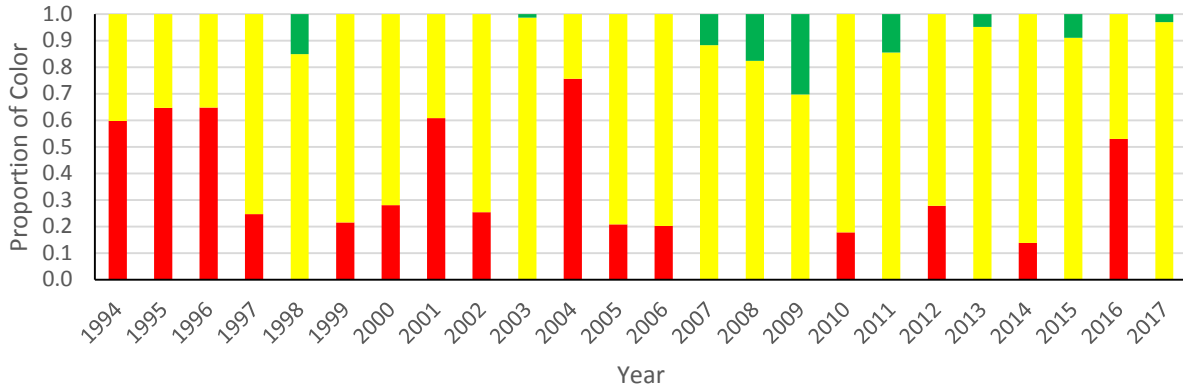
Figure 25. Stratified annual CPUE for Atlantic croaker from core strata from May - Sept. for SCDNR Trammel Net Survey. Error bars are SEM and dashed line is long term mean.



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

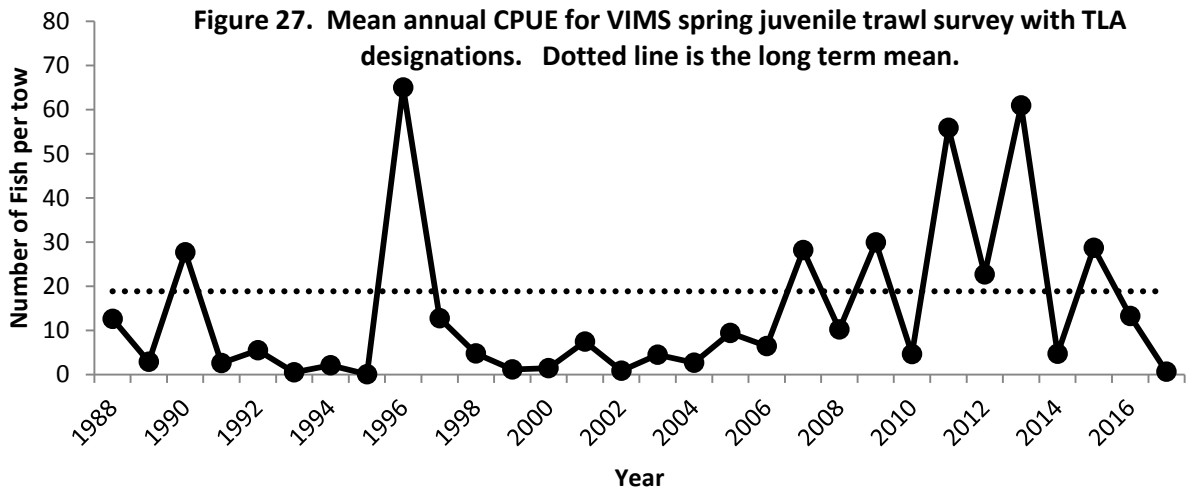
The TLA mirrored this trend with higher red proportions in the 1990s and early 2000s and higher green proportions from 2007-2009 (Fig. 26). There has been only one year since 2010 that has had a red proportion greater than 30% (2016).

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



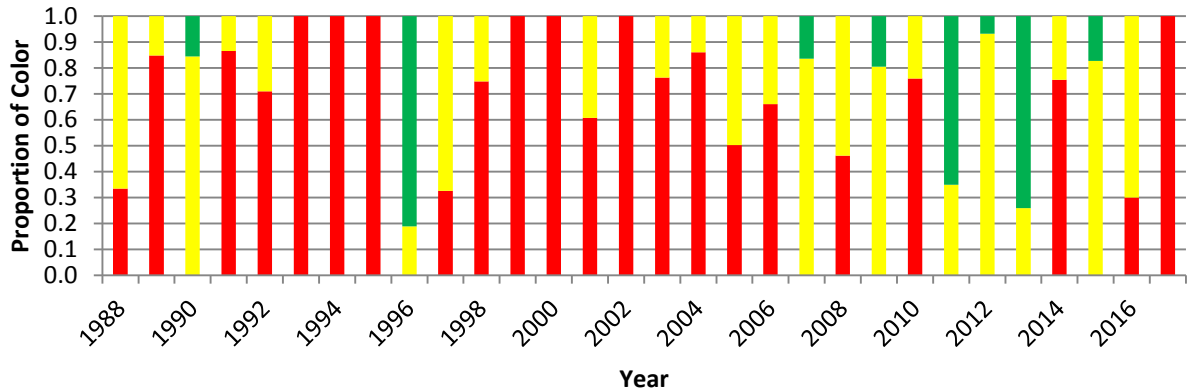
*VIMS Spring Juvenile Fish Survey*

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.



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).

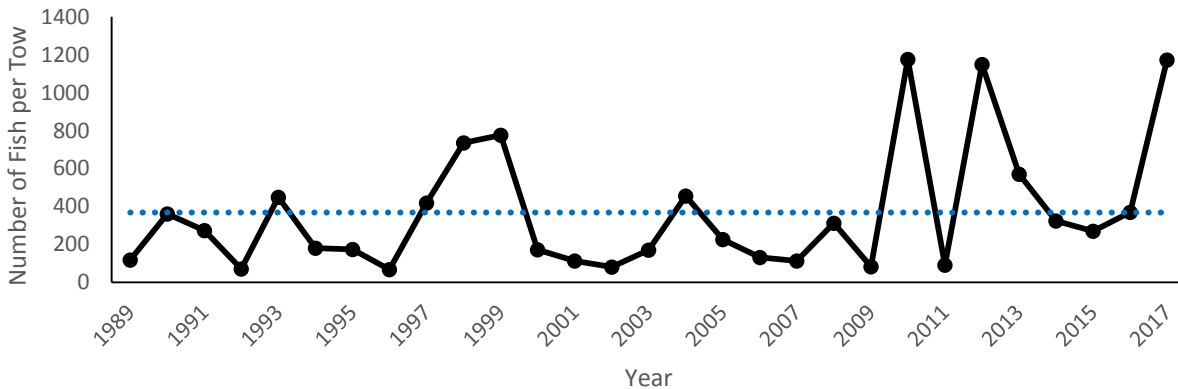
**Figure 28. Annual TLA color proportions for Atlantic croaker from VIMS spring trawl survey using 2002-2016 reference period.**



*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

