Atlantic States Marine Fisheries Commission

South Atlantic State/Federal Fisheries Management Board

February 6, 2014
3:45-5:15 p.m.
Alexandria, VA

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1.	Welcome/Call to Order *(P. Geer)*	3:45 p.m.
2.	Board Consent • Approval of Agenda • Approval of Proceedings from August 2013	3:45 p.m.
3.	Public Comment	3:50 p.m.
4.	Review of Updated Traffic Light Analysis (*C. McDonough*) **Action** • Croaker • Spot • Discuss potential management options	4:00 p.m.
5.	Consider FMP Review and State Compliance (*K.Rootes-Murdy*) **Action** • Spot • Spotted Seatrout • Spanish Mackerel	5:00 p.m.
6.	Review and Consider Proposed Changes to Virginia's Red Drum Commercial Management Measures in 2014 **Action** *(K. Rootes-Murdy)* • Technical Committee Report (*K. Rootes-Murdy*)	5:10 p.m.
7.	Elect Vice Chair **Action**	5:15 p.m.
8.	Other Business/Adjourn	5:15 p.m.

The meeting will be held at the Crowne Plaza Hotel, 901 North Fairfax Street, Alexandria, Virginia; 703-683-6000

MEETING OVERVIEW

South Atlantic State/Federal Fisheries Management Board Meeting
Thursday, February 6, 2014
3:45 p.m. – 5:15 p.m.
Alexandria, Virginia

Chair: Pat Geer (NC) Assumed Chairmanship: 10/13	Technical Committee Chairs Atlantic Croaker: Chris McDonough (SC) Red Drum: Mike Murphy (FL)	Law Enforcement Committee Rep: Doug Lewis (GA)
Vice Chair: VACANT	Advisory Panel Chair: Bill Windley (MD)	Previous Board Meeting: August 7, 2013
Voting Members: NJ, DE, MD, PRFC, VA, NC, SC, GA, FL, NMFS, USFWS, SAFMC (12 votes)		

2. Board Consent

- Approval of Agenda
- Approval of Proceedings from August 2013

3. Public Comment – At the beginning of the meeting, public comment will be taken on items not on the agenda. Individuals that wish to speak at this time must sign-in at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance the Chair will not allow additional public comment on an issue. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Review of Updated Traffic Light Analysis (3:55- 5:00 p.m.) Action
Background • Trigger exercises were established for both species for each non-assessment year to review trends in the fisheries. • At the August 2013 meeting, staff presented an update of the triggers exercise with 2012 landings data as well as preliminary analysis of the fishery using a traffic light approach. The results of the trigger report found declines in the commercial and recreational landings for both Atlantic croaker and spot fisheries but did not trip the triggers. • Based on the results, the Board tasked the Atlantic Croaker Technical Committee (TC) and Spot Plan Review Team (PRT) with developing traffic light approach analyses for both species with management options to consider under a variety of conditions. • The Atlantic Croaker TC and Spot PRT members met via conference call three times during September-December to review the traffic light approach analyses and develop management options. • The Atlantic Croaker TC and Spot PRT have created management memo with updated analyses and management considerations for the fisheries moving forward (**Supplemental material**)
Presentations • Update of the Atlantic Croaker & Spot Traffic Light Analyses and Management Options by C. McDonough
Board actions for consideration at this meeting • Consider management memo for 2014 fishing year

5. Consider FMP Review and State Compliance (5:00-5:10p.m.) Action
Background • Compliance reports were due September 1 (Spotted Seatrout), October 1 (Spanish Mackerel), and November 1 (Spot) (**Briefing CD**) • The Plan Review Teams reviewed each state report and compiled the Fishery Management Plan Reviews **(Briefing CD).**
Presentations • Overview of the Fishery Management Plan Review Reports by K. Rootes-Murdy
Board actions for consideration at this meeting • Accept the 2013 Fishery Management Plan Reviews and State Compliance Reports.

6. Review and Consider Proposed Changes to Virginia's Red Drum Commercial Management Measures in 2014 (5:10-5:15 p.m.) Action
Background • In December 2013, Virginia submitted a proposal to change their regulations for the 2014 commercial Red Drum fishery (**Briefing CD**) • The proposed changes are intended to reduce the regulatory discards and potential waste which current occur through incidental catch. • The proposed changes include lowering the commercial maximum size limit from 26 to 25 inches and increasing the commercial possession limit from 3 to 5 fish. • The Red Drum Technical Committee reviewed the proposal in late January 2014 **(Supplemental Materials)**
Presentations • Overview of Proposed Management Measures for Virginia in 2014 and Technical Committee Report by K. Rootes-Murdy
Board actions for consideration at this meeting • Approval of Virginia proposal for changes to commercial management measures for Red Drum in 2014

7. Elect Vice Chair (5:15 p.m.) Action
Background • At the October 2013 annual ASMFC meeting Pat Geer assumed the chairmanship. • Vice chair is now empty
Board actions for consideration at this meeting • Elect Vice Chair

8. Other Business/Adjourn

Atlantic States Marine Fisheries Commission

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MEMORANDUM

January 30, 2014

TO: **South Atlantic Federal/State Management Board**

FROM: **Kirby Rootes-Murdy, FMP Coordinator**

RE: **Spot and Croaker Traffic Light Analysis & Management Considerations**

This memorandum offers a draft management framework and considerations regarding the use of the traffic light analysis model the South Atlantic State/Federal Management Board requested the Atlantic Croaker Technical Committee (TC) and Spot Plan Review Team (PRT) develop during the 2013 August Board meeting. The intent of this memorandum is to provide the Board with an updated report of the traffic light analysis model for the Spot and Atlantic croaker fisheries as well as draft management options given a variety of scenarios. The TC and PRT requests review and guidance from the Board on the feasibility of these management options for the 2014 fishing year and beyond, as well as the incorporation of the traffic light analysis model and draft management framework into to the Interstate Fishery Management Plans for Atlantic croaker and Spot.

Executive Summary

Introduction

The current management scheme for Atlantic croaker compares annual changes in various trigger indices with the previous two year's average index value. If the index value drops below 70% of the previous two year average, at a minimum, examination of the data is required by the Atlantic croaker technical committee (TC). For spot, index values are compared to the 10^{th} percentile of the indices time series. If two of these indices (one of which must be an independent index) is below the 10^{th} percentile the Plan Review Team (PRT) is to recommend the South Atlantic Board consider management action. Both of these management trigger schemes do not illustrate long term declines or increases in stock since they don't make comparisons over longer time periods. Under the current annual trigger exercises, the high degree of variability in year to year index values results in rapid changes that make it difficult to respond to rapid decreases in the trigger indices beyond a general review by the TC or PRT because of the effort involved. In relatively short lived species like Atlantic croaker and spot it is not always necessary to respond to rapid annual changes in management index triggers but rather to persistent periodic declines that occur over several years. Declines that might occur over several years require close monitoring in order to anticipate when or if management action may be required. With this in mind, a management response scheme which uses techniques that illustrate multi-year changes and trends would be more useful than simply examining year to year changes against the previous year or sharp declines in a single year compared to the time series. Knowing the level at which to respond or initiate some type of management action should be based on long term knowledge of general stock levels as well as how that stock has changed over time. The traffic light model offers the ability to illustrate changing trends based on relevant stock parameters that can include historical abundance, life history parameters, and response to fishing pressure by using assessment based reference points.

To better manage the Atlantic croaker and spot fishery resources, this document proposes a potential management framework that incorporates information on trends in the fisheries using the Traffic Light Analysis Model.

Traffic Light Analysis

The Traffic Light method was originally developed (Caddy and Mahon, 1995; Caddy, 1998, 1999) as a precautionary management framework for data poor fisheries whereby reference points could be developed that would allow for a reasonable level of resource management. The name comes from assigning a color (red, yellow, or green) to categorize relative levels of different indicators of the state of either a fish population or a fishery. These indicators can be combined to form composite characteristics within similar categories and can include biological indicators such as growth and reproduction, population level indicators such as abundance and stock biomass estimates, or fishery indicators such as harvest/landings and fishing mortality. However, each indicator must be evaluated separately in order to determine its appropriateness for use in a management scheme. The complete report on the Traffic Light Analysis Model on the current trigger indices for Atlantic croaker and spot can be found in the second portion of this memo. This brief summary is designed to give an overview of the advantages of the Traffic Light Analysis Model over the current annual trigger exercises for both species.

Overall advantages of the Traffic Light Analysis Model

- This analysis model fits well with both limited and more extensive data sets for setting reference points.
- The basic color scheme is intuitive and easy to explain to both fisheries professionals and the non-scientific community.
- Boundary reference points for the color scheme can be set according to known assessment based time periods for any data series.
- Setting reference time frames over multiple generations can cover known periods of population fluctuations taking into account long term increases and decreases.

- Different indexes can be used to compare trends across production (harvest/landings), abundance (fishery independent surveys), and assessment based metrics (spawning stock biomass or estimated fishing mortality).

Summary of Atlantic croaker and Spot Annual Trigger Exercises compared to Traffic Light Analysis (TLA) Model

Atlantic Croaker

- The commercial and recreational harvest TLA show earlier indications of declining harvest rates versus the 70% trigger for Atlantic croaker (figures 1 and 2)
- The current 70% trigger for Atlantic croaker only tripped if there was a sharp year to year decline and the index only triggered three times over a 30 year period for both recreational and commercial harvest.
- The TLA began to show signs of decline in landings 3-4 years before the 70% trigger demonstrating greater sensitivity to harvest trends.
- The TLA using the fishery independent indices for both adults and juveniles were more variable than the harvest trends, but the overall patterns of declines (through increasing proportions of red/yellow) was still more sensitive than the 70% trigger for Atlantic croaker (figures 5 and 6)
- In Atlantic croaker there were some discrepancies between the harvest indices (commercial and recreational) and the abundance indices (fishery independent surveys) in the TLA (see full report). Most of those discrepancies were accounted for in different age structures of the different data sets. The commercial and recreational harvests were dominated by age 3+ fish while the fishery independent indices were driven largely by age 0-2 fish. When the age structure was taken into consideration in estimating a composite juvenile and adult TLA (ages 0-2 and ages 3+, respectively), the juvenile classes matched up more closely with the trends in the fishery independent indices.

Spot

- The commercial and recreational harvest TLA is much more indicative of change than the 10th percentile trigger for spot. (figures 3 and 4)
- The TLA for spot fishery independent indices offers a much better tool for examining year to year changes in index values with more sensitive reference points that can be set using historic and known levels of abundance or harvest compared to the current 10th percentile method.
- The current 10th percentile trigger for spot was rarely tripped in most of the indexes and when it did, it occurred at some of the lowest values for each index. While this did provide a conservative measure for management responses or action, the triggers should be more responsive at higher levels because this would allow a management response before stock levels got to such low values.

Management Considerations

The next step in this process is determining the level of management response that should be appropriate for the different color proportions that may occur if the Traffic Light Analysis Model is used in a management framework. In general practice with the Traffic Light Analysis Model, the green/yellow boundary is typically set at the long term mean of the data series reference period and the yellow/red boundary is set at 60% of the long term mean, which would indicate a 40% decline from the series mean. Index values that fall in the yellow zone will always have some proportion of either yellow/green or yellow/red depending on where it falls in the transition (yellow) zone. Since increasing proportions of red reflect decreases, the relative proportion of red in the index may offer one way of determining if any management response is necessary to a change in index values.

North Carolina Blue Crab Adaptive Management Framework

One current example of incorporating the Traffic Light Analysis Model was recently implemented for the North Carolina blue crab fishery (table 1). This framework applies the traffic light analysis to a production characteristic (spawning stock and general stock indicators from different fishery independent surveys), as well as an adult abundance characteristic (from different fishery independent surveys that catch adults). There are two management level responses that are tied to the relative proportion of red within each characteristic. A moderate management level response occurs when the proportion of red for the traffic light characteristic reaches 50% and can result in actions that limit harvest such as restricting trip level harvest for sponge crabs, institution of minimum and/or maximum size limits for female crabs, or seasonal closures in spawning areas. An elevated management level occurs when the traffic light characteristic reaches 75% and can result in more restrictive management actions such as prohibition of sponge crabs, no peeler harvest, or closure of the fishery through either season or gear (or both).

Application & Recommendations

In drawing from the North Carolina blue crab adaptive management framework, the application of tiered red proportion thresholds and management tools has much utility in addressing declining trends for both the Atlantic Croaker and Spot fisheries. Additionally, many of the management tools utilized in the blue crab adaptive management framework could be applied to the Atlantic croaker and spot fisheries, particularly size limits, possession limits, and seasonal closures.

The production characteristic which the North Carolina blue crab adaptive management framework utilizes- particularly the unique life history and spawning stock indicators- does not fit as well in application for Atlantic croaker or spot. Additionally, the blue crab adaptive management framework does not use commercial data to prevent any biases or influences not related to the stock condition. For Atlantic croaker and spot, a more appropriate production characteristic might be commercial and recreational data (as a ‘harvest’ characteristic), given their current use in assessing each species through the annual trigger exercises. Utilizing the traffic light anaylsis model, the composite commercial and recreational traffic light analysis for Atlantic Croaker and spot (figures 7 and 9) could be most useful as the harvest characteristic, while the composite of fishery independent surveys and indices (Figures 8 and 10) could be applied as the adult abundance characterisitic

Proportion Thresholds

In considering appropriate thresholds for the proportion of red necessary to enact management measures, the Atlantic Croaker Technical Committee and Spot Plan Review Team determined that approx. 30% (moderate concern) and approx. 60% (elevated concern) currently serve as adequate proxies based on independent and dependent fishery data during the last 30 years. Thresholds significantly higher than these may not work effectively in addressing declining trends. Further analysis will be needed to establish precise thresholds for enacting management measures.

Management Measures

<u>Atlantic croaker</u>

In evaluating the Atlantic croaker fishery in relation to the NC blue crab adaptive management framework, the tiered approach based on the Traffic Light Analysis Model may allow for sufficiently conservative measures to be utilized and still provide flexibility for more or less restrictive measures depending on performance. Effort controls may not be a viable option as a management tool for Atlantic croaker recreational and commercial fisheries due to the inability to enact limited entry or monitor a quota system on a real-time basis. Possible management tools for consideration may be bag limits, size restrictions, time & area closures, and gear modifications. An example of each of these tools is provided in table 2. Closures (as listed in table 2) were determined based on coastwide recreational harvest estimates by wave over the last two years and assessed based on when harvest is highest. Similarly to the NC blue crab adaptive management framework, each level of management response could be enacted based on a 3 year time series and subsequently hold management measures in place for 3 year period so as to provide consistent measures coastwide and allow for sufficient time to evaluate impact of measures.

Spot

In evaluating the spot fishery relative to the NC blue crab adaptive management framework, there is less of 1:1 applicability in the approach, largely due to a lack of age data as well as the short life history of spot. While neither croaker nor spot have reference points to work from in assessing the status of the stock, the additional lack of minimum management measures for spot makes it difficult to determine what impact any proposed measures may have relative to the natural cycles of species abundance. In considering management tools, limited options are available in constraining effort. In trying to improve recruitment, the reduction of landings through season closures and timed gear restrictions may provide some benefits. An example of each of these tools is provided in table 3. Closures were determined based on coastwide recreational harvest estimates by wave over the last two years and assessed based on when harvest is highest. Similarly to the Atlantic croaker example & NC blue crab adaptive management framework, each level of management response could be enacted based on a 2 year time series and subsequently hold management measures in place for a 2 year period so as to provide consistent measures coastwide and allow for sufficient time to evaluate impact of measures. A 2 year period rather than 3 year period was considered more appropriate given the short life history of spot. In implementing these measures, while potentially improving abundance, may allow for an expansion of the age structure for Spot, as current data indicates that few if any are observed beyond age 3, when they may be able to live to age 4 and older.

For both species, the application of an overall harvest percentage reduction using a combination of management tools listed under each tier response could be an option for state-by-state management rather than the implementation of coastwide measures at each tiered level.

Conclusion

The proposed management framework for Atlantic Croaker and Spot is intended to act as interim management measures between stock assessments, and not to be implemented in substitution of a stock assessment. Rather, the measures proposed are aimed addressing mutli-year changes and trends, and the accuracy of their impacts can only be improved through better age data, further highlight the need for an updated stock assessment for both species.

Determining appropriate management responses, at what levels they should occur, and how they should be applied across the different Atlantic states is the next step in adopting the Traffic Light Analysis method for use with Atlantic croaker and spot. The TC and PRT request the Board's review of this draft management framework and Traffic Light Analysis for consideration in the interstate fisheries management of Atlantic croaker and spot.

Figures

Figure 1. Commercial Landings for Atlantic croaker Traffic Light Analysis

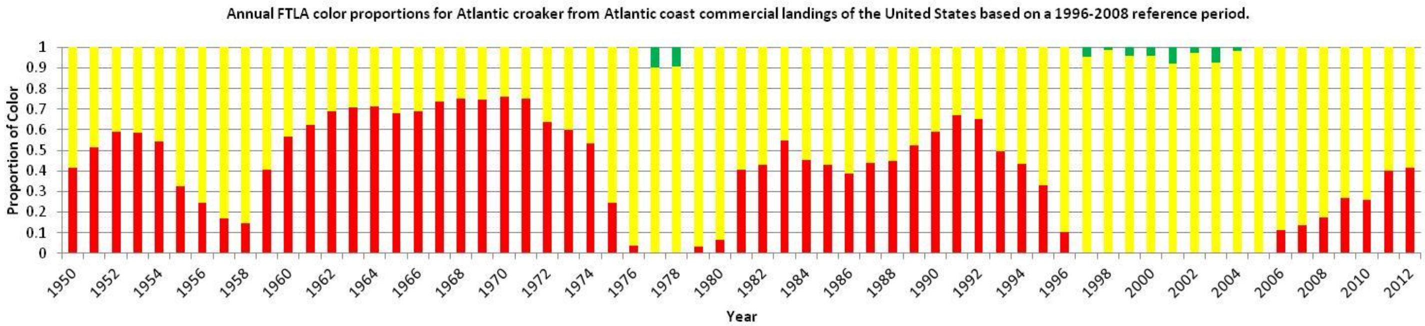


Figure 2. Recreational Harvest for Atlantic croaker Traffic Light Analysis

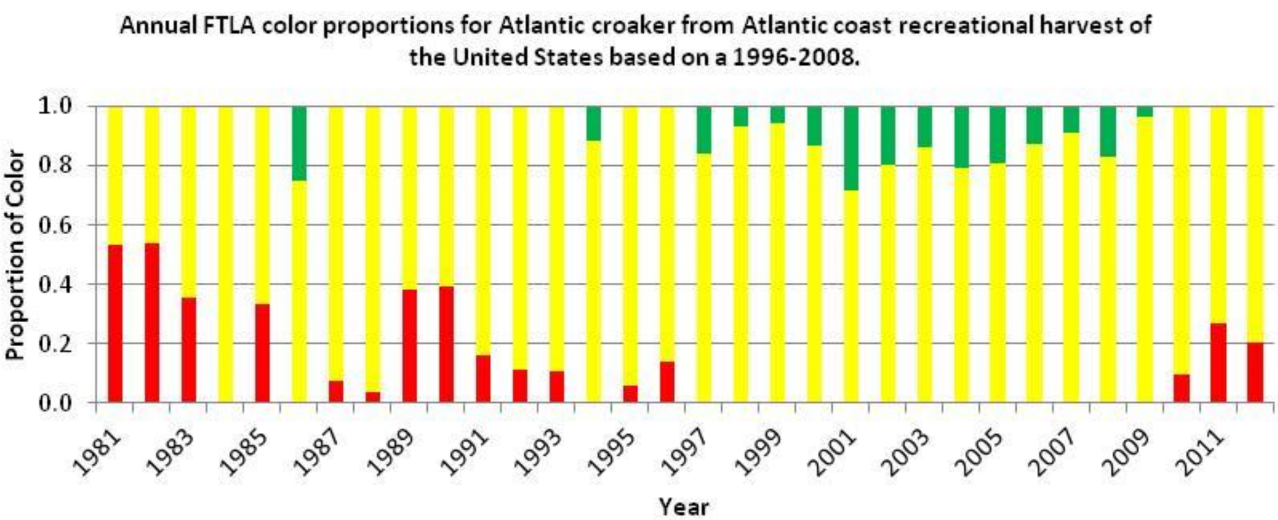


Figure 3. Commercial Landings for spot Traffic Light Analysis

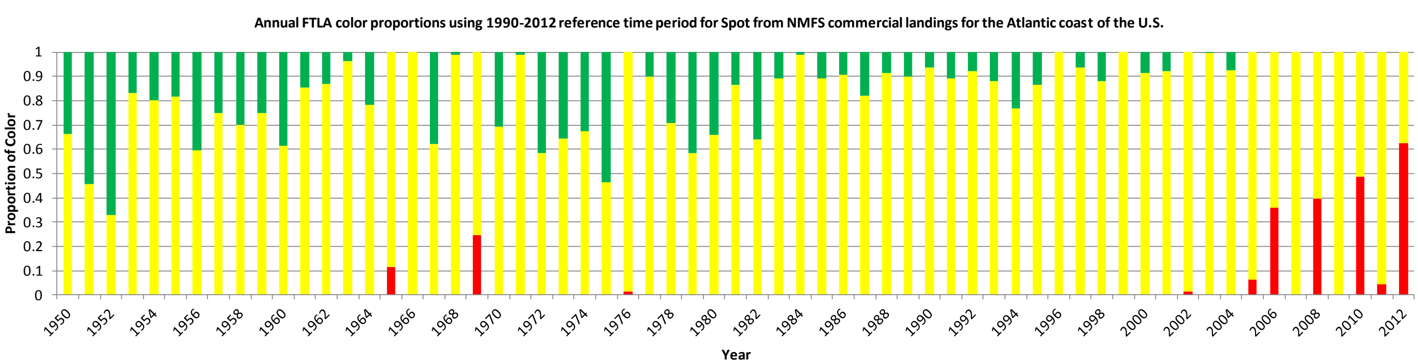


Figure 4. Recreational Harvest for spot Traffic Light Analysis

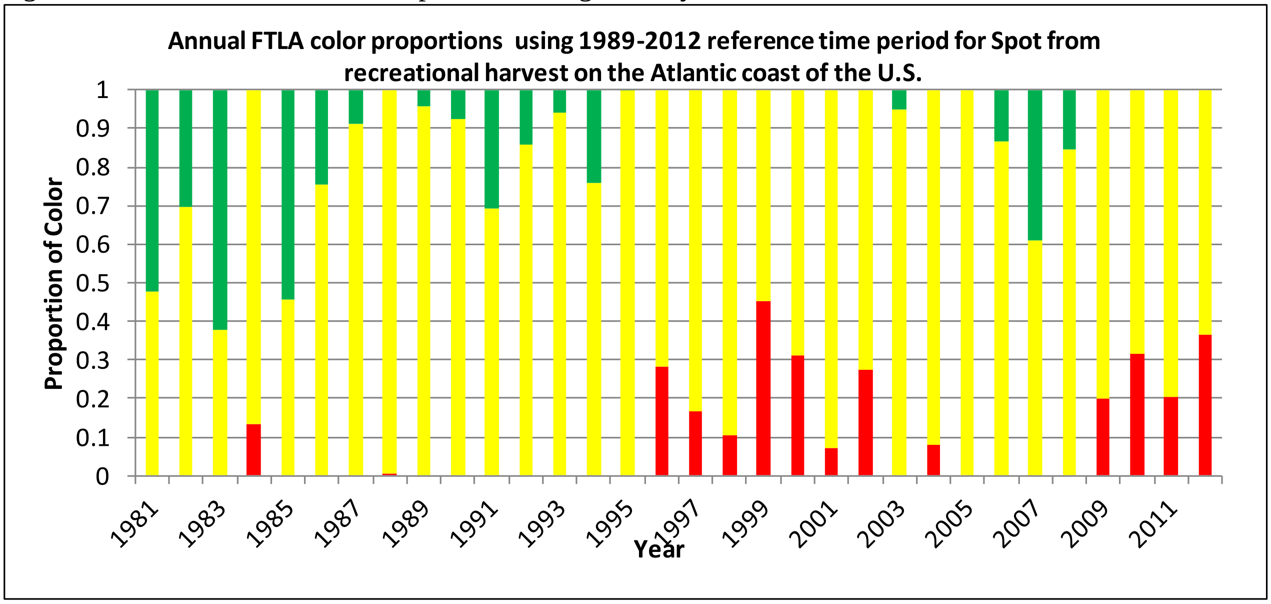


Figure 5. Adult Atlantic croaker Traffic Light Analysis for fishery independent indices

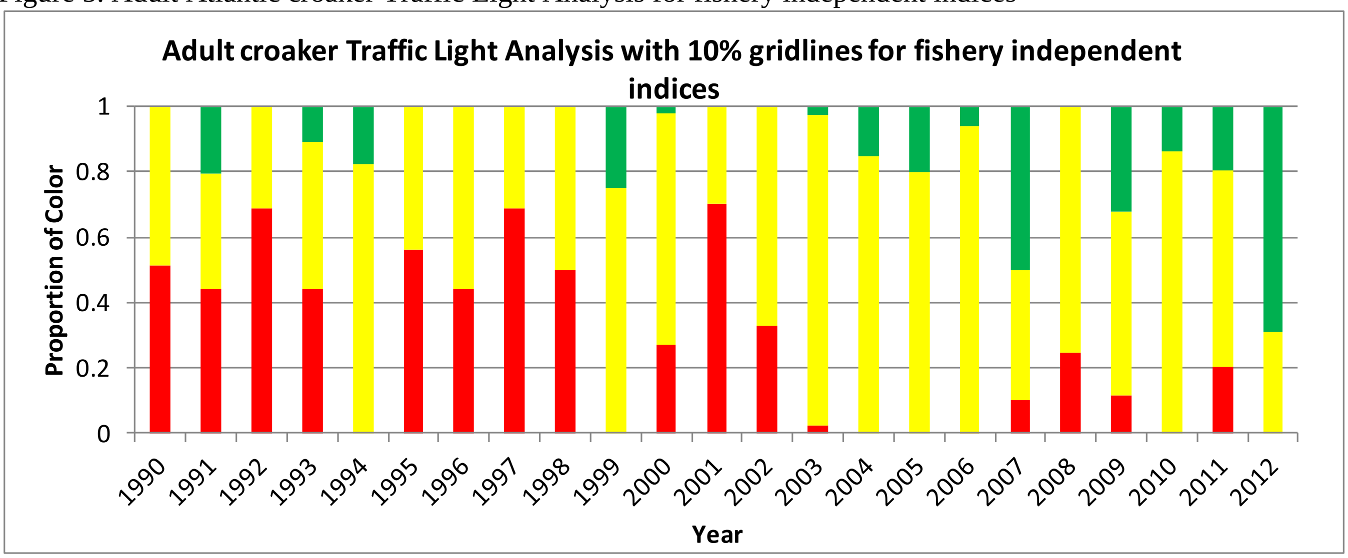
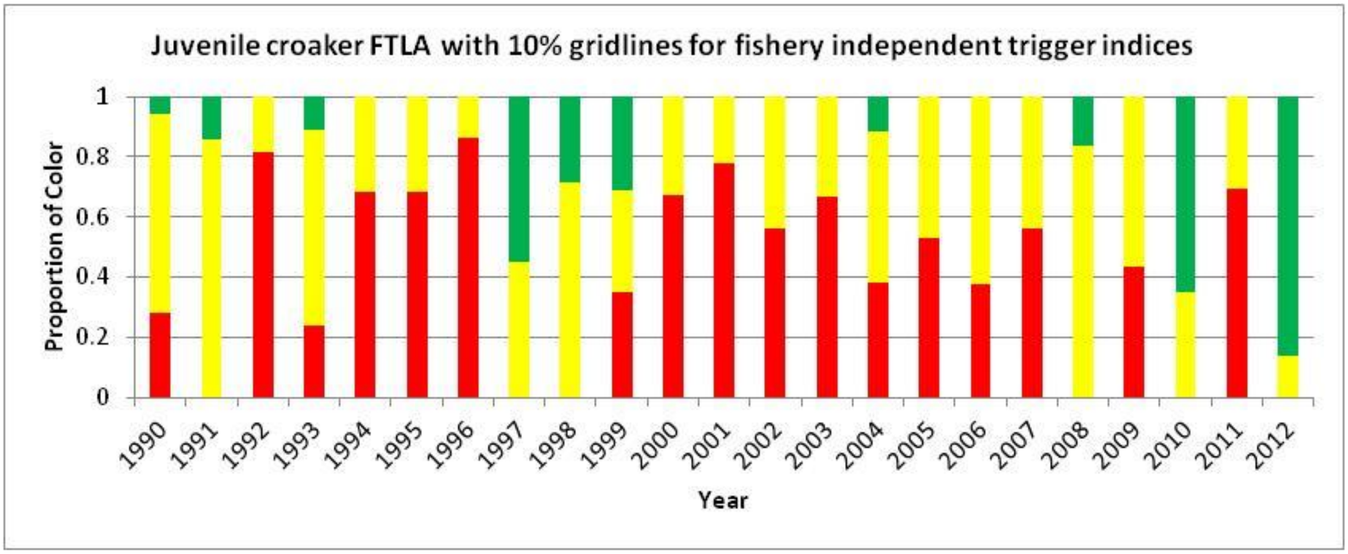


Figure 6. Juvenile Atlantic croaker FTLA for fishery independent trigger indices



Figures 7. Composite Commercial and Recreational Landings Traffic Light Analysis for Atlantic Croaker

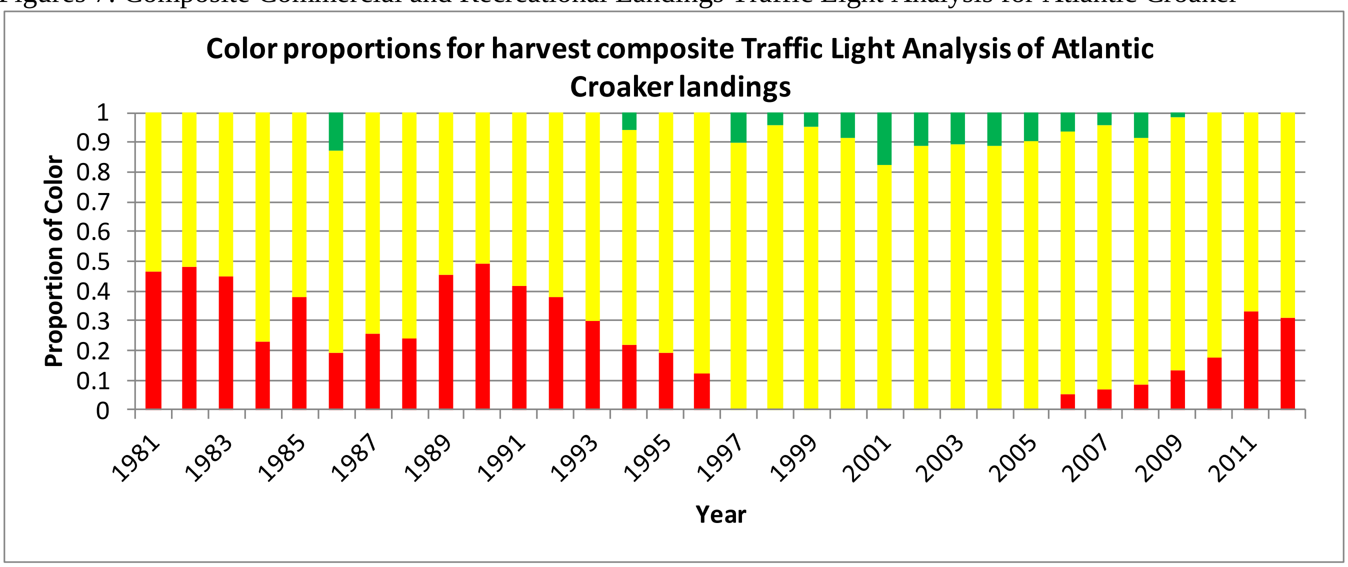


Figure 8. Composite Fishery Independent Surveys and Index Traffic Light Analysis for Atlantic Croaker

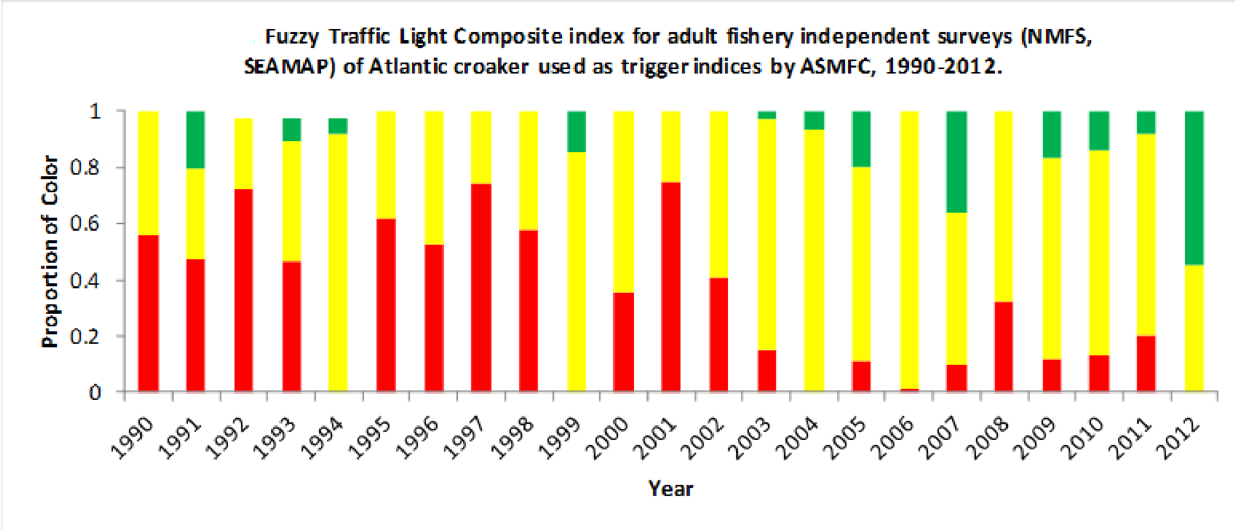


Figure 9. Composite Commercial and Recreational Landings Traffic Light Analysis for Spot

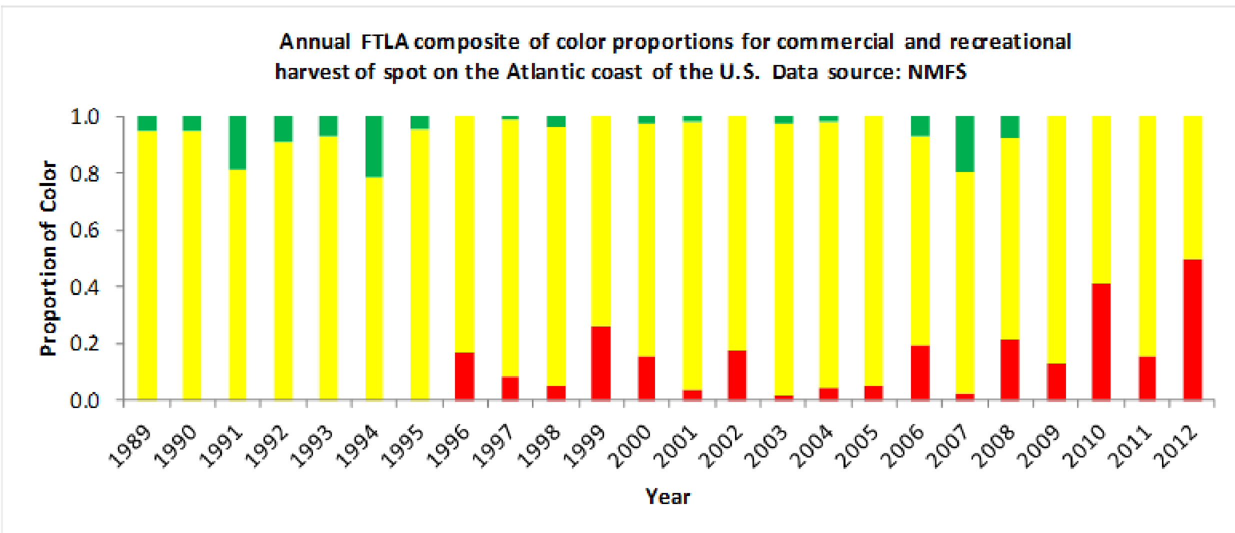
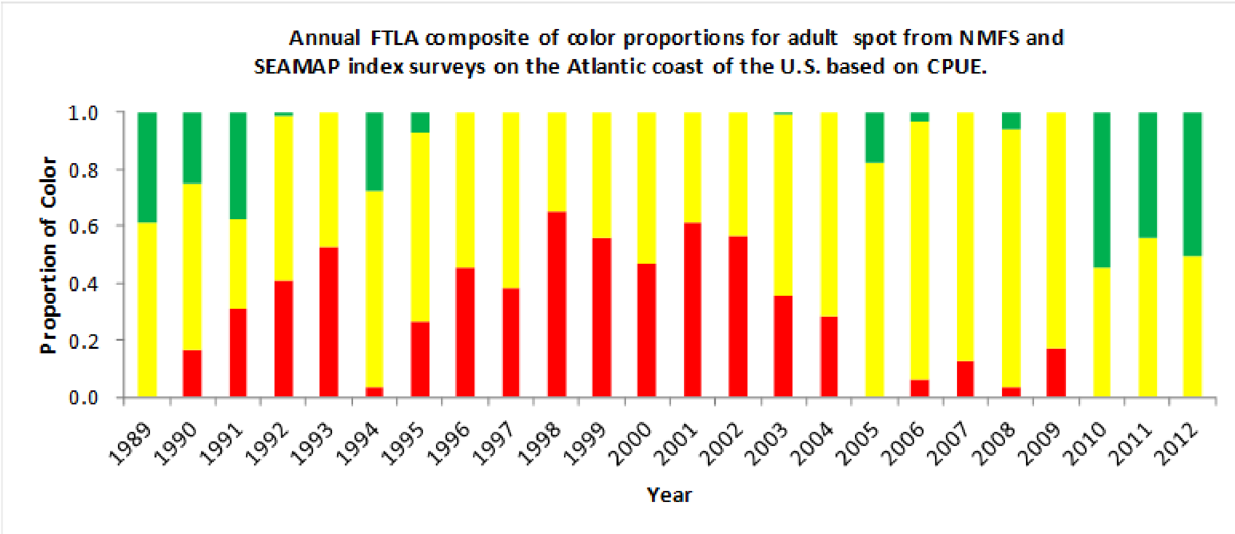


Figure 10. Composite Fishery Independent Surveys and Index Traffic Light Analysis for Spot



Tables

1. Fishery Management Measures for North Carolina blue crab Adaptive Management Framework

Characteristic	Moderate management level (50% red)	Elevated management level (75% red)
Adult abundance	A1. Increase in minimum size limit for male and immature female crabs A2. Reduction in tolerance of sub-legal size blue crabs (to a minimum of 5%) and/or implement gear modifications to reduce sublegal catch A3. Eliminate harvest of v-apron immature hard crab females	A4. Closure of the fishery (season and/or gear) A5. Reduction in tolerance of sub-legal size blue crabs (to a minimum of 1%) and/or implement gear modifications to reduce sublegal catch A6. Time restrictions
Recruit abundance	R1. Establish a seasonal size limit on peeler crabs R2. Restrict trip level harvest of sponge crabs (tolerance, quantity, sponge color) R3. Close the crab spawning sanctuaries from September 1 to February 28 and may impose further restrictions	R4. Prohibit harvest of sponge crabs (all) and/or require sponge crab excluders in pots in specific areas R5. Expand existing and/or designate new crab spawning sanctuaries R6. Closure of the fishery (season and/or gear) R7. Gear modifications in the crab trawl fishery
Production	P1. Restrict trip level harvest of sponge crabs (tolerance, quantity, sponge color) P2. Minimum and/or maximum size limit for mature female crabs P3. Close the crab spawning sanctuaries from September 1 to February 28 and may impose further restrictions	P4. Prohibit harvest of sponge crabs (all) and/or require sponge crab excluders in pots for specific areas P5. Reduce peeler harvest (no white line peelers and/or peeler size limit) P6. Expand existing and/or designate new crab spawning sanctuaries P7. Closure of the fishery (season and/or gear)

1. Fishery Management Measures for Atlantic croaker Management Framework

Characteristic	Moderate management level (30% red)		Elevated management level (60% red)	
	Recreational	Commercial	Recreational	Commercial
Adult abundance	Catch limit: X numbers/day limit (coastwide)	Catch limit: 8" minimum (coastwide); X pounds/day limit (coastwide)	Catch limit: 9" minimum (coastwide); X numbers/day limit (coastwide)	Catch limit: 9" minimum (coastwide); X pounds/day limit (coastwide)
	Closures: state specific areas closure for 20 days after May 1 & before Oct 1	Closures:	Closures: state specific areas closure from Aug 1-Sept 1	Closures: state specific areas from Sept 1-Nov 1
	Gear Modifications:	Gear Modifications:	Gear Modifications:	Gear Modifications: gillnets prohibited from August 1-30
Harvest	Catch limit: X numbers/day limit (coastwide)	Catch limit: 8" minimum (coastwide); X pounds/day limit (coastwide)	Catch limit: 9" minimum (coastwide); X numbers/day limit (coastwide)	Catch limit: 9" minimum (coastwide); X pounds/day limit (coastwide)
	Closures: state specific areas closure for 20 days after May 1 & before Oct 1	Closures:	Closures: state specific areas closure from Aug 1-Sept 1	Closures : state specific areas from Sept 1-Nov 1
	Gear Modifications:	Gear Modifications:	Gear Modifications:	Gear Modifications: gillnets prohibited from August 1-30

2. Fishery Management Measures for spot Management Framework

Characteristic	Moderate management level (30% red)		Elevated management level (60% red)	
	Recreational	Commercial	Recreational	Commercial
Adult Abundance	Closures: May 1- June 15	Closures: NA	Closures: Sept 1- Oct 15	Closures: Sept 1- Oct 1
	Minimum Size Limit: X”	Gear Modifications:	Minimum Size Limit: X”	Gear Modifications: gillnets prohibited from Sept 1-30
Harvest	Closures: May 1- June 15	Closures: NA	Closures: Sept 1- Oct 15	Closures: Sept 1- Oct 1
	Minimum Size Limit: X”	Gear Modifications:	Minimum Size Limit: X”	Gear Modifications: gillnets prohibited from Sept 1-30

Application of the Traffic Light Analysis Model for Developing Management Framework for Atlantic Croaker and Spot for the Atlantic States Marine Fisheries Commission.

Chris McDonough: South Carolina Dept. of Natural Resources
(Atlantic Croaker Technical Committee Chair)
Harry Rickabaugh: Maryland Dept. of Natural Resources

This draft document was developed for Management Board review and discussion. This document is not intended to solicit public comment as part of the Commission/State formal public input process. Comments on this draft document may be given at the appropriate time on the agenda during the scheduled meeting. If approved, a public comment period will be established to solicit input on the issues contained in the document.

ASMFC Vision Statement:
Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.

The current management scheme for Atlantic croaker compares annual changes in various trigger indices with the previous two year's average index value. If the index value drops below 70% of the previous two year average, at a minimum examination of the data is required by the ASMC technical committee. For spot index values are compared to the 10^{th} percentile of the indices time series. If two of these indices (one of which must be an independent index) is below the 10^{th} percentile the plan review team is to recommend the Board consider management action . This type of management trigger scheme does not illustrate long term declines or increases in stock since they don't make comparisons over longer time periods. Under the current trigger schemes, the high degree of variability in year to year index values results in rapid changes that make it difficult to respond to rapid decreases in the trigger indices beyond a general review by the TC or PRT because of the effort involved. In relatively short lived species like Atlantic croaker and spot it is not always necessary to respond to rapid annual changes in management index triggers but rather to persistent periodic declines that occur over several years. Declines that might occur over several years require close monitoring in order to anticipate when management action may be required. With this in mind, a management response scheme which uses techniques that illustrate multi-year changes and trends would be more useful than simply examining year to year changes against the previous year or 2 years or sharp declines in a single year compared to the time series. Knowing the level at which to respond or initiate some type of management action should be based on long term knowledge of general stock levels as well as how that stock has changed over time. The traffic light model offers the ability to illustrate changing trends based on relevant stock parameters based on historical abundance, life history parameters, and response to fishing pressure by using assessment based reference points.

The Traffic Light method was originally developed (Caddy and Mahon, 1995; Caddy, 1998, 1999) as a precautionary management framework for data poor fisheries whereby reference points could be developed that would allow for a reasonable level of resource management. The name comes from assigning a color (red, yellow, or green) to categorize relative levels of different indicators of the state of either a fish population or a fishery. These indicators can be combined to form composite characteristics within similar categories and can include biological indicators such as growth and reproduction, population level indicators such as abundance and stock biomass estimates, or fishery indicators such as harvest/landings and fishing mortality. However, each indicator must be evaluated separately in order to determine its appropriateness for use in a management scheme. The indicators we are interested in for this exercise are primarily abundance and harvest or landings indices as they are the primary trigger mechanisms used for evaluation of whether to implement management actions.

There are several different approaches that can be used for the traffic light method, but we are concerned with two:

1. ***Strict (regular) Traffic Light Method (STLA)***: This method uses defined reference points to designate the boundaries between green/yellow and yellow/red

and annual indicator values can only be assigned one color depending on where they fall relative to the boundary values.

2. ***Fuzzy Traffic Light Method (FTLA)***: This method uses a fuzzy logic model instead of a binary logic model such that the transitional color (yellow) can be expressed as the proportion of the neighboring color it is trending towards (yellow/red or yellow/green).

The tricky part is determining the reference points in relation to where the boundaries are placed between the color indicators (red, yellow, green). There are two types of reference points used in the system (Caddy & Mahon, 1995; Halliday et al., 2001):

1. ***Limit Reference Point*** (LRP): Typically, a LRP is associated with an unacceptable outcome as when an indicator value may pass or cross from a yellow to red using the traffic light indicators.
2. ***Target Reference Point*** (TRP): This defines a desirable condition or status of a stock. However, this is not the yellow/green boundary, but rather a point where some indicator demonstrates stock status has reached a desired objective (such as $F_{0.1}$ or a target SPR or SSB). Generally a TRP is acknowledged as the optimal balance point between conservation and economic benefit.

In order to tie these reference points together using the traffic light method, the LRP would be defined as the yellow/red boundary and the yellow/green boundary would be a predetermined value based on an acceptable or desired stock condition such as long term mean abundance values for a given indicator index. The yellow/green boundary should also be used to define a buffer zone between fully acceptable conditions and those that give warning of proximity to unacceptable conditions (yellow).

Establishing Reference Boundary Points

Strict Traffic Light Model (STLA)

The most commonly used method uses the data series long term mean to establish the yellow/green boundary. Any indicator value above this boundary would be considered green. The yellow/red boundary (LRP) would be based on a percentage of the average value (ex: 60%, which would represent a 40% decrease in CPUE from the index mean). This is most appropriate for data sets with a long time series (≥ 1 generation time period for a given species) which would more accurately illustrate population trends over multiple generations or year classes.

Figure 1 shows and example of the STLA strict model using catch effort data from the Southeast Atlantic Monitoring Area Program using Spot. Each year was given a color code based on the long term stratified catch mean of the series (green/yellow boundary) and 60% of the long term mean (yellow/red boundary). While the strict model clearly demonstrates periods of decline (yellow/red) and periods of higher abundance (green), it doesn't illustrate relative catch levels, annual changes or what is happening during the transitional years (yellow).

Figure 1. Strict Traffic Light Analysis Model for Spot from SEAMAP trawl survey

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
STLA																								

Another way to illustrate changing trends while incorporating the TLA designations can be seen in figure 2.

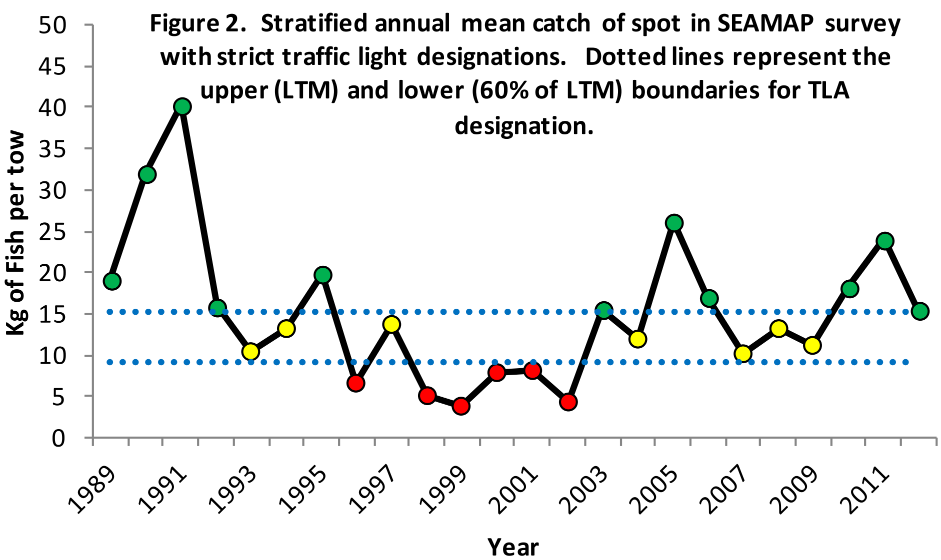


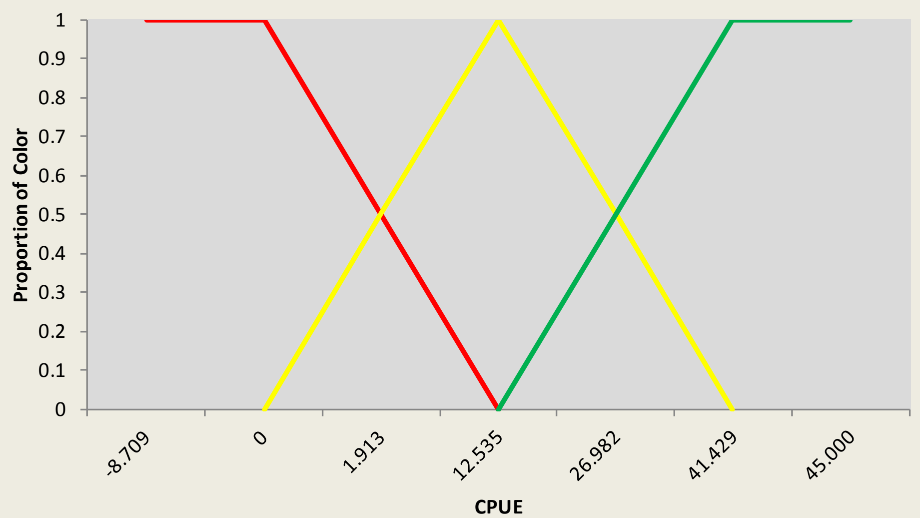
Figure 2. Stratified annual mean catch of spot in SEAMAP survey with strict traffic light designations. Dotted lines represent the upper (LTM) and lower (60% of LTM) boundaries for TLA designation.

This figure shows the annual STLA designations relative to where the actual boundaries are for a given level of catch effort while at the same time showing long term trends of relative declines (1991-2002) or increases (2002-2011). However, because of scalar differences, we aren't necessarily able to take this index and compare it directly with another index side by side. The primary limitation of the strict STLA model is that while it clearly shows changes in abundance relative to the reference boundaries (in this example), it doesn't illustrate the relative level of change within a given color outside of the reference boundaries.

Fuzzy Traffic Light Model (FTLA)

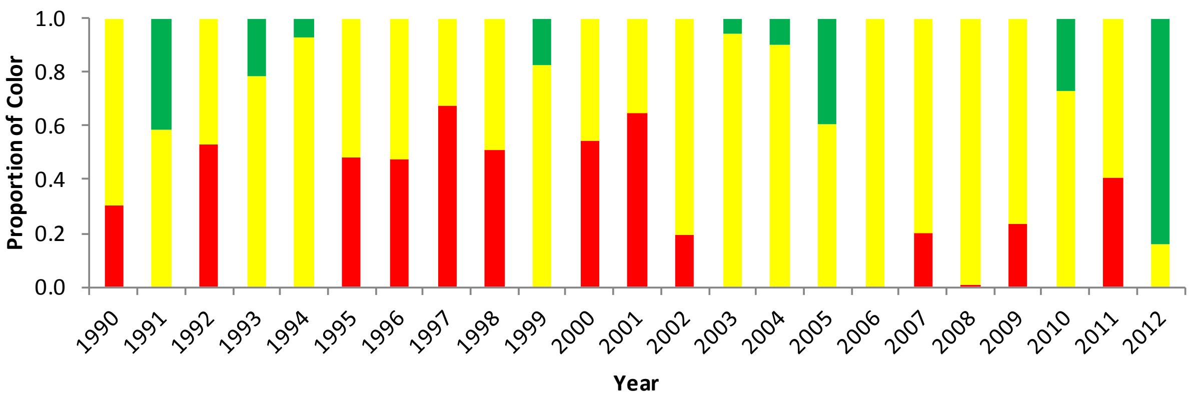
In the fuzzy traffic light model, we use the boundary reference points to determine the relative proportion of each color that includes the buffer (yellow) zone based on the upper and lower 95% confidence intervals from the index values for either the entire data series or a predetermined reference period (Halliday et al., 2001). This is done by setting the mean index value at 1.0 for yellow and 0.0 for both red and green as this is the exact center of the buffer zone. The 0.5 proportion value for all three colors is set at the mean index value minus the lower 95% confidence interval (CI) (red and left yellow leg) and the mean index value plus the upper CI (green and the right yellow leg). Finally, the value of 1.0 is set for red at the mean index value minus 2X the lower CI or zero, if the index mean minus 2X the lower CI is a negative number. For green the 1.0 value is set at 2X the upper 95% confidence limit. Once the known index values at the proportion values for each color are determined, the relative color proportions for each year can be estimated via linear regression using the annual values of the index. Any negative values are reset to zero and the proportion of yellow are set at 1 minus the color proportion for either red or green in that year. This allows a better illustration of the annual trends within a given color and whether or not values are approaching levels of concern about the reference boundaries. Figure 3 shows a schematic representation of the color proportions using catch per unit effort (CPUE) for Atlantic croaker from the SEAMAP survey.

Figure 3. Fuzzy Traffic Light Model Schematic for color proportions in annual CPUE for Atlantic Croaker from the SEAMAP survey.



Composite figures of combined indices can then be created using the color proportion tables from each individual index (Fig. 4). These indexes are additive and the total index is re-scaled to 0-1. It is possible to add weighting factors to each index via the color proportion tables if necessary. This type of composite index is what Halliday et al. (2001) referred to as a Characteristic, while the individual indices that make it up are the Indicators.

Figure 4. FTLA model for Atlantic croaker from SEAMAP survey using 1996-2008 reference period.



Atlantic Croaker: Comparing 70% Management Scheme with FTLA

For Atlantic croaker the current trigger indices from Amendment 1 section 3.2 are the coastwide commercial and recreational harvest (hard triggers) as well as four fishery independent indices using a 70% threshold of the previous 2-year index average and a Fuzzy Traffic Light Analysis (FTLA) of these same indices.

The fishery independent indexes used for Atlantic croaker were the following:

1. NEFSC Fall Groundfish trawl survey (NMFS)
2. VIMS Juvenile fish and blue crab survey
3. NCDMF Program 195 Survey
4. SEAMAP trawl survey of the south Atlantic coast

All years that triggered for Atlantic croaker using the 70% threshold of the previous 2-year index average for the hard triggers and the fishery independent surveys are highlighted in Table 1. The 1996-2008 time period was used to set reference boundaries for color transition zones for the FTLA. This time period was chosen because it encompassed known population changes that were documented in the 2010 stock assessment (ASMFC, 2010) where reference estimates of population characteristics (SSB, F_{msy}, M) were available. Additionally, setting population mean over a longer time period allows inclusion of documented increases and declines in the population.

Table 1. Percent change from previous 2-year average for current trigger indices for Atlantic Croaker: Pink highlighted cells indicate years where trigger was tripped for that particular index.

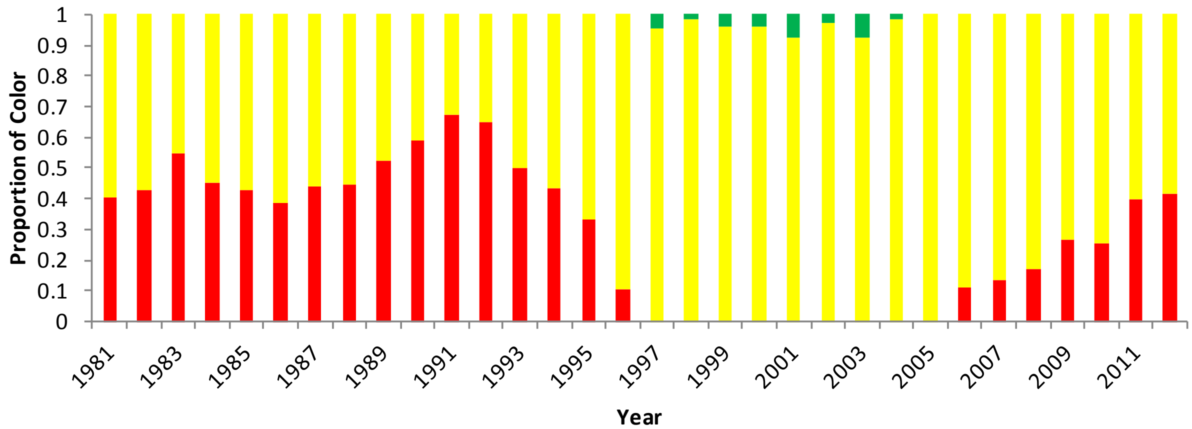
Year	Commercial Harvest LBS	Recreational Harvest Number	VIMS Survey Num/Set	NCDMF(P195) Survey Num/Set	NMFS Fall-Survey Num/Tow	SEAMAP Fall-Survey Num/Tow
1981	-	-	-	-	-	-
1982	94.1	96.6	-	-	27.3	-
1983	65.7	163.0	-	-	85.4	-
1984	110.2	224.6	-	-	790.0	-
1985	124.8	74.6	-	-	82.6	-
1986	114.9	201.9	-	-	69.6	-
1987	92.1	82.3	-	-	128.4	-
1988	91.2	75.4	-	71.7	9.1	-
1989	76.5	57.1	1496.0	138.5	226.9	-
1990	65.5	70.1	84.9	352.6	104.2	-
1991	52.2	152.4	276.5	110.5	2.5	317.8
1992	87.4	130.2	16.1	21.2	58.5	26.8
1993	224.1	104.6	46.3	263.7	34.3	129.5
1994	164.0	150.4	10.5	65.4	5458.0	127.3
1995	141.1	85.6	53.3	52.3	30.7	30.5
1996	168.5	74.2	2.1	40.6	52.8	52.2
1997	155.2	159.4	6272.0	347.3	49.7	45.0
1998	105.8	106.3	38.7	309.6	120.0	125.1
1999	102.2	89.8	12.7	137.0	580.2	502.8
2000	102.6	114.7	13.3	23.5	97.6	37.8
2001	107.1	134.7	50.3	24.6	9.6	24.6
2002	94.1	98.4	562.8	54.9	75.0	269.9
2003	104.4	85.0	19.7	180.4	302.2	237.3
2004	93.3	106.6	101.9	358.9	220.2	131.7
2005	90.7	103.6	103.4	73.1	84.1	161.5
2006	82.7	88.2	267.5	38.5	102.7	61.6
2007	87.9	88.3	104.4	63.0	356.6	51.2
2008	92.8	111.2	354.7	249.2	16.0	112.9
2009	82.3	83.2	59.3	38.6	143.6	81.9
2010	93.4	69.6	151.9	624.4	61.7	196.9
2011	74.1	67.5	22.5	14.2	110.6	42.6
2012	81.6	97.0	317.1	180.3	106.1	276.3

Commercial Harvest

The commercial harvest index was examined beginning in 1981 since the recreational index only went back to 1981 and the first year where a comparison could be made to the previous 2-year average would have been 1984. However, commercial landings were available back to 1951.

The 70% trigger was tripped in 1990-1991 (Table 1). The FTLA model showed steady decline with the increasing proportion of red from 1982-1992 matching the decline seen in total harvest. The years where the index shows some improvement (1997-2003), there was still a relatively high proportion of yellow. The increasing proportion of green in 1997-2003 supports the positive trend in commercial harvest. However, the FTLA does show the beginning of the recent decline beginning in 2004 where the proportion of green decreases until getting back into the

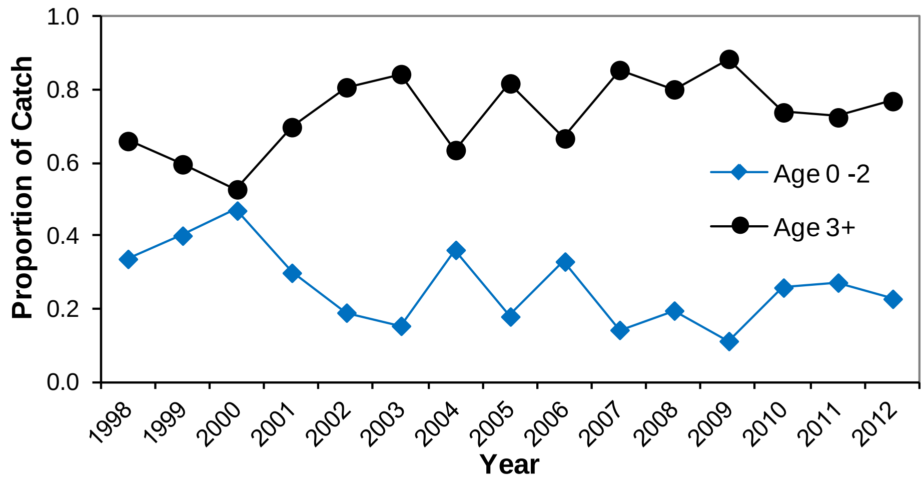
Figure 5. Annual FTLA color proportions for Atlantic croaker from Atlantic coast commercial landings of the United States based on a 1996-2008 reference period.



yellow/red zone in 2006. All of the trends shown in stock changes appear more detailed and better reflected in the FTLA. It should be noted that the harvest levels during the reference time period (1996-2008) were among the highest in the time series and resulted in higher values for the boundary reference points. The reason this reference time period was chosen was because it incorporated data used during the most recent benchmark assessment for Atlantic croaker (ASMFC, 2010). Had a broader time range been used, the overall trends would have remained the same with proportions shifting slightly up with the green and down in the red. However, the FTLA still was more sensitive to changes than the 70% trigger because it takes the longer reference time frame into consideration showing declining trends in the last decade that did not appear with the 70% trigger. It must also be noted that the commercial landings were primarily driven by harvest in only a few states (MD, VA, NC) compared to the recreational harvest.

An additional factor that influencing harvest levels, and the resulting FTLA ,was the age distribution from the commercial harvest. There was no size distribution data available on the commercial harvest but there was age data from MD, VA, and NC for 1998-2012. The annual proportion at age of the harvest during this time period was estimated using a weighted catch at age model of the combined states age data sets. The age range of Atlantic croaker from this data ranged from 0-13 years. The ages were divided into a 0-2 age group and a 3+ group as most croaker had recruited to the fishery by age 3. The resulting annual proportions of the two age groups indicated that the 3+ age group accounted for higher proportions of the sampled harvest than the younger age group (Fig. 6). As this proportion of ages may not be indicative of the age distribution in the population, it could account for discrepancies between the FTLA for the commercial harvest and the fishery independent indices.

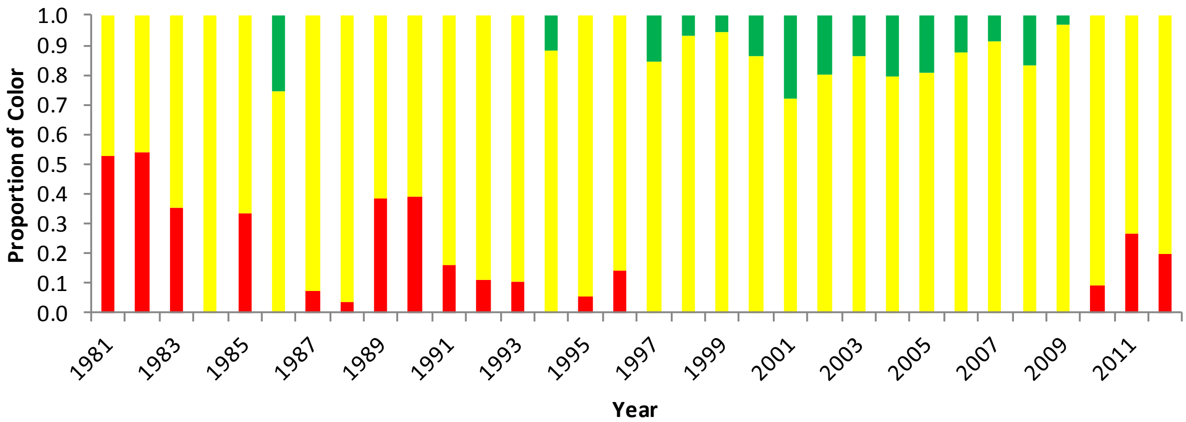
Figure 6. Annual proportion of catch by age groups for commercially harvested Atlantic croaker on the Atlantic coast of the U.S. Age data from (NC, VA, MD).



Recreational Harvest

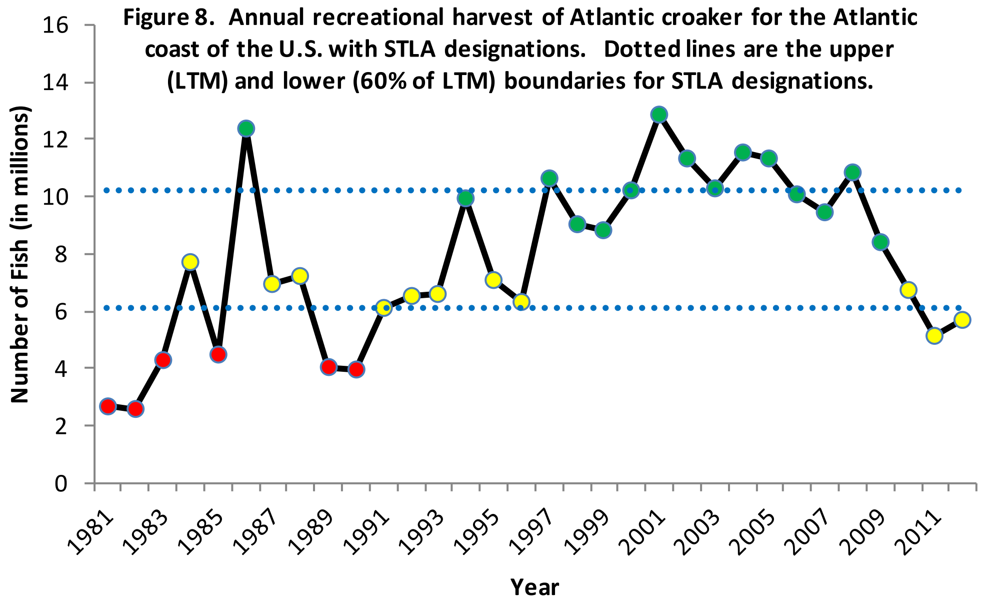
For the recreational harvest, the 70% trigger was tripped in 1989-1990 and 2011 (Table 1). In comparison, the FTLA model showed declining red with single peak (green) year in 1986. Declining proportions of red began in 1989, indicating increasing harvest, the first indication of green proportions showing up in 1997 (Fig. 7). The FTLA model has red showing up 3 years earlier than the STLA model indicating the beginning of the recent declining trend. The boundaries and trends in the FTLA model held with both the entire time series mean as well as the 1996-2008 mean and boundary values.

Figure 7. Annual FTLA color proportions for Atlantic croaker from Atlantic coast recreational harvest of the United States based on a 1996-2008.

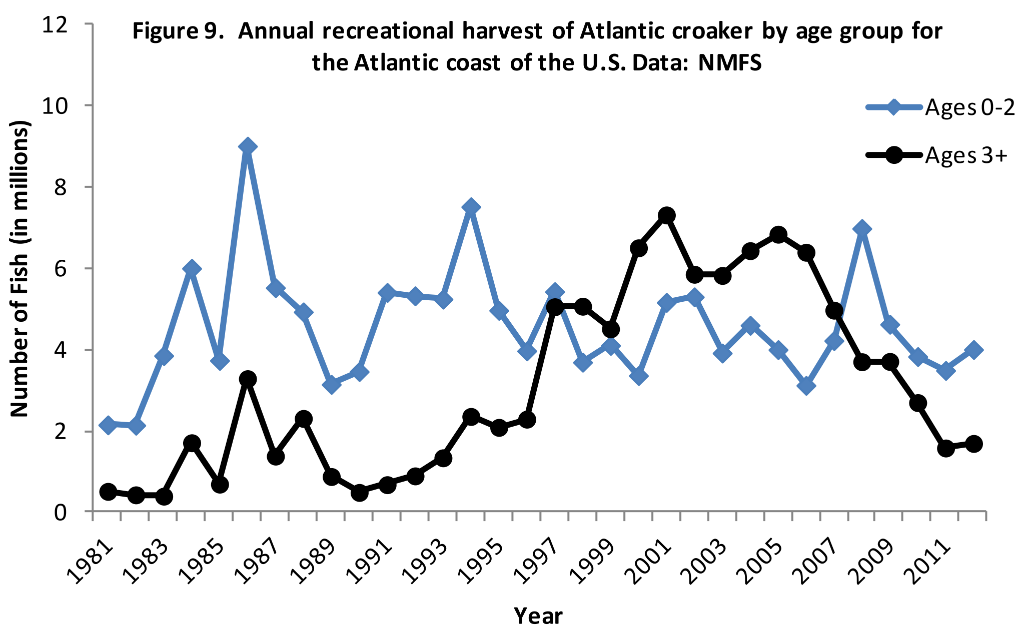


One important point to mention using the harvest data, particularly at the coast wide level, is that trends in annual harvest can be subject to different state management structures, angler effort and preferences in addition to variation in overall abundance and distribution of the population. Fish harvested as part of the fishery may not be representative of the overall population in terms of the general size or age distribution and thus use of harvest landings as a trigger (either recreationally or commercially) should be approached with caution. These types of differences can (and often do) result in disparate results between fishery dependent indices and fishery independent survey indices. Typically, if fishery dependent indices match trends with fishery independent indices they are considered as supporting the general trends found in both and greater weight may be given to the results as a proxy for population trends. However, when the trends between different indices are variable, less weight is usually given to the fishery dependent surveys because fewer control factors are known compared to the fishery independent surveys. The differences between the two index types can sometimes be reconciled by taking into consideration the size and age structure of the data set to make sure the comparisons are being made between similar data structures.

A good example of this can be made with the recreational harvest data for Atlantic croaker. The incorporation of the annual harvest and STLA designations for the Atlantic coast harvest can be seen in figure 8. There is a wide range of sizes (10-54 cm fork length) represented in this data set. Since age data is not taken from recreational surveys an age length key (ALK) must be applied to the length distribution data from the MRIP survey to estimate an age distribution. For this data set, an ALK from the last benchmark assessment (ASMFC, 2010) was used to estimate annual age frequency distribution. The length distribution has a typical unimodal distribution with the mid-range sizes being the most abundant while age frequencies are dominated by



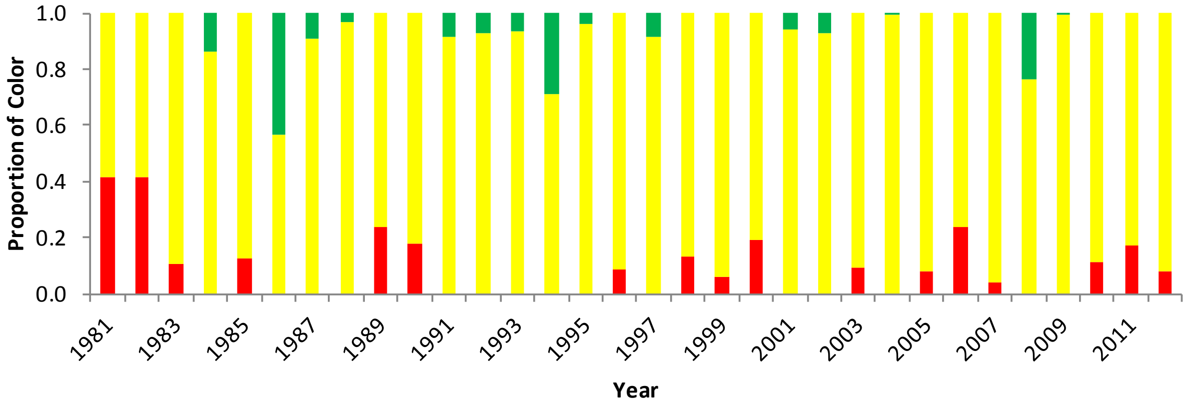
younger age classes (0-2) and account for approximately 66% of the harvest over the entire data set. Since the majority of croaker from the ALK estimates were ages 0-2, the data was divided between two sets of age groups, ages 0-2 and ages 3+. The annual recreational harvest for each of the two age groups can be seen in figure 9.



The changes in total annual recreational harvest appears to be driven more by the 3+ age group than the by the younger age groups. This can affect how the FTLA is interpreted depending on which group is exerting the greater influence on harvest trends. If the FTLA is run on just age 0-

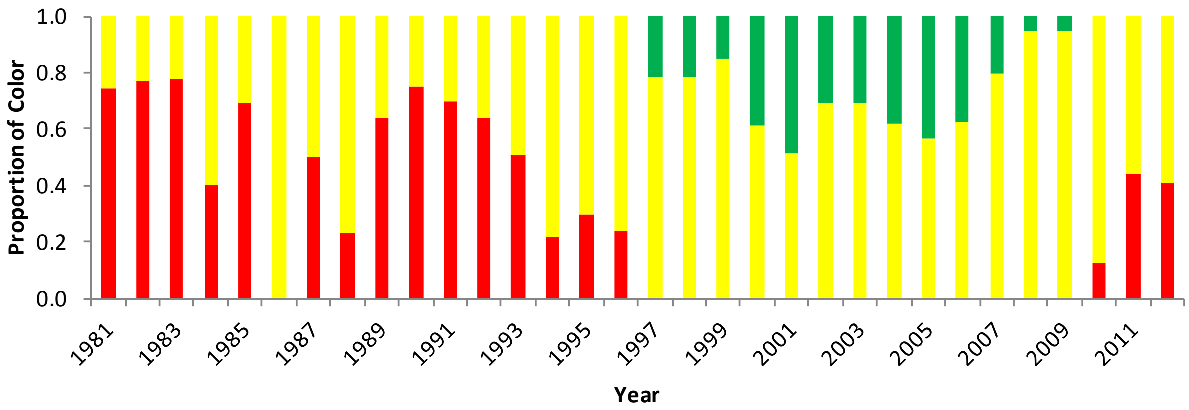
2 (Fig. 10), the pattern is quite different than the total harvest data set with green occurring in more years than with the total data set.

Figure 10. Annual FTLA color proportions for Atlantic croaker recreational harvest for ages 0-2 for the Atlantic coast of the U.S. based on 1996-2008 reference period.



If the FTLA is run using the older (3+) age groups (Fig. 11) the resulting pattern more closely resembles the results from the overall data set and in fact accentuates the shifts in harvest with greater proportions of red and green. Overall this is an indication that the fishery impacts the older age groups more heavily than younger age classes.

Figure 11. Annual FTLA color proportions for Atlantic croaker recreational harvest for ages 3+ for the U.S. Atlantic coast based on a 1996-2008 reference period.

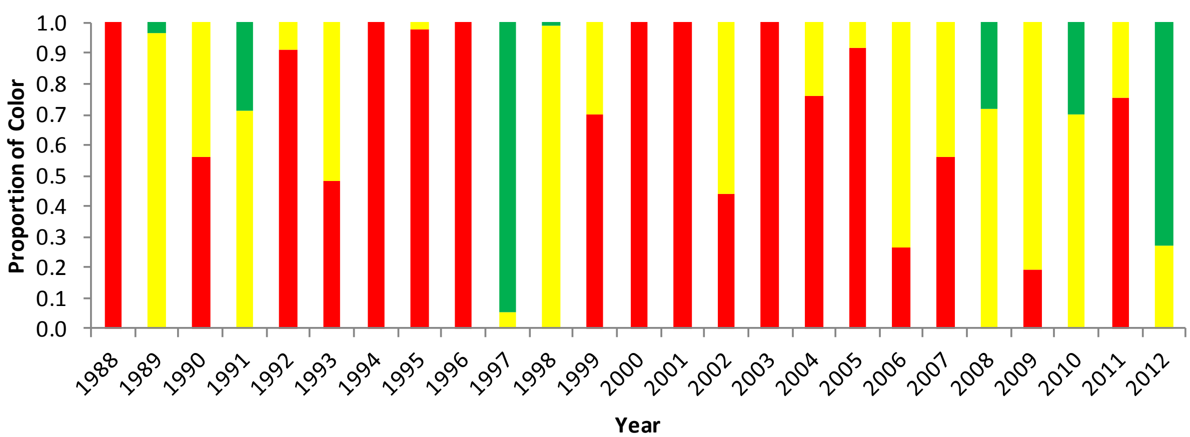


Knowing, in general, what size and/or age classes make up the fishery can allow a more equitable comparison of index changes between both fishery dependent and fishery independent data sources, which in part could account for discrepancies between index trends.

VIMS Spring Surveys

The VIMS survey was conducted in Chesapeake Bay and the rivers in Virginia. This was a juvenile survey and shows a high degree of year to year variability which likely reflects variable recruitment and year-class strength. The FTLA model reflects extended periods of low abundance (1988, 1994-1996, 1999-2005, and 2011) and some periods of highly elevated catches (1997, 2008, 2010, and 2012) (Fig. 12). The FTLA showed high proportions of red the same years that the 70% threshold index triggered, except in 2010 where only the 70% threshold triggered (Table 1). The FTLA model showed the changes in index values earlier as well as covering the overlapping time periods of the 70% threshold scheme. The FTLA model generally showed greater sensitivity to changes than the 70% threshold model or an STLA. There was a greater degree of transition between red and green in the STLA compared to the FTLA which likely reflects that these indexes were being influenced by changes in annual recruitment and year-class strength increasing year to year variability compared to some of the other trigger indexes that sampled adult Atlantic croaker.

Figure 12. FTLA for VIMS Chesapeake survey of Atlantic croaker

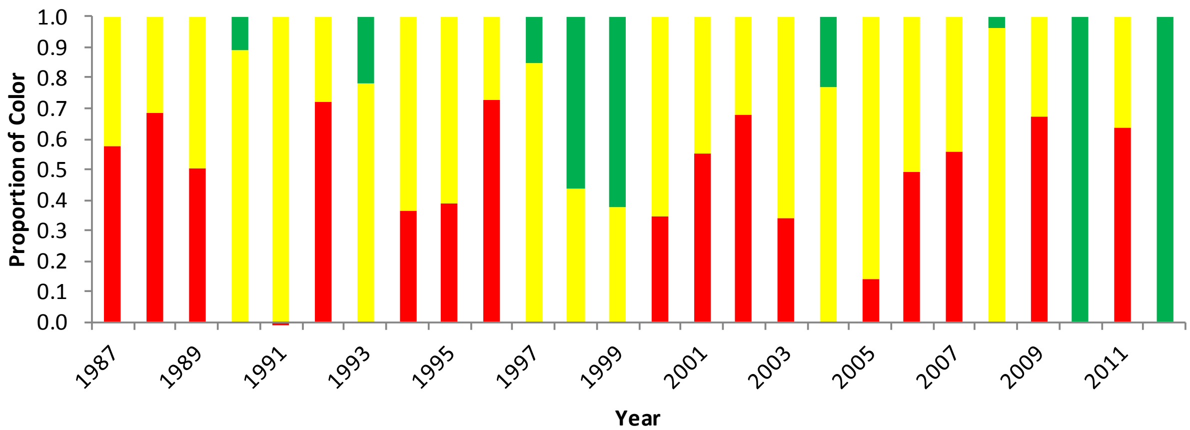


NCDMF- Program 195

The 70% threshold scheme was tripped in 11 out of 26 years (Table 1) indicating a high degree of variability in catch effort. The STLA model showed red for 14 of the 26 years with the red years in the STLA model and the 70% threshold scheme overlapping in all but 3 years (1987-1989). The STLA model showed greater sensitivity with critical levels generally reached earlier than with the 70% threshold scheme.

The FTLA model was, again, more sensitive with the degree of change from year to year being reflected in the changing proportions of colors. This was particularly true in years where the STLA model showed green and the FTLA model would have some proportion of green but a much greater proportion of yellow. There were only a few years where the proportion on green was greater than that of yellow (1998-1999, 2010, 2012) (Fig. 13).

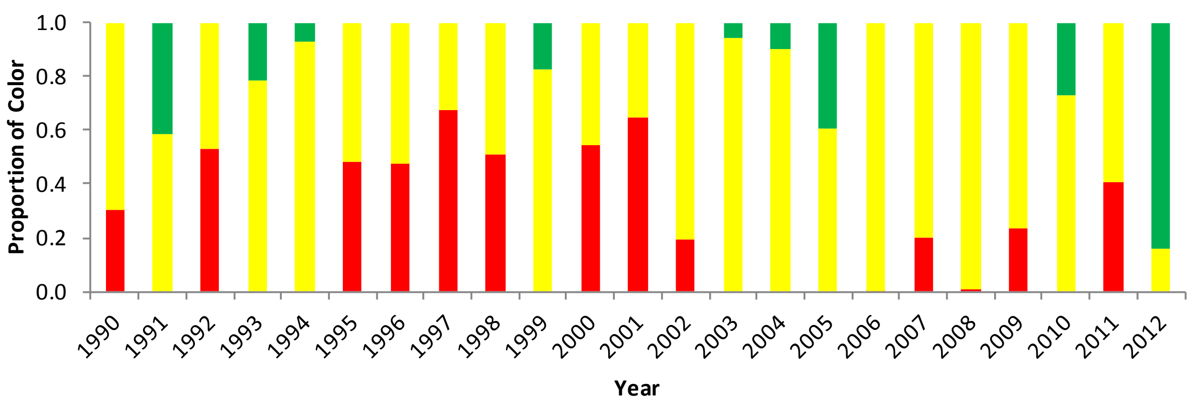
Figure 13. NCDMF Program 195 FTLA color proportions for Atlantic croaker



<u>SEAMAP Fall Trawl Survey</u>

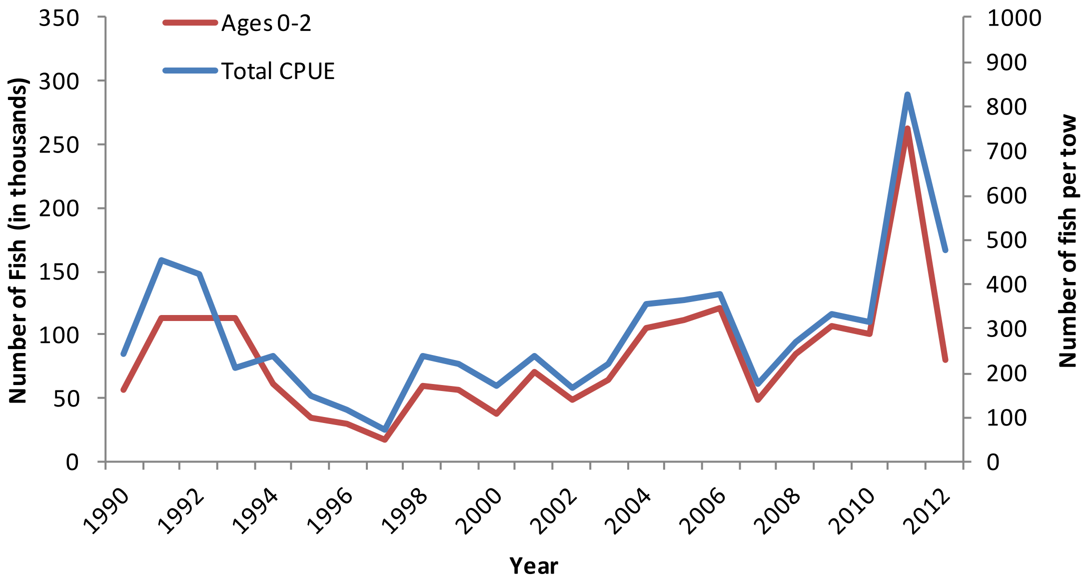
For the SEAMAP survey, the 70% threshold was tripped in 9 out of 20 years: 1992, 1995-1997, 2000-2001, 2006-2007, and 2011 (Table 1). The FTLA model agreed with 7 of the 9 years where the 70% threshold had tripped with high proportions of red (1992, 1995-1997, 2000-2001, 2011) (Fig. 14). The FTLA model generally showed the general decline beginning from 1994-2001, with the exception of one year (1999) in that time period. The FTLA model showed higher proportions of yellow indicating the early declining trends, except in 2005 which was the second highest CPUE in the index. The most recent year (2012) was the highest year in the entire index for CPUE.

Figure 14. FTLA model for Atlantic croaker from SEAMAP survey using 1996-2008 reference period.



The SEAMAP data set did have age and length data corresponding to the catch data. The annual proportionate age at length distributions were applied to the annual length frequency distributions to estimate the annual catch at age for ages 0-7. Ages 0-2 accounted for the majority of samples (95.9%) and so ages were divided into two groups of age 0-2 and age 3+ (similar to the recreational and commercial age comparisons). As would be expected, given that most of the fish were ages 0-2, the annual stratified mean CPUE is driven almost entirely by the 0-2 age classes (Fig. 15).

Figure 15. Total annual number of Atlantic croaker for ages 0-2 and mean annual CPUE from SEAMAP survey on the south Atlantic coast of the U.S.



This result would indicate that the FTLA from the SEAMAP survey was indicative of changes in the younger (and dominant) age classes.

<u>NMFS Fall Ground-Fish Survey</u>

The NMFS fall ground-fish survey was the longest time series (1972-2012) and had two different trends in the overall abundance index. From 1972 to 1993 the range of annual CPUE values was relatively narrow, while the most recent years (1994-2012) have shown an approximate 80% increase in mean annual CPUE and a much higher degree of year to year variability (Fig. 16). During the early time period (1972-1993) the CPUE was well below the lower threshold for both the long term mean for the data series as well as the 1996-2008 time period, which represented the yellow/red boundary. During the second time period (1994-2012) the mean CPUE increased approximately 80% with 7 years above the series long-term mean and 7 years below.

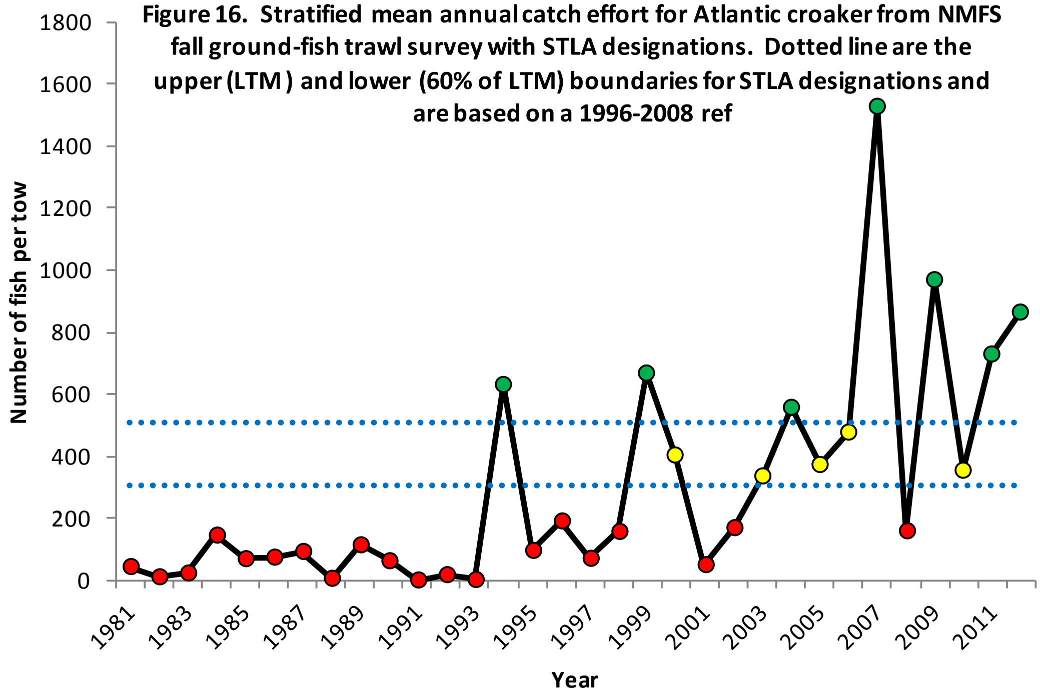
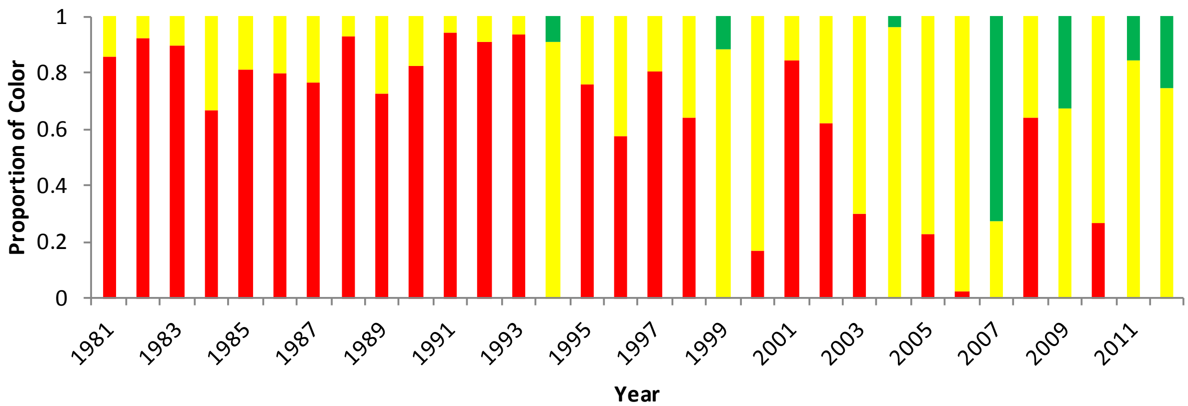


Figure 16. Stratified mean annual catch effort for Atlantic croaker from NMFS fall ground-fish trawl survey with STLA designations. Dotted line are the upper (LTM) and lower (60% of LTM) boundaries for STLA designations and are based on a 1996-2008 ref

Under the 70% threshold scheme, the entire index has tripped 15 out of 41 years, with 9 of those events occurring in the 1972-1993 time period. In recent years, the threshold was tripped 6 times from 1994-2012 and 4 times in the 1996-2008 reference time period (Table 1). The overall increase in the index in the last 20 years has resulted in fewer instances where the 70% threshold could be tripped unless there was a single year where a drastic reduction in CPUE occurred.

The FTLA was run using the same time frame as the commercial and recreational harvest data sets (1981-2012), with the 1996-2008 reference period for setting the color proportion boundaries. The FTLA model (Fig. 17) had highest proportions of red (> 50%) prior to 1998 (with the exception of 1994 and 1996). This was due to the increase in the long term mean from the increased catch levels which occurred in the reference time period, although, this same pattern occurs using the entire time series as the reference time period as well. The FTLA model was more sensitive to changes with downward or upward shifts occurring earlier than would have occurred in the STLA model.

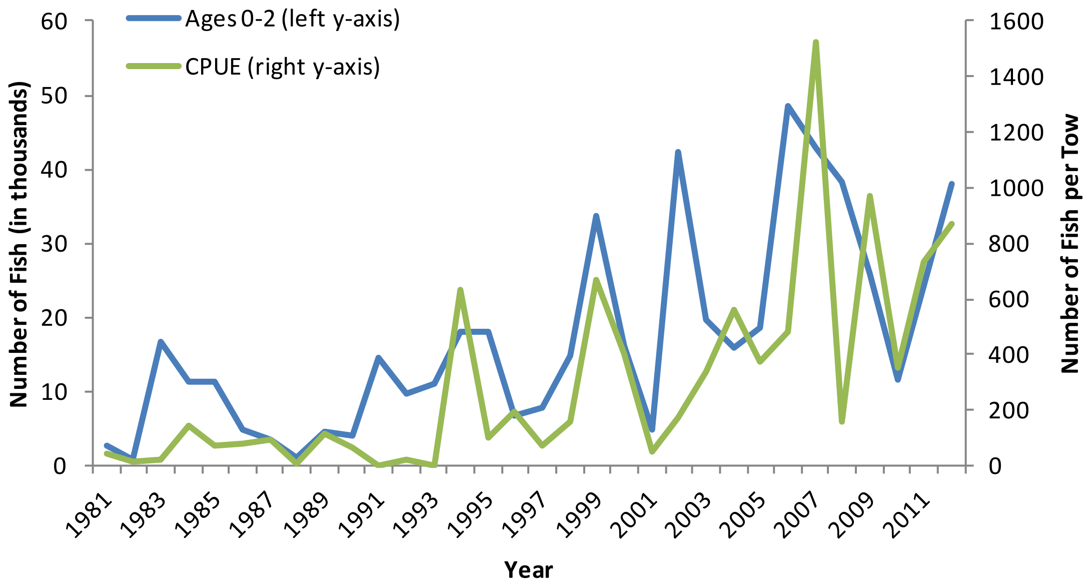
Figure 17. Annual FTLA color proportions for Atlantic croaker from NMFS ground-fish trawl survey based on a 1996-2008 reference time period.



Given the changes in catch levels that occurred after 1994, the use of the entire time series means to set boundary reference points would not be prudent because of the level of low catches which occurred in the first 20 years of the data series, relative to catch levels in the second 20 years of the time series. Additionally, increased year to year variability in catch levels since 1994 makes the use of the 70% threshold problematic since catch levels can shift by this amount annually and could be the result of stochastic and system perturbations as opposed to fishing pressure. The NMFS survey data set is a good example of why it is important to pick representative time periods for setting reference points and color boundaries for the traffic light method that relate to the current time period, as well as, documented population trends from the most recent stock assessment.

There was age data available from the NMFS survey from 1997-2012 which ranged from ages 0-13. As with the SEAMAP data set, the majority of specimens fell in the 0-2 age range (65.7%) and the comparison of annual numbers of this age grouping versus the mean annual CPUE revealed that the catch trend was driven primarily by this age group as well (Fig. 18).

Figure 18. Annual total catch for 0-2 age groups and stratified annual mean CPUE for Atlantic croaker from NMFS fall ground-fish survey.



<u>FTLA Composite Models Summary:</u>

One important thing to note on the composite models is that since each indicator is additive within a given characteristic (abundance, harvest, etc) all three colors can occur within a given year for any particular composite characteristic. The abundance characteristic was separated into adult and juvenile models because of the differences in distribution and life history stage as well as year to year variability. All of the composite FTLA models were run using the 1990-2012 time period which was when all of the indicator component indices were available.

The composite FTLA model for harvest (commercial and recreational harvest combined) showed peak harvests occurring from 1997-2005 with only yellow and green lights present (Fig. 19). The 1990-1996 time period, while having red lights present, did show the increase in general harvest levels via the decreasing proportion of red during this time period. While the decrease in red was a positive sign, the presence of the red light was indicative that relative harvest levels were still low. The increase in harvest that occurred from 1997-2005 still had relatively high proportions of yellow compared to green which indicated that while harvest was up, it was still largely in the transition (yellow) zone. In the most recent years (2006-2012), harvest has declined, indicated by the increasing proportion of red in the FTLA harvest index. The years with highest proportions of green in the harvest composite FTLA (2001-2004) coincided with decreasing abundance in the FTLA fishery independent composite model during those years, which suggests that there is either a lag between peak abundance years and general harvest levels or that the two are not directly comparable. The harvest FTLA levels might be affected by additional fishery related factors that would not influence the fishery independent FTLA composite model. It must also be noted that while recreational harvest occurred all along the Atlantic coast, the majority of the commercial harvest occurred in only two states (VA, NC), which may also be a contributing factor. Additionally, the estimated age distribution of the recreational harvest indicated harvest patterns were influenced more by age 3+ fish versus younger age groups.

The juvenile FTLA showed much greater variability with rapid shifts between red and green and not as high a proportion of yellow (indicating rapid transition) in most years (Fig. 20). This should be somewhat expected given the high degree of variability in juvenile recruitment indices in most fishery independent surveys. The green years would be those years with strong recruitment and (likely) subsequent strong year classes. Strong recruitment years included 1991, 1997, 1998, 2008, 2010, and 2012. Two of the most recent years (2010, 2012) appear to be a particularly strong year-classes. The FTLA juvenile index's higher proportion of red during the 1993-1996 and 1999-2005 time periods would indicate periods of poor recruitment but should not be used to draw conclusions on trends in the adult population.

The adult FTLA composite model had higher proportions of green occurring at approximately 5-6 year intervals (1994, 1999, 2004) through the mid 2000's (Fig. 21). After 2005, the years with higher proportions of green occurred in shorter intervals of approximately every 2 years (2005, 2007, 2010, 2012). Declining trends (higher proportions of red) showed this cyclical pattern for similar time periods (1990-1992, 1994-1998, 2000-2003) but after 2006 the relative proportion of red remains at a similar level, except in 2012 where there is no red due to the high proportion of green in the index that year. The long term trend in the FTLA beginning in 2003 is an overall increasing trend in the all of the threshold indices.

Figure 19. Annual FTLA composite index for commercial and recreational (all ages) Atlantic croaker harvest on the Atlantic coast of the United States, 1990-2012.

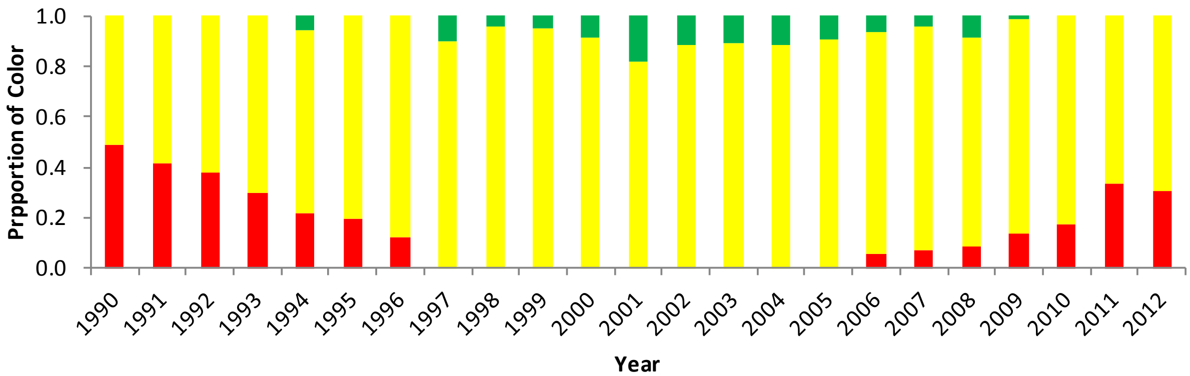


Figure 20. Fuzzy Traffic Light Composite index for juvenile fishery independent surveys (VIMS, NCDMF) of Atlantic croaker used as trigger indices by ASMFC, 1990-2012

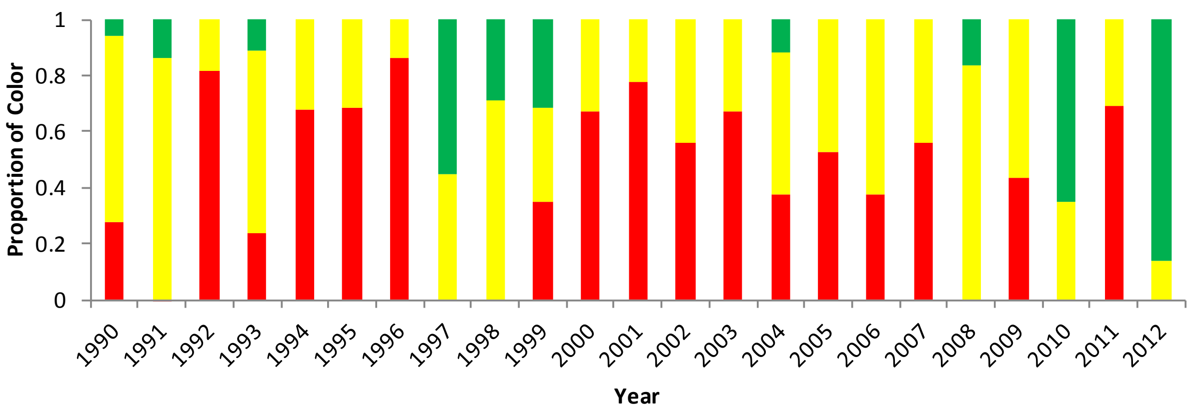
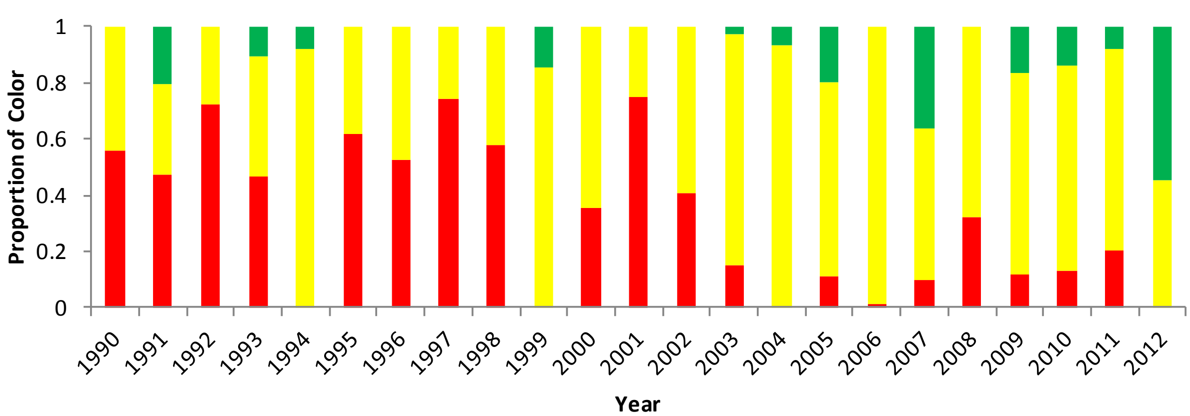


Figure 21. Fuzzy Traffic Light Composite index for adult fishery independent surveys (NMFS, SEAMAP) of Atlantic croaker used as trigger indices by ASMFC, 1990-2012.



Spot: Comparing 10th Percentile Management Scheme with FTLA

For spot, the current trigger indices used are also the coastwide commercial and recreational harvest as well as three different fishery independent surveys. For spot, all changes using the 10th percentile threshold of the time series average for the fishery dependant data and fishery independent surveys are highlighted in Table 2.

The fishery independent indexes used for spot were the following:

1. NMFS Fall Ground-fish trawl survey (NEFSC, Woodshole, MA)
2. Maryland Chesapeake Bay Seine Survey
3. SEAMAP trawl survey of the south Atlantic coast

Commercial Harvest

The period examined for spot landings was 1981-2012. This was done because it matched the same time period as the recreational harvest index , although commercial landings were available back to 1950. Overall, spot landings have been on a declining trend since the 1980's, however this trend has become more pronounced since 1999 (Fig. 22). Recent years (2005-2012) have seen a high degree of annual variability in landings remaining below the long term mean harvest and the green/yellow boundary from the FTLA. The FTLA mirrored this trend (Fig. 23) with increasing proportions of red beginning in 1999. The 10th percentile trigger would have been set off in 2006, 2008, 2010, and 2012 (Table 2), while the FTLA began showing signs of decline with increasing proportions of red and declining proportions of green beginning in 1999.

Figure 22. Annual commercial landings of Spot on the Atlantic coast of the United States with STLA designations. Dotted lines are the upper (LTM) and the lower (60% of the LTM) boundaries of the FTLA. The red dotted line is the current 10th percentile trigger level.

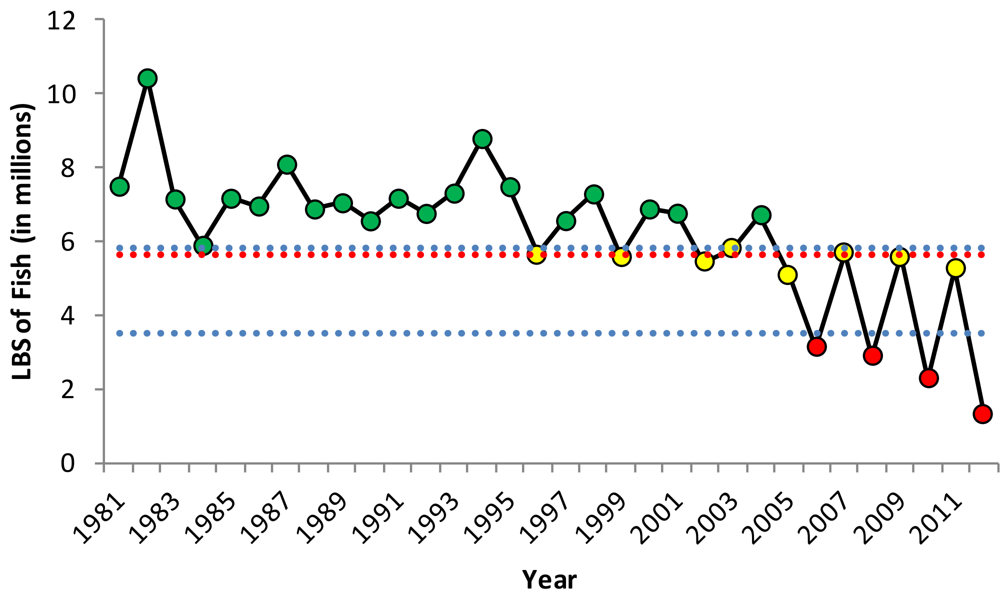


Figure 23. Annual FTLA color proportions using 1989-2012 reference time period for Spot from NMFS commercial landings for the Atlantic coast of the U.S.

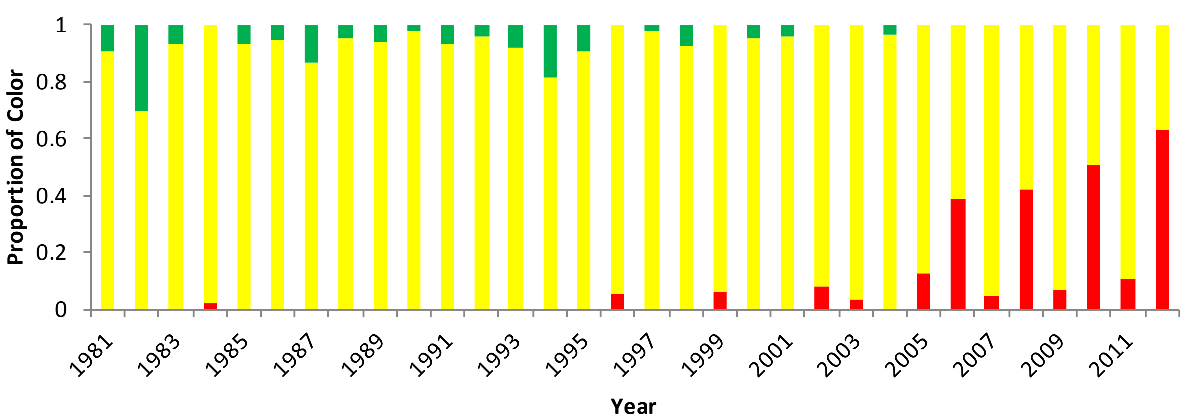


Table 2. The current fishery dependent (commercial and recreational harvest) and fishery independent (NMFS, SEAMAP, and MD Chesapeake seine survey) management trigger indices used for spot on the Atlantic coast of the United States. Pink highlighted cells are years where the index value fell below the 10th percentile for the entire data set and would have triggered a management response.

	Commercial	Recreational	NMFS	SEAMAP	MD(Juv)
	Harvest	Harvest	CPUE	CPUE	CPUE
Year	LBS	Number	Num/tow	Kg/tow	Num/tow
1981	7502660	18211373	233.3	-	1.647
1982	10440456	14035394	45.6	-	2.254
1983	7156787	20125239	246.8	-	1.074
1984	5899237	6662176	322.9	-	3.428
1985	7175456	18616969	51.7	-	1.498
1986	6965468	12932596	256.4	-	1.766
1987	8100735	9927128	180.2	-	1.174
1988	6885465	7888631	180.2	-	4.495
1989	7053374	9022104	453.8	19.2	0.697
1990	6563745	9699092	102.4	32.1	1.046
1991	7176632	14083432	47.6	40.3	0.809
1992	6765078	10945571	10.1	15.9	0.441
1993	7315577	9399408	7.9	10.5	1.425
1994	8795939	12819339	411.7	13.3	1.486
1995	7489478	8258786	65.1	19.9	0.096
1996	5647298	5234337	77.4	6.6	0.283
1997	6570132	6346999	29.7	13.7	1.343
1998	7293919	6928839	17.4	5.0	0.437
1999	5589288	3624213	67.8	3.7	0.607
2000	6884989	4976923	59.0	8.0	0.828
2001	6770093	7239378	0.2	8.1	0.367
2002	5449507	5327170	60.4	4.3	0.357
2003	5808929	9189041	31.0	15.6	0.306
2004	6730217	7166471	85.0	12.0	0.805
2005	5120448	8166637	187.8	26.2	3.485
2006	3137120	10818374	144.9	17.1	0.342
2007	5684401	15717617	166.2	10.2	0.609
2008	2883286	11200109	225.2	13.2	0.867
2009	5578379	6035163	136.9	11.2	0.443
2010	2275959	4951340	635.3	18.2	2.889
2011	5267410	5989196	436.1	24.0	0.065
2012	1328774	4448237	825.4	15.5	0.827
10th Percentile	3335453	5002664	18.628	5.511	0.310

Recreational Harvest

The recreational harvest of spot (in numbers) has been generally declining along the Atlantic coast since the mid-1980's, with the exception of 2006-2008 (Fig. 24). The lowest index values occurred in 1996-2002 and 2009-2012.

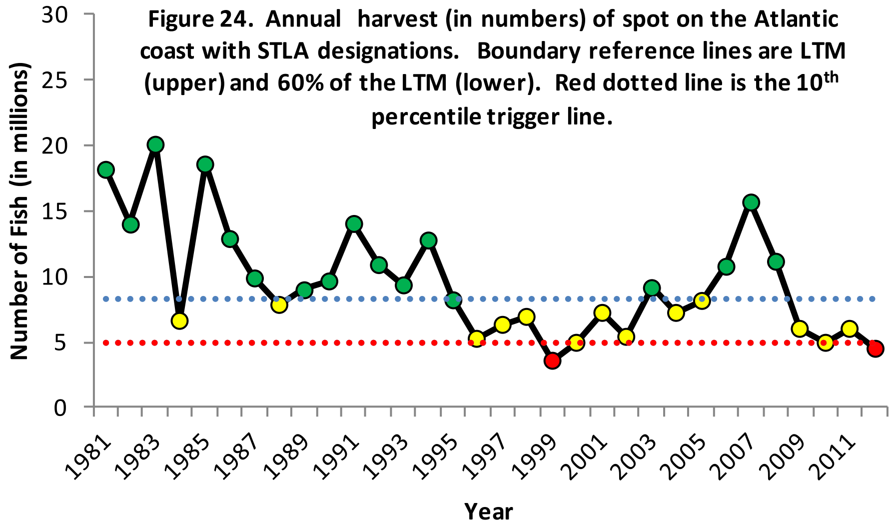
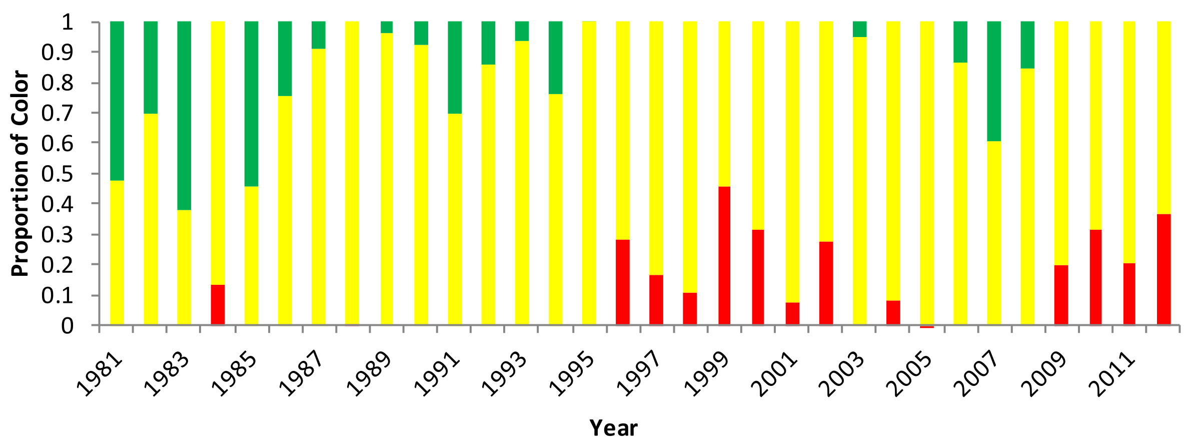


Figure 24. Annual harvest (in numbers) of spot on the Atlantic coast with STLA designations. Boundary reference lines are LTM (upper) and 60% of the LTM (lower). Red dotted line is the 10th percentile trigger line.

The 10th percentile trigger was tripped in 1999-2000, 2010, and 2012, while the FTLA began to show increasing proportions of red 1-2 years before the 10th percentile trigger was tripped (Fig. 25).

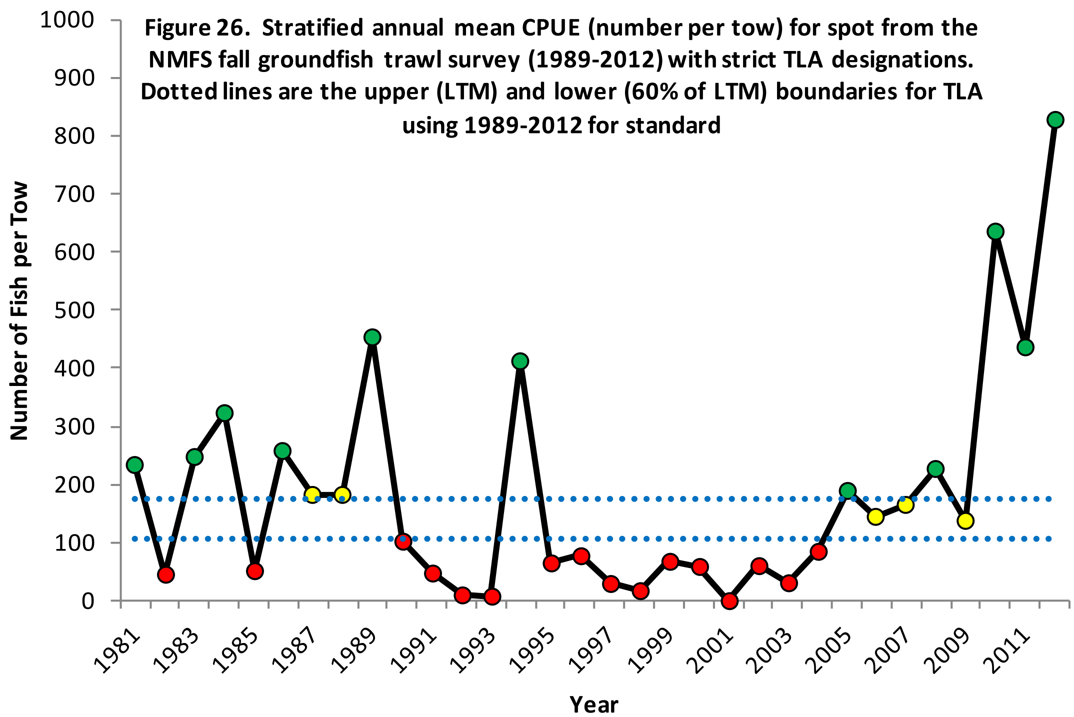
Figure 25. Annual FTLA color proportions using 1989-2012 reference time period for Spot from recreational harvest on the Atlantic coast of the U.S.



The level of the 10th percentile trigger was very close in value to the red/yellow boundary of the FTLA (5,002,664 vs. 4,939,694 respectively) and would indicate that the 10th percentile trigger is a poor indicator, relative to the FTLA, because it did not trip until reaching some of the lowest index values. The FTLA provided better reference points for relative harvest levels with a higher and more conservative limit reference point (green/yellow boundary) that would trigger (at a minimum) a management review by the ASMFC.

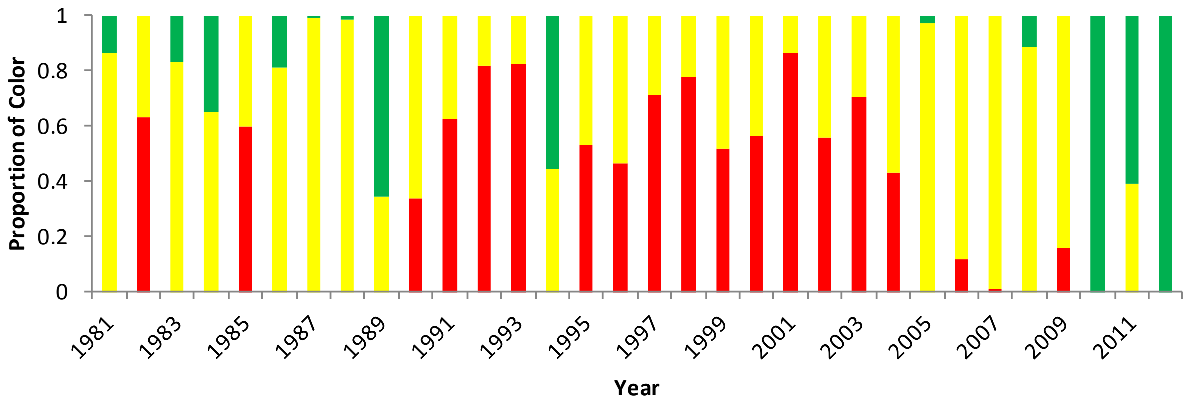
NMFS Fall Ground-Fish Trawl Survey

The NMFS index went through a period of decline from the 1980's through 2004, with the exception of two peak years (1989 and 1994) (Fig. 26). Index values began increasing in 2005 and reached the highest values for the entire survey time period (1972-2012) in the last three years.



The 10th percentile trigger was only tripped in four years (1992-1993, 1998, 2001) (Table 2). The index value for the 10th percentile trigger (18.6 fish/tow) was essentially an order of magnitude less than the long term mean for the 1989-2012 reference period (177.7 fish/tow). The FTLA was a much better indicator of trends in catch with more realistic reference boundaries based on the catch effort. In order for the 10th percentile trigger to be tripped, index values had to drop significantly, making possible management responses more drastic or reactionary. The 10th percentile trigger vastly underestimates when a problem may be occurring. The FTLA (Fig. 27), while also showing green peak years during the declining period (1989 and 1994), better demonstrated the drop in index values through the increasing proportions of red, accentuating the two major periods of decline in the index (1990-1993 and 1995-2004). With exception of the two peak years in the midst of the declines, the FTLA essentially demonstrated a steady decline in the index for almost a 20 year period, until recent years where the index has reached catch levels over four times the series average.

Figure 27. Annual FTLA color proportions for spot from NMFS fall groundfish survey using 1989-2012 reference time period.



For this data set, the FTLA is a much better indicator of changes in catch effort compared to the 10th percentile trigger. By setting a limit reference point at the series mean over an extended reference period, the FTLA would give an earlier indicator of changes in the index which would allow more timely management responses if warranted.

<u>SEAMAP Trawl Survey</u>

The overall index trend from the SEAMAP survey showed a decline from 1991-2002 and an increasing trend from 2003-1012, although index values have not reached the levels seen in the early 1990's (Fig. 28).

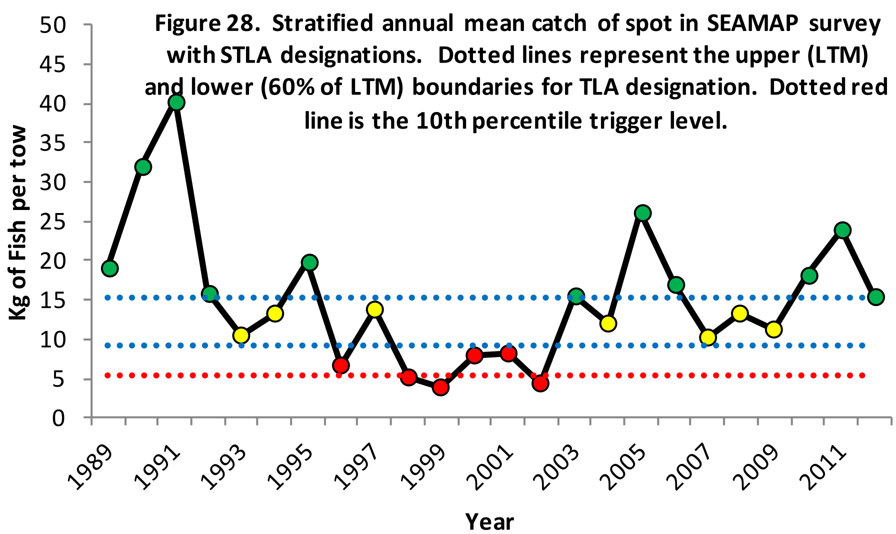
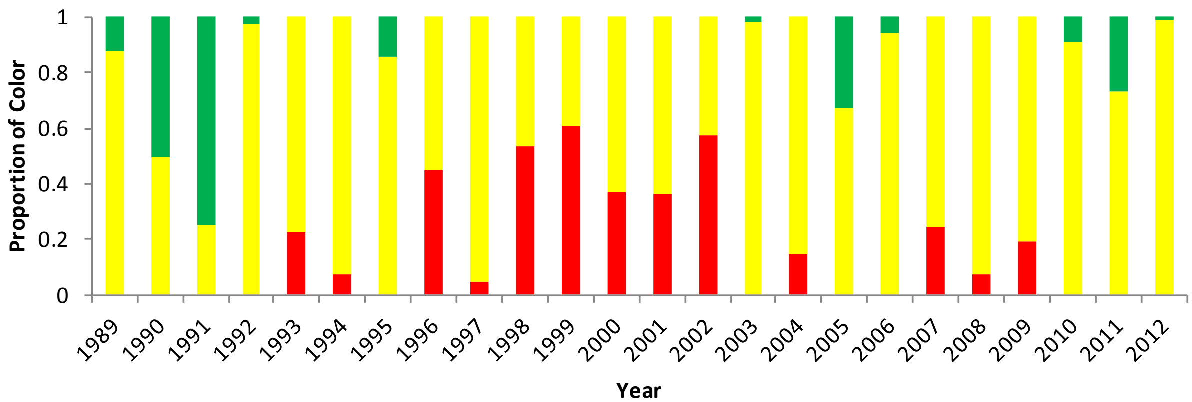


Figure 28. Stratified annual mean catch of spot in SEAMAP survey with STLA designations. Dotted lines represent the upper (LTM) and lower (60% of LTM) boundaries for TLA designation. Dotted red line is the 10th percentile trigger level.

The 10th percentile trigger for SEAMAP tripped in 1999, 2002, and 2007, which was far below the lower yellow/red reference boundary. The FTLA showed steady index level decline (through increasing proportions of red) from 1993-2002 (except one year, 1995) (Fig. 29).

Figure 29. Annual FTLA color proportions for spot from SEAMAP survey using 1989-2012 reference time period.

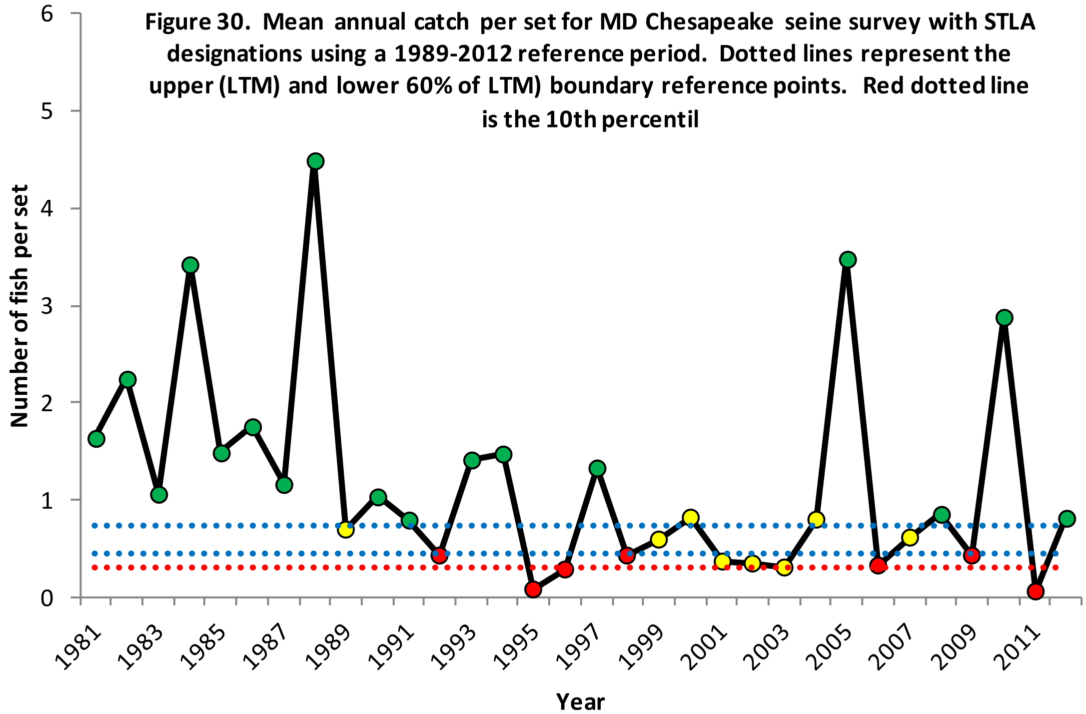


The FTLA indicated a drop below the limit reference boundary (LTM) in 1996, three years before the 10th percentile was tripped for the first time. While index values had been increasing from 2003 to the present, the high proportion of yellow indicated index values were still close to the limit reference (green/yellow) boundary. The 10th percentile trigger was too low to allow a timely response to decreasing index values, only tripping after index values reached a level well below even the red/yellow boundary from the FTLA. The FTLA, as with the other indices, provided earlier warning to decreasing values which would allow a more timely management response if warrented.

Maryland Chesapeake Bay Seine Survey

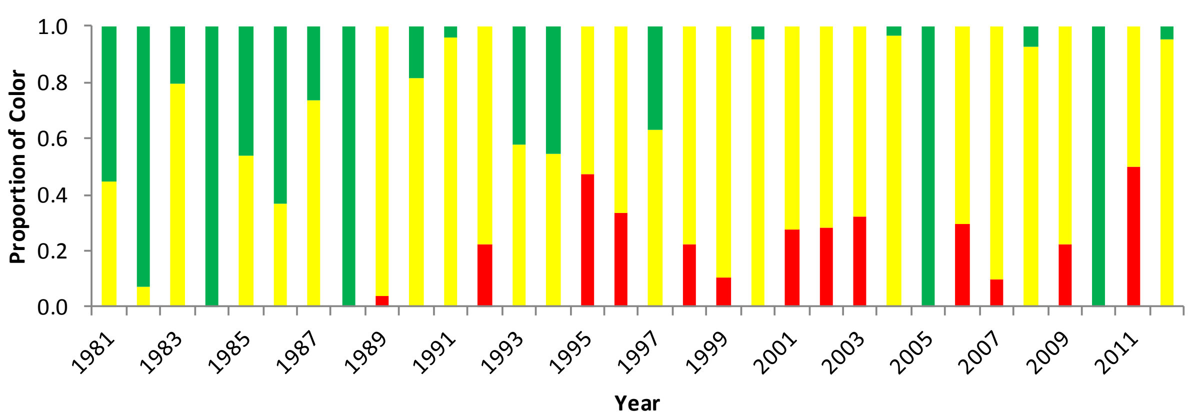
The MD JI survey was conducted in Chesapeake Bay tributaries in Maryland's portion of the bay. The index indicated a high degree of year to year variability which likely reflects variable recruitment and year-class strength (Fig. 30). Peak recruitment years occurred in 1988, 2005, and 2010, however the long term linear trend was a general decline.

Figure 30. Mean annual catch per set for MD Chesapeake seine survey with STLA designations using a 1989-2012 reference period. Dotted lines represent the upper (LTM) and lower 60% of LTM) boundary reference points. Red dotted line is the 10th percentil



The FTLA model reflects an extended period of high abundance in the mid 1980s and some periods of low catches in 1995 – 1996, 2001 – 2003 and in 2011. The FTLA showed high proportions of red the same years that the 10th percentile threshold index triggered, except during the 2001-2003 period when the 10th percentile threshold did not trigger (Table 2). The FTLA model indicates a more prolonged period of generally poor year classes from 1995-2003, a trend that has generally continued with the exception of two very strong index values in 2005 and 2010.

Figure 31. Annual FTLA color proportions for spot from Maryland Chesapeake Bay seine survey using 1989-2012 reference time period.



FTLA Composite Models Summary:

One important thing to note on the composite models is that since each indicator is additive within a given characteristic (abundance, harvest, etc) all three colors can occur within a given year for any particular composite characteristic. The abundance characteristic was separated into adult and juvenile models because of the differences in distribution and life history stage as well as year to year variability. All of the composite FTLA models were run using the 1989-2012 time period which was when all of the indicator component indices were available.

The FTLA composite for the harvest data (commercial and recreational) showed that peak harvests occurred in the early 1990's and then small peak in 2007 (Fig. 32). The increase in the proportion of red indicated a steady decrease in spot harvest beginning in 1996 continuing through 2012. The lowest harvest levels, and consequently the highest proportion of red, occurred in two of the last three years in the index.

In comparison, the FTLA composite for the adult spot catch effort (NMFS and SEAMAP indices) showed a steady decline in abundance throughout the 1990's and early 2000's (Fig. 33). The increased proportion of green in the last three years were largely driven by the four-fold increase in CPUE in the NMFS survey index, although the SEAMAP index also has increased during this time period. There is a disparity in the FTLA's between the harvest and catch effort composite indexes that, like Atlantic croaker, is likely due to differences in the age distribution of the harvest composite. Both the NMFS and SEAMAP survey catch primarily smaller, and presumably younger, spot than the recreational harvest index.

The Maryland Chesapeake seine survey is the only juvenile index currently used as a trigger index for spot and it generally reflects the typical variable annual recruitment levels seen in most estuarine fishes (Fig. 34). However, taking into consideration a 1-2 year lag in the juvenile composite index, the evident strong year-classes of juveniles in 1993-1994, 2005, and 2010 match up with several of the higher proportion green years (1994-1995, 2005, and 2010-2011). However, disparities between the two composite indexes could also be attributed to differences in geographic range as the MD survey only covers a potion of the Chesapeake Bay and both the NMFS and SEAMAP survey cover much larger geographical areas of the Atlantic coast. Adding additional juvenile indices from other estuaries within the south and mid-Atlantic to this composite index in the future may provide a better fit with the adult composite index.

In all of the current trigger indices, the FTLA offers a better tool for examining year to year changes in index values with more sensitive reference points that can be set using historic and know levels of abundance or harvest compared to the 10th percentile method currently used. The current 10th percentile trigger was rarely tripped in most of the indexes and when it was it occurred at some of the lowest values for each index. While this does provide a conservative measure for management responses or action, the triggers should be more responsive at higher levels because this would allow a management response before stock levels got to such low values.

Figure 32. Annual FTLA composite of color proportions for commercial and recreational harvest of spot on the Atlantic coast of the U.S. Data source: NMFS

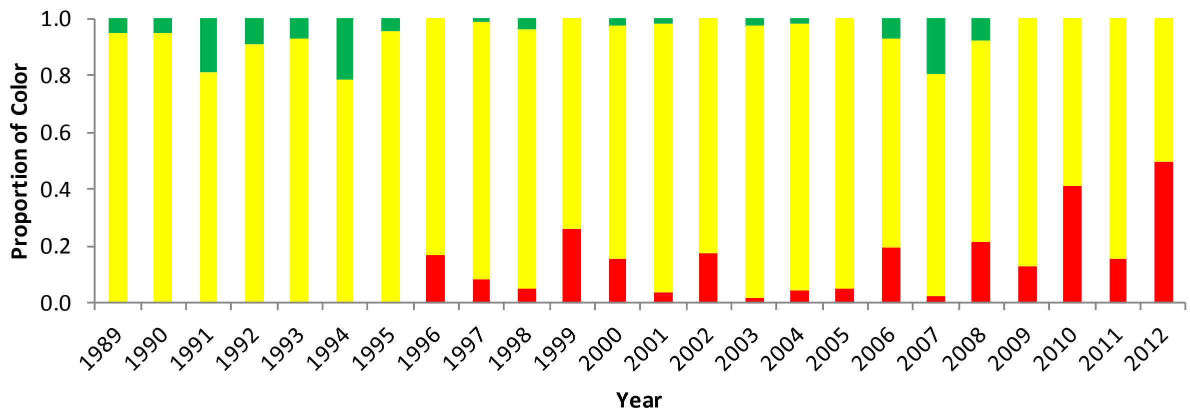


Figure 33. Annual FTLA composite of color proportions for adult spot from NMFS and SEAMAP index surveys on the Atlantic coast of the U.S. based on CPUE.

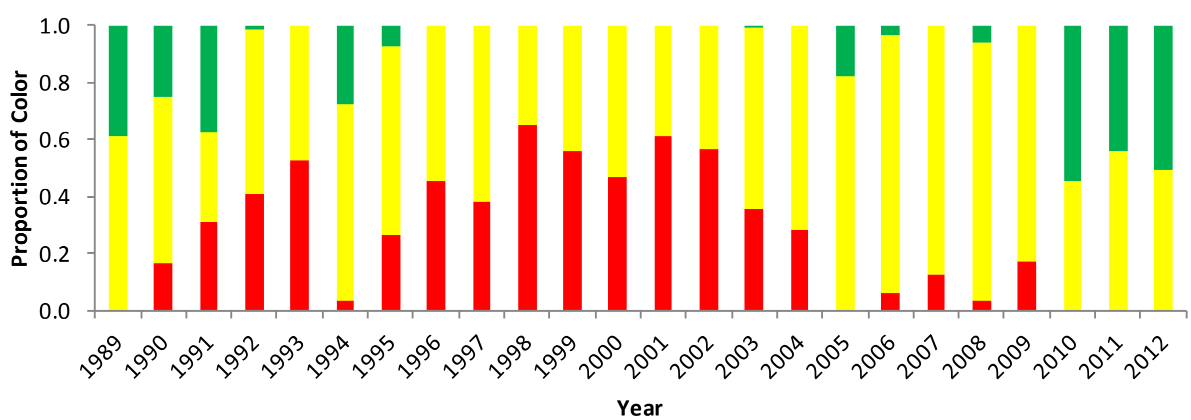
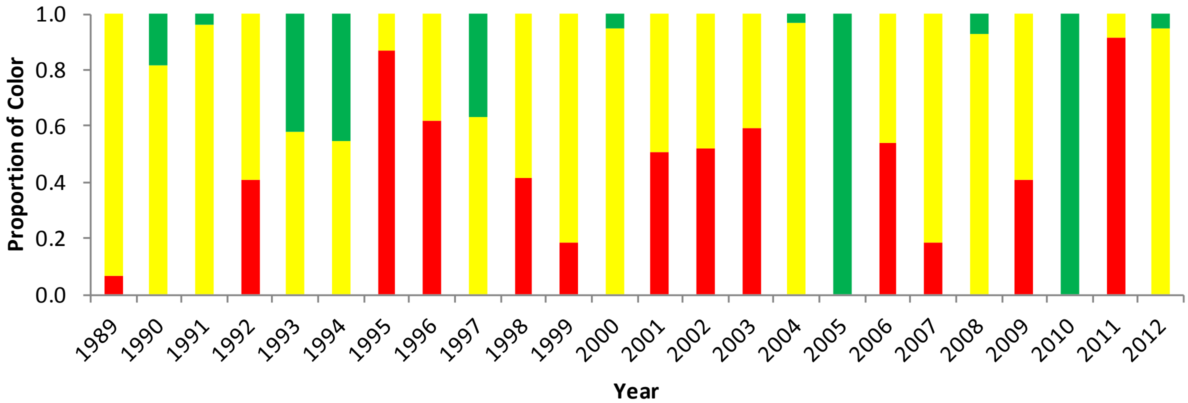


Figure 34. Annual FTLA for juvenile spot from the Maryland Chesapeake Bay seine survey using a 1989-2012 reference period.



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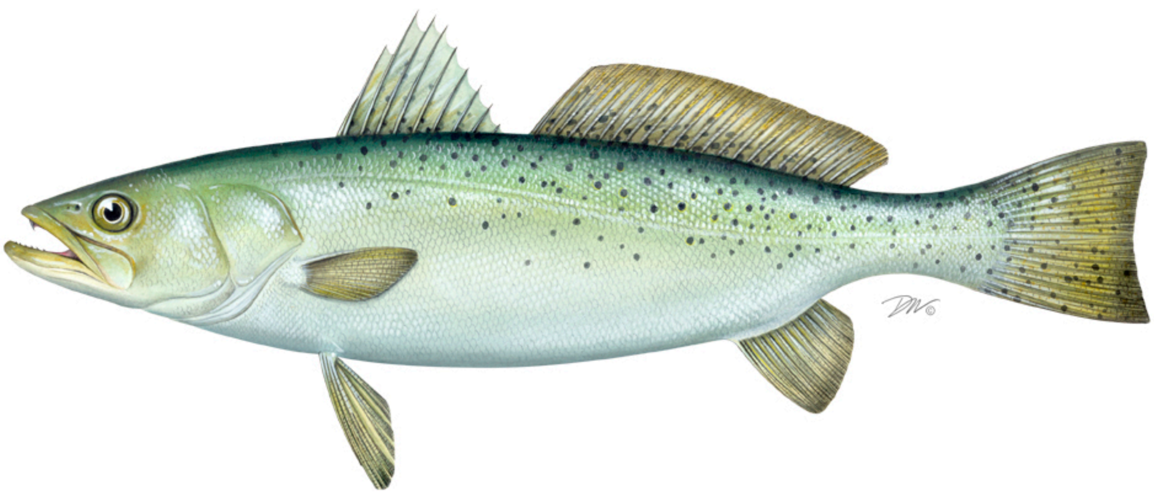
2013 REVIEW OF THE
ATLANTIC STATES MARINE FISHERIES COMMISSION
FISHERY MANAGEMENT PLAN FOR

SPOTTED SEATROUT
(Cynoscion nebulosus)

2012 FISHING YEAR



The Spotted Seatrout Plan Review Team
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Mike Murphy, Florida Fish & Wildlife Conservation Commission
Dr. Steve Arnott, South Carolina Department of Natural Resources

September 2013

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I. Status of the Fishery Management Plan

<u>Date of FMP Approval</u>: Original FMP – October 1984

<u>Amendments</u>: Amendment 1 – November 1991
Omnibus Amendment to Spanish Mackerel, Spot, and Spotted Seatrout (Amendment 2)- August 2011

<u>Management Area</u>: The Atlantic coast distribution of the resource from Maryland through the east coast of Florida

<u>Active Boards/Committees</u>: South Atlantic State/Federal Fisheries Management Board; Spotted Seatrout Plan Review Team, Omnibus Amendment Plan Development Team

The Atlantic States Marine Fisheries Commission (ASMFC) adopted the Fishery Management Plan (FMP) for spotted seatrout in 1984. The states of Florida through Maryland have a declared interest in the Commission's FMP for spotted seatrout. The ISFMP Policy Board approved Amendment 1 to this FMP in November 1991. In August of 2011, the South Atlantic State/Federal Management Board approved the Omnibus Amendment to Spanish Mackerel, Spot, and Spotted Seatrout FMPs. The Omnibus Amendment (Amendment 2) brought the Spotted Seatrout FMP under the authority of the Atlantic Coastal Fisheries Cooperative Management Act (1993) and the ASMFC Interstate Fishery Management Plan Charter (1995).

The goal of the management plan is "to perpetuate the spotted seatrout resource in fishable abundance throughout its range and generate the greatest possible economic and social benefits from its harvest and utilization over time." Plan objectives include: 1) attain over time optimum yield; 2) maintain a spawning potential ratio of at least 20% to minimize the possibility of recruitment failure; 3) promote conservation of the stocks in order to reduce the inter-annual variation in availability and increase yield per recruit; 4) promote the collection of economic, social, and biological data required to effectively monitor and assess management efforts relative to the overall goal; 5) promote research that improves understanding of the biology and fisheries of spotted seatrout; 6) promote harmonious use of the resource among various components of the fishery through coordination of management efforts among the various political entities having jurisdiction over the spotted seatrout resource; and 7) promote determination and adoption of standards of environmental quality and provide habitat protection necessary for the maximum natural protection of spotted seatrout. Amendment 2 to the Spotted Seatrout FMP added the following objectives in support of the compliance under the Act: 1) Manage the spotted seatrout fishery restricting catch to mature individuals; 2) manage the spotted seatrout stock to maintain sufficiently-high spawning stock biomass; 3) develop research priorities that will further refine the spotted seatrout management program to maximize the biological, social, and economic benefits derived from the spotted seatrout population.

Recommended management measures include a minimum size limit of 12 inches total length (TL) with comparable mesh size regulations in directed fisheries, and data collection for stock assessment and monitoring the status of the fisheries. All states with a declared interest in spotted seatrout have implemented at least the recommended minimum size limit. In addition, each state has either initiated spotted seatrout data collection programs or modified other programs to collect improved catch and effort data. Table 1 provides the states' recreational and commercial regulations for spotted seatrout in 2012.

II. Status of the Stock

A coastwide stock assessment of spotted seatrout has not been conducted given the largely non-migratory nature of the species and the lack of data on migration where it does occur. Instead, state-specific age-structured analyses of local stocks have been performed by several states. These stock assessments provide estimates of spawning potential ratio (SPR), which is a measure of the effect of fishing pressure on the relative abundance of the mature female segment of the population. The FMP recommends a goal of 20% SPR; North Carolina, South Carolina, and Georgia have adopted this goal, and Florida has established a 35% SPR goal.

Florida's stock assessments are for separate northern and southern populations. Average transitional SPR estimates for Florida's spotted seatrout during 2007-2009 were 67% in the northeast region of the state's Atlantic coast and 45% in the southeast region (Murphy et al. 2011). This assessment provided the basis for some relaxation in the management of spotted seatrout in Florida (Table 1).

The South Carolina Department of Natural Resources packaged three state-specific assessments into a report in 2001; however, these assessments were not peer reviewed. This initial assessment of South Carolina spotted seatrout covered 1986-1992 and indicated that female SPR was just above the 20% goal in the terminal year (Zhao and Wenner 2001). This assessment led to an increase in the minimum size limit and decrease in the creel limit for spotted seatrout in South Carolina. A more recent assessment of the population of South Carolina spotted seatrout was conducted for the period 1981-2004, but not peer reviewed (de Silva, Draft 2005). Two modeling approaches were used, and both models indicated that the current spawning stock biomass is below what would be required to maintain 20% SPR.

Assessments in North Carolina and Georgia spotted seatrout covered 1981-1997 and 1986-1995, respectively, and both indicated that female SPR was below the 20% goal in the terminal year (Zhao and Burns 2001, Zhao *et al.* 2001). A more recent assessment of spotted seatrout in Georgia has been performed; however, it remains unpublished. This 2002 Georgia assessment is unpublished because the results were highly questionable due to data deficiencies and changing methodologies.

North Carolina recently completed a peer reviewed stock assessment of spotted seatrout covering 1991-2008, which included all spotted seatrout caught in North Carolina and Virginia (Jensen 2009). The assessment indicated that SPR has been below 20% SPR in recent years. Jensen (2009) recommended the implementation of management measures to account for recent increases of recreational fishing and discard mortality and maintain a sufficiently large spotted seatrout population to act as a buffer against the effects of future cold stun events. Based on the assessment, North Carolina developed a draft state FMP for spotted seatrout, with the final version approved in April 2012.

III. Status of the Fishery

Both commercial and recreational fishermen regularly catch spotted seatrout from Maryland through the east coast of Florida (except in South Carolina where spotted seatrout has been declared a gamefish and can only be taken by recreational means). Landings from states north of Maryland are minimal and/or inconsistent from year to year. All catch estimates in this section include those in the management area only (MD-FL). Total recreational landings have surpassed total commercial landings every year since recreational landings have been recorded in 1981 (Figure 1). In 2009, recreational landings were more than five times the commercial landings. A coastwide (VA, NC, SC) winter mortality event in 2000/2001 likely contributed to the sudden decline in commercial and recreational landings in 2001 and 2002. Both fisheries' landings have increased since then.

Commercial Fishery
The National Marine Fisheries Service (NMFS) compiles commercial spotted seatrout landings. The data are cooperatively collected by the NMFS and state fishery agencies from state mandated trip-tickets, landing weigh-out reports from seafood dealers, federal logbooks, shipboard and portside interviews, and biological sampling of catches. See Table 2.

Atlantic coast commercial landings of spotted seatrout (1960-2012) have ranged from 165,000 pounds to 1.38 million pounds (Figure 1). Commercial landings historically came primarily from Florida and North Carolina, with Virginia, South Carolina, and Georgia accounting for a small portion of the total. From 1960 to 1976, annual commercial landings of spotted seatrout averaged 1.07 million pounds, but have declined since then due to increased regulation and possible declines in abundance. Significant changes to regulations include the 1987 designation of spotted seatrout as a gamefish in South Carolina, and the 1995 prohibition on the use of entangling nets in Florida's coastal waters. From 2002 to 2011, commercial landings have averaged approximately 292,022 pounds. North of Florida, variability in annual harvest is typical and seems to parallel the climatic conditions of the preceding winter and spring. In 2012 the commercial landings are estimated to be 408,520 pounds, representing a 161% increase from the previous year's harvest and a 39.9% increase from the previous ten-year average. North Carolina accounted for approximately 65% of the total coastwide catch, with Virginia and Florida responsible for approximately 19% and 15% of the 2012 commercial landings, respectively.

Recreational Fishery
Recreational catch statistics are collected by the NMFS recreational fisheries survey. Effort data are collected through telephone interviews. Catch data are collected through access-point angler intercept surveys. Catch per trip estimates are produced for each type of fish encountered, either observed or reported, and these estimates are combined with the effort estimates by sampling stratum to produce the catch and harvest estimates. See Tables 3, 4, and 5.

Over the last 28 years, the recreational catch of spotted seatrout (kept and released) has shown a strong upward trend, increasing from 1.1 million fish in 1981 to a peak of 8.8 million fish in 2012 (Figure 2). The recreational harvest of spotted seatrout, however, has remained relatively stable around the time series average of 1.3 million fish. The recreational harvest increased from approximately 952,458 fish in 2010 to 1.8 million in 2012. Due in part to recreational size and creel limits and closed seasons, as well as the encouragement of catch and release practices, the percentage of caught fish being released has increased to 75-87 percent of the catch since 2000. In 2012, the release percentage (79.4%) was similar to the previous 10-year average (76.3%). In 2012, Georgia anglers took the largest proportion of harvested fish with 29%, followed closely by North Carolina anglers at 27%. Recreational catches are generally made with rod and reel, but some are taken by recreational nets and by gigging, where these methods are permitted. Most recreational fishing is conducted from private boats and the majority of the catch is taken from nearshore waters.

IV. Status of Assessment Advice

A coastwide stock assessment of spotted seatrout has not been conducted and the Plan Review Team (PRT) does not recommend that one be completed due to the life history of the fish and the available data. Several states have performed age-structured analyses on local stocks of spotted seatrout. Recent Florida and North Carolina stock assessments for spotted seatrout provide divergent trends on the status of the species. The 2005 stock assessment in South Carolina indicated an increasing population trend but a status level that is still below target spawning stock biomass levels (de Silva 2005). The PRT supports the continuation of state-specific assessments, yet recognizes the difficulty most states face to attain sufficient data of a quality that can be used in the assessment process and personnel who can perform the necessary modeling exercises.

The lack of biological and fisheries data for stock assessment and effective management of the resource was recognized in the 1984 FMP and continues to be a hindrance. Some states are increasing their collection of biological and fisheries data, which should provide insight on stock status over time.

V. Status of Research and Monitoring

In addition to the commercial and recreational fishery-dependent data collected and/or compiled through the National Marine Fisheries Service, Fisheries Statistics Division, some states have implemented fishery-independent or additional fishery-dependent monitoring programs.

The Florida Fish and Wildlife Conservation Commission (FWC) implemented a juvenile finfish monitoring program in the northern Indian River Lagoon in the spring of 1990 and in the estuarine reaches of the St. Johns, St. Marys, and Nassau Rivers in northeast Florida in the spring of 2001 (FWC-FWRI 2013). Florida also initiated a stratified random sampling program in 1997 on the Atlantic coast that utilizes a 183-m haul seine to catch exploitable-sized fishes. This has been conducted in the northern Indian River and southern Indian River since initiation and in northeast Florida since 2001. Trends in the YOY abundance have been relatively stable with periods of strong recruitment evident. Recent strong recruitment appears to have occurred in Northeast Florida (2011 and 2012) but is not as evident in the central and southern areas of Florida's Atlantic coast. For 2012 sampling program, 191 lengths were measures and 131 otoliths were collected from adult sized spotted seatrout.

Florida's fishery-dependent sampling includes commercial trip-ticket information and biostatistical sampling of the commercial and recreational catch. A voluntary angler logbook program was implemented in 2002 to collect information on the lengths of spotted seatrout released alive by anglers. Recently (2011) this program changed to 'postcard' program enlisting anglers encountered at sites visited during the MRIP angler intercept survey.

Georgia collects fishery-dependent data through a Marine Sportfish Carcass Recovery Program. Data collected through this survey are used to examine trends in the size and age composition of the recreationally harvested population, valuable information for future stock assessments. For 2012, a total of 4,428 fish carcasses were donated through the program. Approximately 77% (3,431) of the carcasses were seatrout, with an average centerline (CL) length of 362.2 mm CL (minimum: 290 mm CL; maximum: 651 mm CL), were reported from 16 recovery locations.

Georgia also collects fishery-independent data through the Marine Sportfish Population Health Study, was implemented in 2003 to provide age and sex specific estimates of relative abundance in two Georgia estuaries, Wassaw Sound and the Altamaha Sound region. This trammel net survey is conducted monthly, September through November, and utilizes a hybrid random-stratified and fixed station design in which each station is sampled once in a given month. For 2012, the average centerline length in Wassaw was 362.4 mm CL and 351.0 mm CL in Altamaha.

South Carolina has an extensive directed research program on this species. Current project objectives include determining the size and age composition of the recreational catch by sampling independent angler and fishing tournament catches as well as a carcass program, and producing fisheries independent relative abundance estimates from trammel net surveys along the South Carolina coast. The latter is a stratified random sampling design and has been conducted monthly since November 1990. South Carolina also has an electrofishing survey of upper estuarine waters. It uses a stratified random design and has been operating monthly since 2001. In 2012, a total of 50 Spotted Seatrout were captured by random electrofishing sets, with a mean overall CPUE of 0.24 Spotted Seatrout per set. CPUE has generally declined in the electrofishing survey since 2009. In contrast to electrofishing, the trammel net survey, catches some YOY as well as older seatrout (S. Arnott, Personal Communication, 2011). During 2012, a total of 3,258 Spotted Seatrout were captured in random trammel net sets, with an overall mean CPUE of 3.37 Spotted Seatrout per trammel set. Additionally, South Carolina also has ongoing seatrout parasite studies (Moravec et al. 2006). Catch rates, size composition, and sub-samples of the catch on a bi-monthly basis are used for generating age-length keys for cohort specific indices of abundance. Roumillat and Brouwer (2004) have described the reproductive dynamics of female spotted seatrout in South Carolina.

North Carolina has collected age, growth, and maturity data for spotted seatrout caught in fishery-dependent and fishery-independent sampling programs since 1991. A fishery-independent monitoring program was initiated in May 2001, supported by USFWS Sports Fish Restoration funds. The program utilizes a stratified random, multi-mesh size gill net survey along North Carolina's Outer Banks, the bays of western Pamlico Sound, the Neuse, the Pamlico, Pungo, New and Cape Fear Rivers, and the Atlantic Ocean. Project objectives include calculating annual indices of abundance for important recreational fish (spotted seatrout included); supplementing samples for age, growth, and reproductive studies; evaluating catch rates and species distribution for identifying and resolving bycatch problems; and characterizing habitat utilization. Additional areas of the Neuse and Pamlico-Pungo Rivers contribute to the

Pamlico Sound Area Independent Gill Net Survey, with common objectives and sampling design. Hydrophone work was conducted in North Carolina to characterize critical spawning habitats for spotted seatrout in Pamlico Sound. For the 2012 surveying program, the overall spotted seatrout CPUE was 0.68 (n=193) for Pamlico Sound (second highest in the time series); 0.64 (n=204) for surveys in the Pamlico-Pungo, and Neuse rivers (also second highest in the time series); and 0.37 (n=45) for surveys in the Cape Fear and New Rivers. Hook-and-line and estuarine gill net discard mortality studies were conducted in North Carolina in 1998-2001, supported by Atlantic Coastal Fisheries Cooperative Management Act funds.

A spotted seatrout tagging study was initiated in September 2008 and is scheduled to conclude in August 2012. Funding for one year was to collect preliminary data necessary to design and conduct an effective long-term tagging study on spotted seatrout in North Carolina, 2008-2009 (funded by NC Sea Grant Fishery Resource Grant). This was followed by an advanced tagging study by NC State University researchers who are using a combined conventional tag and telemetry approach to study the movement and mortality of spotted seatrout in North Carolina, 2009-2012 (funded by NC Marine Resources Fund, which consists of proceeds from the sale of the Coastal Recreational Fishing License).

VI. Status of Management Measures and Issues

Changes to State Regulations

North Carolina:
Reduction in recreational bag limit from six fish to four fish and removed restriction limiting two fish to greater than 24 inches total length.

Florida

Effective September 1, 2013, the recreational seasons were dropped, the commercial season was lengthened, and the commercial possession limit was modified to accommodate twice the possession limit on a vessel occupied by two or more license fishers.

Omnibus Amendment (Interstate)
In August 2011, the Management Board approved an amendment to the Spotted Seatrout FMP to address three issues: compliance measures, consistency with federal management in the exclusive economic zone, and alignment with Commission standards. The updated FMP's objectives are to: (1.) Manage the spotted seatrout fishery restricting catch to mature individuals.(2.) Manage the spotted seatrout stock to maintain sufficiently-high spawning stock biomass. (3.) Develop research priorities that will further refine the spotted seatrout management program to maximize the biological, social, and economic benefits derived from the spot population. Through the Omnibus Amendment requires the following fishery management measures in either the recreational or commercial fisheries for states within the management unit range:
12"TL minimum size with comparable mesh size requirements

<u>De minimis Guidelines</u>

A state qualifies for *de minimis* status if its past 3-years' average of the combined commercial and recreational catch is less than 1% of the past 3-years' average of the coastwide combined commercial and recreational catch. Those states that qualify for *de minimis* are not required to implement any monitoring requirements, none of which are included in the plan.

De Minimis Requests

The state of New Jersey requests *de minimis* status. The PRT notes they meet the requirements of *de minimis*.

VII. Implementation of FMP Compliance Requirements for 2012

12'' TL minimum size with comparable mesh size requirements (both commercial and recreational)

VIII. Recommendations of Plan Review Team

Management and Regulatory Recommendations

- Increase observer coverage in states that have a commercial fishery for spotted seatrout.

Prioritized Research Recommendations

High Priority

- Conduct state-specific stock assessments to determine the status of stocks relative to the plan objective of maintaining a spawning potential of at least 20%.
- Collect data on the size or age of spotted seatrout released alive by anglers and the size and age of commercial discards.
- Continue work to examine the stock structure of spotted seatrout on a regional basis, with particular emphasis on advanced tagging techniques.
- Expand the NMFS recreational fishery survey to assure adequate data collection for catch and effort data, increased intercepts, and state add-ons of social and economic data needs.
- Conduct telemetry tagging surveys to provide precise estimates of mortality attributed to winter kills.
- Provide state-specific batch fecundity estimates for use in stock assessments.
- Develop state-specific juvenile abundance indices.
- Increase observer coverage in states that have a commercial fishery for spotted seatrout.

Medium Priority

- Identify essential habitat requirements.
- Evaluate effects of environmental factors on spawning frequency and stock density.
- Initiate collection of social and economic aspects of the spotted seatrout fishery.

IX. References

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X. Figures

Figure 1. Commercial landings (1960-2012) and recreational landings (1981-2012), in pounds, from Maryland to Florida (See Tables 2 and 4 for values and sources)

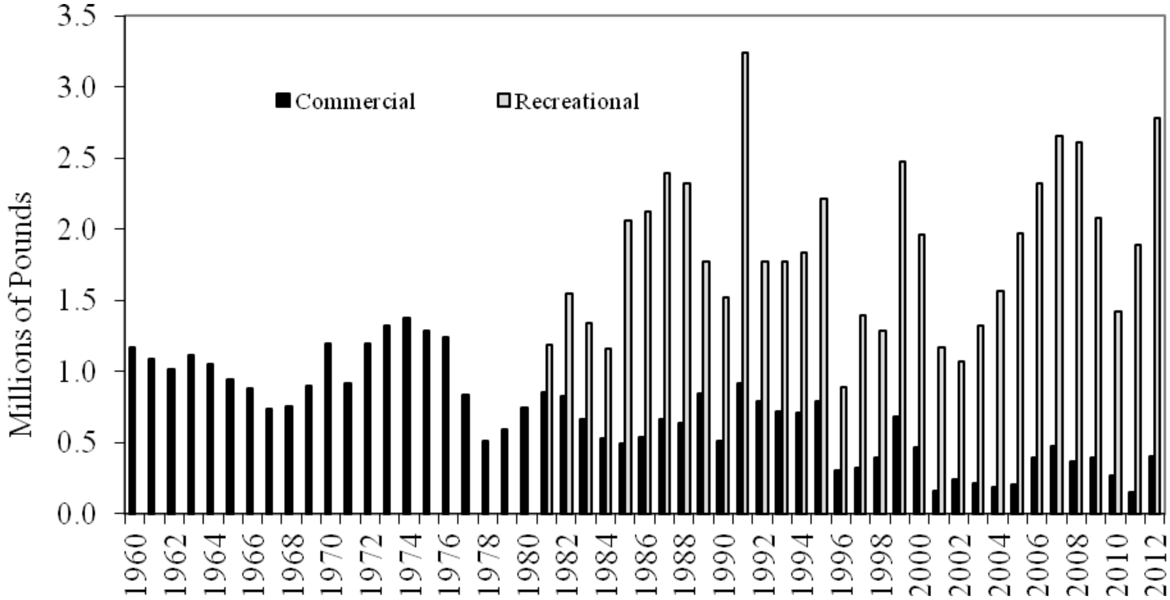
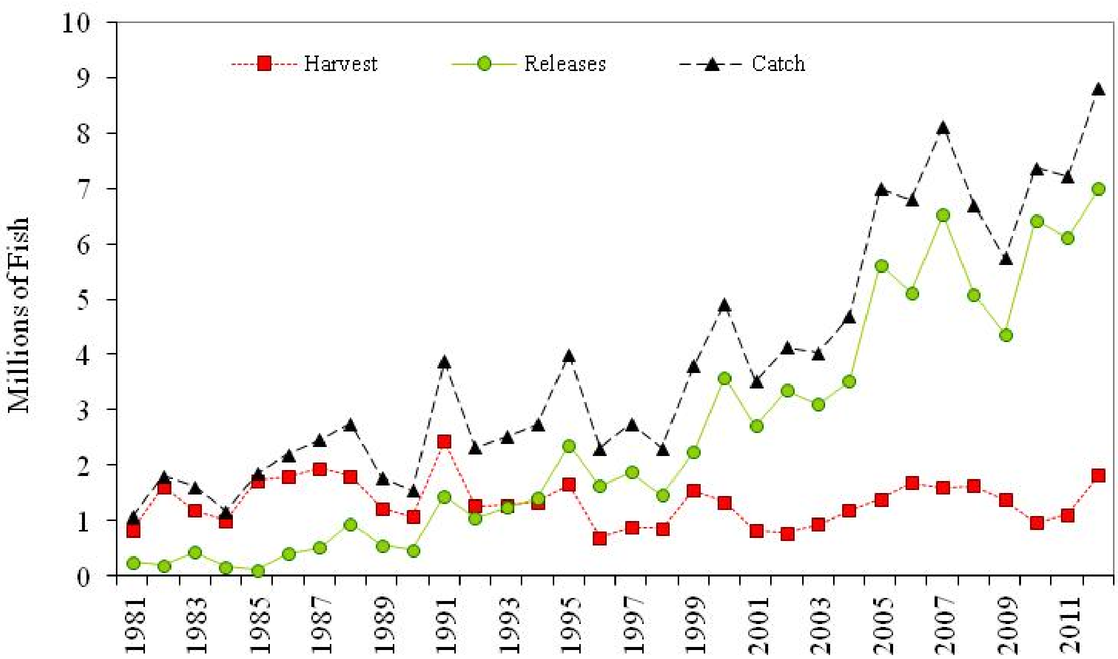


Figure 2. Recreational catch (numbers), 1981-2012, from Maryland to Florida (See Tables 3 and 5 for values and sources)



XI. Tables

Table 1. Summary of state regulations for spotted seatrout in 2012

State	Recreational	Commercial
New Jersey	13" TL; 1 fish	Gill net: 13"; open 1/1-5/20 & 9/3-10/19 & 10/27-12/31; 100 lb possession limit; 100 lb bycatch limit; mesh ≥3.25" stretched except 2.75 - 3.25" stretched allowed within 2nm for permitted fishermen doing monthly reporting. Trawl: 13"; open 1/1-7/31 & 10/13-12/31; mesh ≥3.75" diamond or 3.375 square; 100 lb possession limit' 100 lb bycatch limit. Pound net: 13"; open 1/1/-6/6 & 7/1-12/31; 150 lb bycatch limit. Hook & line: open 1/1-12/31, 13", 1 fish.
Delaware	12" TL	12" TL. Gill net restrictions.
Maryland	14" TL; 10 fish	12" TL. Minimum mesh size restrictions for trawl (3-3/8" sq. or 3-3/4" diag.) and gill nets (3").
PRFC	14" TL; 10 fish	14" TL
Virginia	14" TL; 10 fish	14" TL except pound nets and haul seines allowed 5% by weight less than 14". Hook & line - 10 fish limit. Quota: 51,104 lbs (Sept. 1-Aug. 31).
North Carolina	14" TL; 4 fish	14" TL; hook & line - 75 fish limit.
South Carolina	14" TL; 10 fish. May be taken by rod & reel year-round or gigging March-November.	Gamefish status: native caught fish may not be sold.
Georgia	13" TL; 15 fish	13" TL; 15 fish. BRD requirement for trawl; gear mesh regulations.
Florida	15-20" TL slot with 1 fish >20" allowed; north region: 6 fish limit; south region: 4 fish limit	15-24" TL; June 1-Nov 30 season (north), May 1-Sept 30 season (south); 75 fish per day or vessel (up to 150 per day if two or more licensed commercial fishers aboard); hook & line or cast net only

Note: A commercial fishing license is required to possess spotted seatrout in all states with a fishery.

Table 2. Commercial landings (pounds) of spotted seatrout by state, 1981-2012
(Source: NMFS Fisheries Statistics Division, 09/30/2013)

Year	MD	VA	NC	SC	GA	FL	Total
1981		4,000	113,304		629	736,026	853,959
1982		3,400	83,847	1,944	4,994	732,278	826,463
1983		4,400	165,360	4,479	5,795	481,535	661,569
1984		3,000	152,934	2,374	4,348	367,541	530,197
1985		8,302	109,048	1,770	7,149	369,756	496,025
1986		18,500	191,514	12,214	8,691	307,261	538,180
1987		13,300	315,380	11,941	10,739	317,044	668,404
1988		15,500	296,538	486	9,110	315,947	637,581
1989		18,500	451,909	33	10,565	361,973	842,980
1990		21,435	250,634	1,095	5,942	236,453	515,559
1991	98	21,200	660,662		7,380	225,812	915,152
1992	364	10,395	526,271		11,310	247,189	795,529
1993	24	38,033	449,886		8,550	223,931	720,424
1994	30	44,636	412,458		5,112	247,666	709,902
1995	182	28,722	574,410		8,482	184,269	796,065
1996	14,961	4,476	226,668		7,501	48,254	301,860
1997	15,688	11,711	232,583		7,621	57,316	324,919
1998	19,794	21,774	307,777		2,845	41,556	393,746
1999	36,365	38,513	546,775		3,244	61,802	686,699
2000	20,270	19,918	376,657		1,997	45,392	464,234
2001	24,754	3,773	105,797			30,234	164,558
2002	11,771	9,308	175,643		969	44,640	242,331
2003	902	5,310	181,529			27,075	215,676
2004	342	17,290	131,019		815	29,605	187,700
2005	2,410	21,448	129,645			36,762	210,280
2006	245	28,529	312,714			36,687	398,897
2007	32	41,003	374,817	0	0	46,838	476,804
2008	0	43,666	304,504	0	0	20,887	369,057
2009	243	27,762	320,336	0	0	46,297	394,695
2010		28,346	200,562			39,374	268,282
2011	557	17,107	75,239			63,592	156,495
2012	1890	79,490	265,476	0	0	61,664	408,520

Table 3. Recreational harvest (numbers of fish) of spotted seatrout by state, 1981-2012 (Source: NMFS Fisheries Statistics Division, 09/30/2013)

Year	MD	VA	NC	SC	GA	FL	Total
1981			30,037	20,934	189,080	576,847	816,898
1982			112,023	849,634	226,758	426,378	1,614,793
1983			91,956	121,940	325,655	645,120	1,184,671
1984			90,262	95,281	114,403	700,876	1,000,822
1985			263,878	347,851	251,764	866,162	1,729,655
1986	7,507	82,671	270,867	477,136	401,490	550,591	1,790,262
1987	29,295	17,415	320,977	392,329	439,782	744,330	1,944,128
1988	20,769	288,705	420,115	355,547	389,276	331,709	1,806,121
1989	151,986	66,033	181,149	174,011	448,767	198,617	1,220,563
1990	20,416	67,939	251,088	113,160	368,787	249,824	1,071,214
1991	17,995	69,032	316,895	438,502	1,204,116	385,817	2,432,357
1992	3,235	30,091	333,990	200,030	338,175	363,238	1,268,759
1993	7,038	103,131	206,523	222,144	463,702	274,118	1,276,656
1994	33,511	115,025	457,636	139,551	337,965	255,216	1,338,904
1995	19,198	90,838	325,927	223,751	607,095	381,884	1,648,693
1996	35,765	46,098	151,380	137,530	171,676	148,571	691,020
1997	19,951	92,725	256,719	111,576	167,287	228,096	876,354
1998	13,620	34,623	294,501	125,038	197,293	189,621	854,696
1999	2,112	138,492	410,321	101,260	655,407	241,096	1,548,688
2000	1,634	90,135	250,450	219,740	486,673	288,443	1,337,075
2001		13,447	182,124	63,452	309,487	250,987	819,497
2002		16,303	197,484	84,777	271,357	206,310	776,231
2003	2,091	102,484	106,415	123,027	425,993	169,587	929,597
2004		74,747	316,894	247,156	336,254	199,523	1,174,574
2005	3,828	31,416	512,262	268,467	231,429	337,744	1,385,146
2006	5,136	56,475	577,537	294,096	453,394	299,337	1,685,975
2007		145,736	525,156	122,419	499,709	302,625	1,595,645
2008		79,545	584,024	175,975	623,619	160,455	1,623,618
2009	11,680	40,109	509,416	147,266	478,895	182,752	1,370,118
2010	3,146	17,417	195,065	101,053	384,077	251,455	952,213
2011	3,058	247,736	215,922	66,207	289,950	286,501	1,109,374
2012	6,032	125,627	500,522	234,921	526,604	427,469	1,821,175

Table 4. Recreational harvest (pounds of fish) of spotted seatrout by state, 1981-2012
(Source: NMFS Fisheries Statistics Division, 09/30/2013)

Year	MD	VA	NC	SC	GA	FL	Total
1981			63,036	14,808	138,720	967,921	1,184,485
1982			120,045	588,999	177,847	660,295	1,547,186
1983			96,359	138,442	323,889	784,531	1,343,221
1984			39,861	116,118	141,306	866,077	1,163,362
1985			288,088	509,551	234,704	1,032,344	2,064,687
1986	4,960	64,394	328,439	587,570	440,774	695,168	2,121,305
1987	22,511	38,495	366,442	592,612	491,317	883,707	2,395,084
1988	36,629	460,378	390,836	448,473	536,959	453,063	2,326,338
1989	184,318	112,344	259,726	277,489	608,009	328,338	1,770,224
1990	39,059	121,136	282,872	174,845	423,815	475,045	1,516,772
1991	34,753	121,604	472,397	628,011	1,449,853	534,371	3,240,989
1992	7,802	56,685	508,760	227,210	430,946	543,491	1,774,894
1993	12,800	201,562	307,151	268,055	586,426	392,827	1,768,821
1994	26,764	175,184	679,996	183,343	412,392	357,441	1,835,120
1995	31,464	148,544	478,674	247,987	667,379	642,670	2,216,718
1996		77,269	197,261	171,727	196,487	249,898	892,642
1997	32,963	261,911	311,891	163,771	242,506	380,276	1,393,318
1998	37,189	61,888	444,441	151,718	262,896	329,793	1,287,925
1999		290,694	690,606	146,277	916,860	428,061	2,472,498
2000	2,972	195,544	385,190	267,297	565,903	545,202	1,962,108
2001		26,733	213,438	58,885	369,083	502,254	1,170,393
2002		28,882	274,100	111,954	302,559	353,693	1,071,188
2003	3,494	218,061	145,936	140,276	502,278	316,279	1,326,324
2004		134,602	385,624	229,541	377,370	390,880	1,518,017
2005	10,761	76,325	628,739	326,501	263,209	603,891	1,909,426
2006	9,993	132,629	941,161	369,165	531,441	533,121	2,517,510
2007		305,599	988,527	211,225	531,637	594,506	2,631,494
2008		195,987	922,733	302,019	733,307	298,679	2,452,725
2009	13,261	85,358	833,568	199,554	579,270	322,941	2,033,952
2010	6,724	28,146	407,193	138,514	425,854	411,495	1,418,046
2011	4,664	549,976	403,160	116,979	353,472	464,863	1,893,114
2012	10,257	226,556	817,451	388,105	518,189	819,009	2,779,567

Table 5. Recreational releases (number of fish) of spotted seatrout by state, 1981-2012
(Source: NMFS Fisheries Statistics Division, 09/30/2013)

Year	MD	VA	NC	SC	GA	FL	Total
1981				5,522	36,853	209,059	251,434
1982				8,007	17,645	171,093	196,745
1983			16,579	32,860	12,038	367,881	429,358
1984			30,173	44,436	16,174	76,346	167,129
1985			16,578	6,409	22,917	66,960	112,864
1986	13,639	28,606	19,792	115,315	189,798	35,646	402,796
1987		30,070	136,104	130,253	176,415	41,391	514,233
1988	26,999	148,934	74,818	78,568	182,628	431,665	943,612
1989	52,859	11,977	82,909	54,279	167,025	187,406	556,455
1990	4,874	23,435	84,235	35,223	114,624	203,439	465,830
1991	21,811	40,550	169,921	51,415	369,972	789,779	1,443,448
1992	701	19,855	139,616	97,813	192,261	597,254	1,047,500
1993		65,605	149,744	92,101	146,665	780,573	1,234,688
1994	32,466	243,463	207,262	220,941	125,421	574,629	1,404,182
1995	157,530	327,643	277,896	194,996	327,835	1,074,703	2,360,603
1996	51,594	165,169	153,051	107,691	63,585	1,081,893	1,622,983
1997	4,826	168,964	98,377	89,147	61,148	1,449,278	1,871,740
1998	49,460	74,569	73,024	151,935	100,059	1,005,443	1,454,490
1999	7,082	152,120	253,442	92,792	160,801	1,577,378	2,243,615
2000	4,805	264,550	90,070	368,332	547,765	2,310,491	3,586,013
2001		110,308	194,982	38,709	365,140	1,995,635	2,704,774
2002		136,265	385,162	147,962	357,953	2,326,420	3,353,762
2003		207,270	131,619	314,642	737,730	1,707,957	3,099,218
2004	9,430	295,518	300,025	333,537	608,193	1,969,884	3,516,587
2005	4,612	277,307	817,036	395,483	678,057	3,446,336	5,618,831
2006	9,721	125,135	559,786	666,865	872,395	2,889,495	5,123,397
2007	2,231	414,709	973,516	560,272	957,682	3,623,247	6,531,657
2008		373,146	1,005,298	850,006	719,622	2,140,752	5,088,824
2009	30,381	171,028	1,213,526	398,971	915,301	1,641,702	4,370,909
2010	107,017	550,118	1,684,872	407,228	742,215	2,937,411	6,428,861
2011	7,685	1,214,620	1,916,249	279,969	552,123	2,141,212	6,111,858
2012	55,183	428,540	1,646,512	817,017	1,029,479	3,025,556	7,002,287

2013 REVIEW OF THE ATLANTIC STATES MARINE FISHERIES COMMISSION FISHERY MANAGEMENT PLAN FOR

SPANISH MACKEREL
(*Scomberomorus maculatus*)

2012 FISHING YEAR

Prepared by the
Spanish Mackerel Plan Review Team
Kirby Rootes-Murdy, Atlantic States Marine Fisheries Commission, Chair
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I. Status of the Plan

The Fishery Management Plan (FMP) for the Coastal Migratory Pelagic Resources (1983 and subsequent amendments) and the Interstate Fishery Management Plan for Spanish Mackerel (1990) manage Atlantic group Spanish mackerel in federal and state Atlantic waters from New York through the east coast of Florida. All states in that range, excluding Pennsylvania, have a declared interest in the Interstate FMP for Spanish Mackerel. The South Atlantic State/Federal Fisheries Management Board serves as the Commission's Spanish Mackerel Management Board. The Interstate FMP for Spanish Mackerel is a flexible document intended to track the federal FMP; thus, the South Atlantic Fishery Management Council (SAFMC) has the lead on Atlantic group Spanish mackerel management.

The SAFMC manages Atlantic group Spanish mackerel based on guidance from its Scientific and Statistical Committee (SSC). The SAFMC determines needed adjustments to regulatory measures, including allowable catch, bag limits, size limits, and trip limits. The SAFMC deliberations are assisted by a Mackerel Committee that includes representatives from the Mid-Atlantic Fishery Management Council, and an Advisory Panel with South Atlantic and Mid-Atlantic industry representation.

The SAFMC approved Amendment 18 to the Coastal Migratory Pelagic Resources FMP in December 2011 which established a new ABC based on the SSC recommendation of using median landings of the last 10 years (2001-2011). With this change, the Allowable Biological Catch (ABC) is set equal to the Annual Catch Limit (ACL) and Optimum Yield (OY) [ABC=ACL=OY] at approximately 5.29 million lbs. With this the commercial ACL= 3.13 million lbs and the recreational ACL=2.56 million lbs.

Under the federal FMP, the 2012-2013 fishing year ran from March 1, 2012 to February 29, 2013. The federal FMP divides the commercial fishery into a quota system between the Atlantic and Gulf migratory groups. Within the Atlantic migratory group, there are two zones- the Northern (consisting of the states from New York through Georgia) and the Southern (Florida). For the Atlantic migratory group, the 2012/2013 year, the full quota was 3.13 million pounds and the adjusted quota was 2.88 million pounds. The adjusted quota is used to determine trip limit reductions. The federal commercial trip limit was a year-round 3,500 pound daily possession/landings limit for the states from New York through Georgia. Florida's commercial trip limit varies depending on the season and percent of quota remaining. The recreational bag limit was set at 15 fish. The minimum size limit for both fisheries was 12" fork length or 14" total length.

The goals of the interstate FMP are to complement federal management in state waters, to conserve the Atlantic group Spanish mackerel resource throughout its range, and to achieve compatible management among the states that harvest Spanish mackerel. In accordance with the 2011 Omnibus Amendment, the updated FMP's objectives are to: (1.) Manage the Spanish mackerel fishery by restricting fishing mortality to rates below the threshold fishing mortality rates to provide adequate spawning potential to sustain long-term abundance of the Spanish mackerel populations. (2.) Manage the Spanish mackerel stock to maintain the spawning stock biomass above the target biomass levels. (3.) Minimize endangered species bycatch in the Spanish mackerel fishery. (4.) Provide a flexible management system that coordinates management activities between state and federal waters to promote complementary regulations throughout Spanish mackerel's range 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. (5.) Develop research priorities that will further refine the Spanish mackerel management program to maximize the biological, social, and economic benefits derived from the Spanish mackerel population. See Table 1 for state Spanish mackerel regulations in 2012.

II. Status of the Stocks

The Atlantic coast Spanish mackerel resource is not experiencing overfishing and the stock is overfished (SEDAR. 2012). As updated the SEDAR 28 Stock Assessment Report, using the Beaufort Assessment Model (BAM) the current stock biomass is estimated to be $SSB_{2011}/MSST=2.29$. The current level of fishing (exploitation rate) was $F_{2009\text{-}2011}/F_{MSY}=0.526$, with $F_{2011}/F_{MSY}=0.521$. The overfished ratio ($B/\ B_{MSY}$) shows that the biomass declined as a result of the high fishing mortality but has increased in recent years and remains above B_{MSY} (Figure 1). The overfishing ratio (F/Fmsy) shows that fishing mortality increased from the late 1970s through 1994 but has since declined (Figure 2). Fishery-dependent data also indicate an increasing biomass trend (except during the last four years which show a decline). The current fishing mortality rate does not seem to be inhibiting stock growth.

III. Status of the Fishery

Spanish mackerel are an important recreational and commercial fishery in South Atlantic waters, and are taken as far north as Massachusetts, although recreational landings north of Maryland are limited and sporadic (Tables 2 and 5). Trip limits implemented in state and federal waters continue to prevent premature closure of the commercial fishery. Total landings of Spanish mackerel in 2012 are estimated at 4.73 million pounds (compared to the 5,29 million pound limit). The commercial fishery harvested approximately 69.5% of the total, and the recreational fishery about 30.5%.

From 1960 to 2012, commercial landings of Atlantic coast Spanish mackerel have ranged between 1.9 and 11.1 million pounds, although that range is limited to between 1.9 and 6.0 million pounds if the unusually large harvests in 1976-77 and 1980 are excluded. Since 1981, landings have averaged 3.65 million pounds (Figure 3). Coastwide commercial landings have generally been below 4 million pounds since 1995 (exception of 2010; landings of 4.53 million pounds); this coincided with the entanglement net ban in Florida. Gill nets were the dominant commercial gear in Florida prior to the ban. After the ban was instituted, the use of cast nets has increased. Coastwide, cast nets took 28% of the commercial harvest in 2012, as compared to the 40% taken with gillnets and 30% taken with line gears (Table 3). The 2012 commercial landings were 3.54 million pounds, of which 2.58 million pounds were landed in Florida (73% of the harvest). North Carolina harvested approximately 26% of the total 2012 landings (Table 2).

Recreational anglers harvested an estimated 835,263 Spanish mackerel (1.2 million pounds) in 2012, about 41% fewer fish than in 2008 (Tables 4 and 5). The number of recreationally harvested fish appears to show a cyclical trend, with low harvests in the early to mid 80s and mid to late 90s, interspersed with higher harvests (Figure 4). Florida and North Carolina continue to account for the majority of recreational landings in both number and weight, averaging 86.5% of total landings since the time series began in 1981. In 2012, Florida harvested 30% of the total number of fish and North Carolina 59%. The number of recreational releases of Spanish mackerel has generally increased over time, reaching a peak of over one million fish in 2008 (Table 6, Figure 4).

IV. Status of Assessment Advice

The most recent stock assessment was completed in 2012 through the SouthEast Data, Assessment, and Review (SEDAR) process (SEADR 2012). The input data (through 2011) were applied to two assessment models, with the primary model a statistical catch at age model, the Beaufort Assessment Model (BAM); while the a secondary surplus-production model (ASPIC) provided a comparison of model results. The Review Panel concluded that the statistical catch at age model was the most appropriate model to characterize the stock status for management purposes.

The Council's Scientific and Statistical Committee (SSC) reviewed the assessment during its December 2012 meeting and accepted the SEDAR 28 Spanish Mackerel stock assessment as best available science. The SSC concurred with the Review Panel's conclusion that the stock is not experiencing overfishing and the stock is not overfished.

V. Status of Research and Monitoring

The National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) continues to monitor length and weight at age and size frequencies, fishing mortality, and migration; collect age data and catch per unit effort by area, season, fishery, and gear; monitor shrimp trawl bycatch; investigate methods to predict year class strength; calculate estimates of recruitment, and develop conservation gear to reduce bycatch. The NMFS is also collecting discard data through a bycatch logbook in the mackerel and snapper-grouper fisheries. The Gulf and South Atlantic Fisheries Development Foundation and several states (North Carolina, South Carolina, Georgia, and Florida) have evaluated finfish bycatch in the southeastern shrimp trawl fishery, including bycatch of Spanish mackerel. The South Atlantic component of the Southeast Area Monitoring and Assessment Program (SEAMAP) collects Spanish mackerel data in its coastal trawl survey from Cape Hatteras to Cape Canaveral. Additionally, the Northeast Area Monitoring and Assessment Program (NEAMAP) began regular spring and fall surveys between Martha's Vineyard and Cape Hatteras in the fall of 2007.

Abundance trends continue to be monitored primarily through fishery-dependent sources. The states and the SEFSC monitor catch data through the cooperative commercial statistics collection program and the recreational fisheries survey. Commercial trip reports are tallied more frequently in the winter and early spring by the state of Florida and the NMFS as the commercial quota is approached.

VI. Status of Management Measures

2008 Framework Adjustment (Federal)

In February 2008, NOAA Fisheries finalized a framework adjustment to change the beginning date for trip limits in the Atlantic Spanish mackerel fishery off the east coast of Florida. The 3,500 pound trip limit begins March 1 each year to correspond with the beginning of the fishing year (as changed in Amendment 15).

Omnibus Amendment (Interstate)

In August 2011, the Management Board approved an amendment to the Spanish Mackerel FMP to address three issues: compliance measures, consistency with federal management in the exclusive economic zone, and alignment with Commission standards. Through the Omnibus

Amendment, the following fisheries management measures are required for states within the management unit range;

Recreational Fishery

- 12” Fork Length (FL) or 14” Total Length (TL) minimum size limit
- 15 fish creel limit
- Must be landed with head and fins intact
- Calendar year season
- Prohibited gear: Drift gill nets prohibited south of Cape Lookout, NC
- Decrease in the recreational quota the following year via reduced bag limits if the Total Annual Catch Limit (ACL) is exceeded and stock is overfished.

Commercial Fishery

- Prohibited: purse seines; drift gill nets south of Cape Lookout, NC
- 12” FL or 14” TL minimum size limit
- March 1 – end of February season
- Trip limits (per vessel, per day)
  NY-GA: 3500 lbs
  FL: 3500 lbs, 3/1-11/30;
  3500 lbs Mon-Fri & 1500 lbs Sat-Sun, 12/1 until 75% adjusted quota taken;
  1500 lbs, when 75% adjusted quota taken until 100% adjusted quotas taken;
  500 lbs after 100% of adjusted quotas taken (the adjusted quota compensates for estimated catches of 500 lbs per vessel per day to the end of the season)
- Commercial quotas decreased the following year if Total ACL is exceeded and stock is overfished

Amendment 18 (Federal)

In August 2011, The Gulf of Mexico, South Atlantic, and Mid-Atlantic Fishery Management Councils approved Amendment 18 to the Coastal Migratory Pelagics FMP. The primary action under consideration established Annual Catch Limits (ACLs) and Accountability Measures (AMs) for the cobia, king mackerel, and Spanish mackerel. The amendment designates ACLs and ACTs for each of the two migratory groups of Spanish mackerel (Atlantic and Gulf). For the Atlantic migratory group, the commercial sector ACL is set equivalent to the commercial sector quota of 3.13 million pounds. The AM for the commercial sector is that the commercial sector will close when the commercial quota is reached or projected to be reached. In addition, current trip limit adjustments will remain in place. When the commercial sector closes, harvest and possession of Spanish mackerel would be prohibited for persons aboard a vessel for which a commercial permit for Spanish mackerel has been issued.

For the recreational sector, the ACT is set to 2.32 million pounds, while the ACL is set at 2.56 million pounds. Regarding the AM, if the stock ACL is exceeded in any year, the bag limit will be reduced the next fishing year by the amount necessary to ensure recreational landings achieve the recreational ACT, but do not exceed the recreational ACL in the following fishing year. A payback will be assessed if the Atlantic migratory group Spanish mackerel is determined to be overfished and the stock ACL is exceeded. The payback will include a reduction in the sector ACL for the following year by the amount of the overage by that sector in the prior fishing year.

VII. Implementation of FMP Compliance Requirements for 2012

All states must implement the requirements specified in section 5 (5.1 Mandatory Compliance Elements for States; 5.1.1 Mandatory Elements of State Programs; 5.1.1.1 Regulatory Requirements). The PRT finds all states in compliance.

De minimis Guidelines

A state qualifies for *de minimis* status if its past 3-years' average of the combined commercial and recreational catch is less than 1% of the past 3-years' average of the coastwide combined commercial and recreational catch. Those states that qualify for *de minimis* are not required to implement any monitoring requirements, none of which are included in the plan.

De Minimis Requests

The states of New York, New Jersey, Delaware, Georgia request *de minimis* status. The PRT notes these states meet the requirements of *de minimis*.

VIII. Recommendations of the Plan Review Team

Research and Monitoring Recommendations

High Priority

- Length, sex, age, and CPUE data are needed for improved stock assessment accuracy. Simulations on CPUE trends should be explored and impacts on VPA and assessment results determined. Data collection is needed for all states, particularly those north of North Carolina.
- Evaluation of weight and especially length at age of Spanish mackerel.
- Development of fishery-independent methods to monitor stock size of Atlantic Spanish mackerel (consider aerial surveys used in south Florida waters).
- More timely reporting of mid-Atlantic catches for quota monitoring.
- Provide better estimates of recruitment, natural mortality rates, fishing mortality rates, and standing stock. Specific information should include an estimate of total amount caught and distribution of catch by area, season, and type of gear.
- Develop methodology for predicting year class strength and determination of the relationship between larval abundance and subsequent year class strength.
- Commission and member states should support and provide the identified data & input needed to improve the SAFMC's SEDAR process.
- The full implementation of ecosystem-based management and the implementation of monitoring /research efforts needed to support ecosystem-based management needs should be conducted.

Medium Priority

- Yield per recruit analyses should be conducted relative to alternative selective fishing patterns.
- Determine the bycatch of Spanish mackerel in the directed shrimp fishery in Atlantic Coastal waters (partially met: Branstetter, 1997; Ottley et al., 1998; Gaddis et al., 2001;Page et al., 2004).
- Evaluate potential bias of the lack of appropriate stratification of the data used to generate age-length keys for Atlantic and Gulf Spanish mackerel.
- Evaluate CPUE indices related to standardization methods and management history, with emphasis on greater temporal and spatial resolution in estimates of CPUE.

- Consideration of MRFSS add-ons or other mechanisms for collection of socioeconomic data for recreational and commercial fisheries.
- Determine normal Spanish mackerel migration routes and changes therein, as well as the climatic or other factors responsible for changes in the environmental and habitat conditions which may affect the habitat and availability of stocks.
- Determine the relationship, if any, between migration of prey species (i.e., engraulids, clupeids, carangids), and migration patterns of the Spanish mackerel stock.

Low Priority

- Final identification of Spanish mackerel stocks through multiple research techniques.
- Complete research on the application of assessment and management models relative to dynamic species such as Spanish mackerel.
- Delineation of spawning areas and areas of larval abundance through temporal and spatial sampling.

IX. References

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X. Figures

Figure 1. Estimated total biomass (metric tons) at start of year. Horizontal dashed line indicates B_{MSY}. (SEDAR 2012).

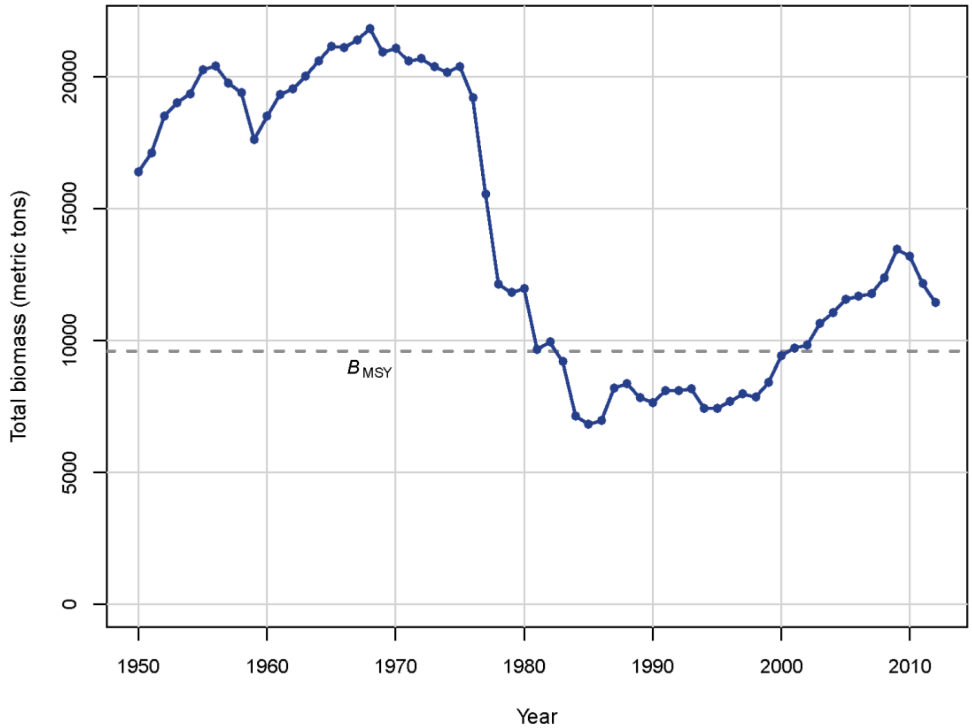


Figure 2. Estimated time series of Atlantic group Spanish mackerel fishing mortality rate (F) relative to F_{MSY} benchmark. Solid line indicates estimates from base run of the Beaufort Assessment Model; gray error bands indicate 5th and 95th percentiles of the Monte Carlo Bootstrap analysis trials (SEDAR 2012).

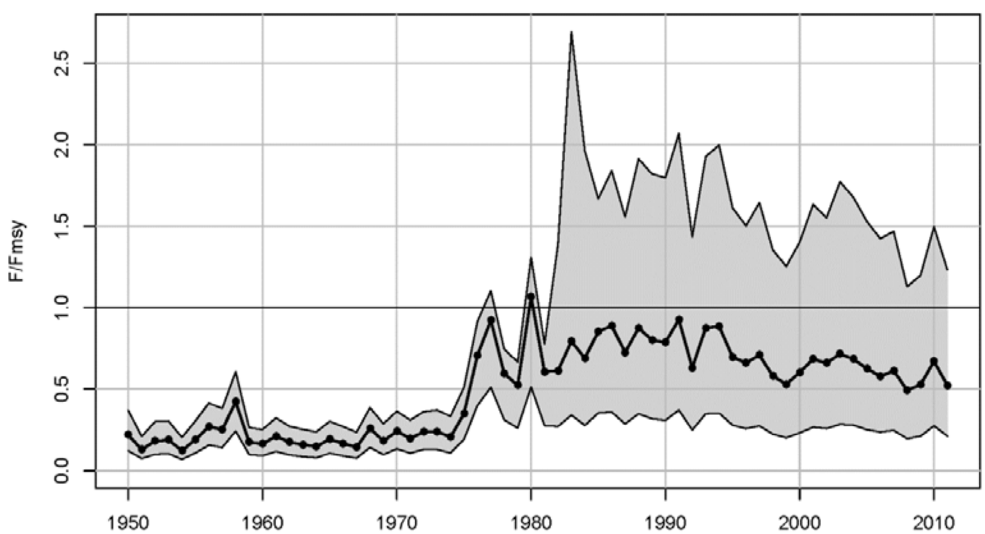


Figure 3. Commercial and recreational harvest (pounds) of Spanish mackerel, 1960-2012
(Recreational data available from 1981-present only; see Tables 2 and 5 for values and sources)

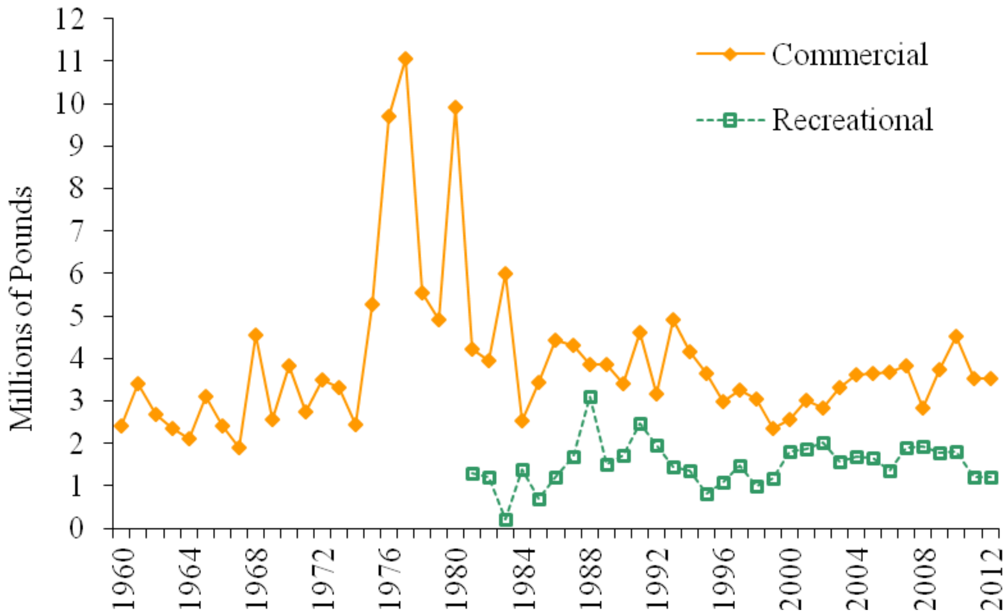
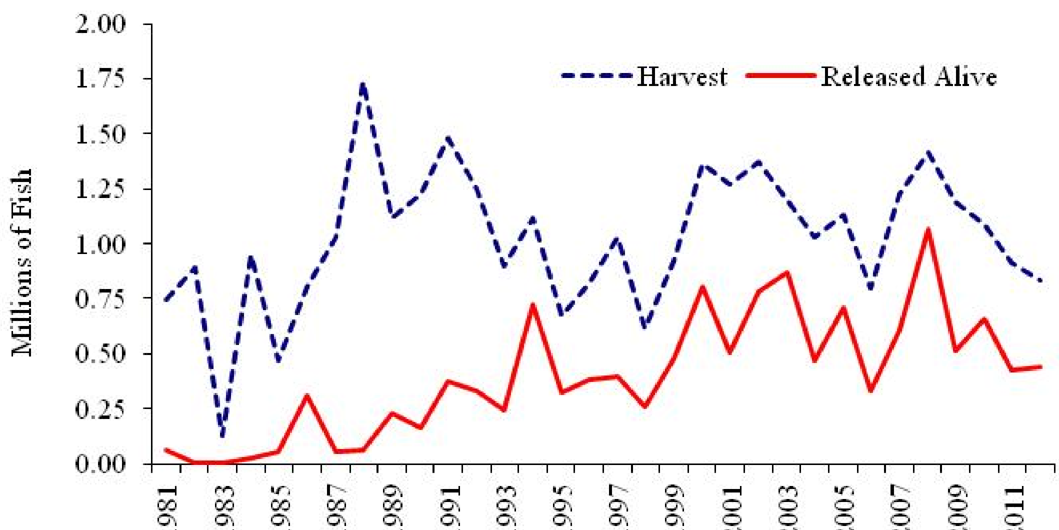


Figure 4. Recreational harvest and releases (numbers of fish) of Spanish mackerel, 1981-2012
(See Tables 4 and 6 for values and sources)



XI. Tables

Table 1. Summary of state regulations for Spanish mackerel in 2012
Notes: A commercial license is required to sell Spanish mackerel in all states; other general gear restrictions apply to the harvest of Spanish mackerel.

State	Recreational	Commercial
NY	14" TL, 15 fish	14" TL. 3,500 lb trip limit
NJ	14" TL, 10 fish	14" TL.
DE	14"TL, 15 fish	14" TL.
MD	14" TL, 15 fish	14" TL.
PRFC	14" TL, 15 fish	14" TL. Closure if/when federal waters close.
VA	14" TL, 15 fish	14" TL. 3,500 lb trip limit. Closure if/when federal waters close.
NC	12" FL, 15 fish	12" FL. 3,500 lb trip limit (Spanish and king mackerel combined). Purse gill nets prohibited.
SC	12" FL, 15 fish	12" FL. 15 fish. Closure if/when federal waters close.
GA	12" FL, 15 fish	12" FL. 15 fish. Closure from December 1 - March 15.
FL	12" FL, 15 fish. Transfer to other vessels at sea is prohibited. Cast nets less than 14’ and beach or haul seines with no greater than 2” stretched mesh allowed	12" FL. Trip limits: April 1 until Nov. 30 - 3500 lb; Dec. 1 until 75% of adjusted quota reached – 3500 lb Mon-Fri. & 1500 lb Sat-Sun; >75% adjusted quota until quota filled -1500 lb; > 100% of adjusted quota - 500 lb. Restricted Species Endorsement Required Transfer of fish between vessels prohibited Allowed gear: beach or haul seine, cast net, hook and line, or spearing

Table 2. Commercial landings (pounds, calendar year) of Spanish mackerel by state, 1981-2012
(Source: NMFS Fisheries Statistics Division, 10/25/2013)

Year	MA	RI	NY	NJ	MD	VA	NC	SC	GA	FL	Total
1981			500	500		3,500	51,639		518	4,174,432	4,231,089
1982			1,000	200		12,700	189,217	1,081	745	3,758,603	3,963,546
1983	2,600	2,600	600	100		3,500	41,336	706		5,947,102	5,998,544
1984			300	100		10,000	127,467	1,321		2,397,373	2,536,561
1985			100			15,300	173,186	847		3,244,980	3,434,413
1986	600		3,200	1,500		168,400	232,197	6,375	1,335	4,003,738	4,417,345
1987	16,000	4,900	16,600	24,000	4,800	251,200	504,063	961	255	3,497,135	4,319,914
1988		3,400	19,200	16,900	4,300	291,600	438,222	1,029	726	3,071,687	3,847,064
1989	12,400	8,900	17,700	24,100	10,400	354,400	589,383	1,605		2,853,177	3,872,065
1990	6,585	5,530	24,329	28,336	43,411	491,651	838,914	384	491	1,979,081	3,418,712
1991	19,698	9,530	149,321	77,151	62,688	447,127	858,808	444	197	2,986,871	4,611,835
1992	608	2,277	31,873	51,751	37,930	271,313	738,362	1,952	71	2,022,961	3,159,098
1993	5	2,843	42,063	23,036	9,445	335,688	589,868	480	95	3,902,240	4,905,763
1994	3,273	893	124,733	19,915	3,363	376,818	531,355	362		3,099,780	4,160,492
1995		12,419	9,136	2,153	3,089	168,732	402,305			3,064,926	3,662,760
1996		2,523	17,980	40,821		283,750	401,546			2,244,667	2,991,287
1997	15	86	31,107	12,122	3,033	164,639	766,901			2,269,289	3,247,192
1998	71	109	37,238	13,242	13,204	121,109	372,440			2,498,461	3,055,874
1999	2,407	276	47,831	17,144	21,604	251,626	459,120			1,566,706	2,366,714
2000		188	35,825	11,757	26,607	168,679	659,431			1,675,473	2,577,960
2001		20,052	13,851	9,401	18,899	178,849	653,491			2,115,782	3,010,325
2002		65	18,741	11,196	20,725	102,454	698,463			1,995,212	2,846,856
2003	514	366	18,339	5,432	5,239	103,409	456,794			2,740,632	3,330,725
2004	198	5,971	16,921	3,060	4,881	66,482	456,243			3,066,186	3,619,942
2005		294	5,197	2,074	7,750	43,126	446,013			3,133,772	3,638,226
2006		1,486	5,720	1,456	290	43,192	470,669			3,142,721	3,665,534
2007		2,143	7,244	2,075	3,734	58,064	487,891			3,264,452	3,825,603
2008			2,513		6,192	156,011	415,416			2,262,661	2,844,947
2009		218	3,462	3,324	11,570	138,292	961,836			2,629,343	3,748,048
2010	0	522	3,713	829	4,939	47,562	911,878	0	0	3,553,155	4,522,605
2011			1,149	305	5,054	36,314	45,222			3,432,932	3,521,009
2012		2,135	2,294	2,806	3,630	18,317	916,439			2,596,981	3,542,602

Table 3. Coastwide commercial landings of Spanish mackerel by gear, 2012
(Personal communication with NMFS Fisheries Statistics Division, 11/13/2013)

Gear	Pounds	% of total
Gillnets	1,407,993	40.1%
Cast Nets	965,327	27.5%
Line Gears	1,056,938	30.1%
Pound Nets	54,035	1.5%
Other	25,306	0.7%
Total	3,509,599	

(Line gears include rod and reel, electric or hydraulic reel, troll lines and hand lines.)

Table 4. Recreational harvest (numbers) of Spanish mackerel by state, 1981-2012
(NMFS Fisheries Statistics Division, 10/24/2013**)**

Year	MA	RI	CT	NY	NJ	DE	MD	VA	NC	SC	GA	FL	Total
1981	4,277								231,744	25,058	1,786	485,395	748,260
1982									694,420	21,092	408	173,649	889,569
1983									6,156	3,279	2,109	117,532	129,076
1984									618,313	79,855	3,718	248,048	949,934
1985									344,965	36,606	4,809	84,226	470,606
1986					1,479		457	6,942	431,021	147,358	25,257	195,385	807,899
1987				1,417			8,036	1,520	815,920	65,846	20,925	118,184	1,031,848
1988								101,691	1,312,070	82,136	4,403	233,582	1,733,882
1989		320		1,010	22,067			73,236	679,360	121,115	7,444	213,665	1,118,217
1990		403		1,726	2,495	319	1,355	63,821	821,334	81,375	31,567	225,263	1,229,658
1991	7,071	78	4,173	7,608	25,071	2,054	41,250	68,102	676,717	132,198	2,391	517,290	1,484,003
1992				1,325	10,549	210	4,847	71,265	701,974	62,546	25,736	370,809	1,249,261
1993	188			2,681	3,457		43,050	73,832	451,523	92,621	12,979	219,458	899,789
1994					7,910		43,710	145,872	535,949	113,991	15,235	252,668	1,115,335
1995							26,216	86,899	285,882	34,355	16,726	226,334	676,412
1996					1,172			69,399	355,036	134,282	16,948	245,085	821,922
1997								68,517	585,765	101,067	28,396	246,885	1,030,630
1998					4,046	186	3,633	33,140	239,052	65,584	28,002	244,235	617,878
1999		438			1,335	226	1,220	75,972	476,019	27,477	9,007	327,621	919,315
2000	1,528			4,453	923		15,219	71,249	671,353	28,283	20,545	547,315	1,360,868
2001	2,561			802			8,025	29,590	400,706	43,501	11,013	774,065	1,270,263
2002								17,433	401,982	24,235	1,927	926,600	1,372,177
2003	3,373						6,975	17,063	349,170	24,879	11,235	784,385	1,197,080
2004	1,338				1,531		8,800	21,012	308,996	144,394	7,906	532,956	1,026,933
2005							20,792	20,525	331,601	70,273	12,140	676,973	1,132,304
2006					465		3,118	21,303	305,343	42,867	2,441	439,324	814,861
2007							12,360	821	491,357	104,741	13,795	601,335	1,224,409
2008					470		5,777	121,773	686,501	58,465	14,519	566,397	1,453,902
2009					655		24,725	16,560	703,393	60,925	6,306	375,512	1,188,076,
2010							7,526	20,524	470,212	93,574	4,723	494,586	1,091,145
2011							10,554	35,054	367,086	87,109	7,486	406,068	913,357
2012							2,962	11,874	491,238	80,204	2,119	246,866	835,263

Table 5. Recreational harvest (pounds) of Spanish mackerel by state, 1981-2012
(NMFS Fisheries Statistics Division, 10/8/2013)

Year	MA	RI	CT	NY	NJ	DE	MD	VA	NC	SC	GA	FL	Total
1981									423,801	53,292	4,306	808,808	1,290,207
1982									928,201	29,546	483	251,115	1,209,345
1983									14,725	8,274	4,198	199,331	226,528
1984									848,537	116,083	5,540	427,501	1,397,661
1985									507,545	34,445	3,547	152,113	697,650
1986					2,500		1,008	9,709	639,105	256,157	47,941	251,673	1,208,093
1987				2,890			14,345	2,011	1,296,732	117,053	40,681	230,725	1,704,437
1988								160,407	2,136,806	140,896	5,141	656,047	3,099,297
1989		847		3,560	35,415			81,107	877,911	197,982	6,162	303,485	1,506,469
1990				2,332	3,320	470	1,790	86,932	1,084,167	153,932	45,748	346,585	1,725,276
1991	26,327	251	16,958	19,612	36,096	3,062	57,249	72,708	1,056,524	291,717	3,717	887,777	2,471,998
1992				3,880	16,526	302	9,634	76,411	947,065	145,451	79,818	669,160	1,948,247
1993	580			7,590	5,280		68,757	93,272	664,815	135,287	22,209	439,555	1,437,345
1994					8,613		44,969	160,610	588,035	152,836	66,949	350,679	1,372,691
1995							34,705	110,433	329,466	40,995	12,072	302,632	830,303
1996								80,505	385,922	184,655	31,856	413,687	1,096,625
1997								22,233	862,497	143,297	37,877	400,148	1,466,052
1998					9,189	379	5,725	57,467	305,630	106,209	112,562	408,872	1,006,033
1999		1,303			2,207	240	1,715	79,601	469,258	44,917	10,031	578,123	1,187,395
2000	5,053			10,798	1,118		20,642	83,296	671,616	30,543	47,137	946,395	1,816,598
2001	10,351			1,168			14,526	42,046	499,829	46,945	23,056	1,232,506	1,870,427
2002								12,163	475,742	47,057	4,795	1,475,232	2,014,989
2003							9,762	22,031	446,052	29,107	34,855	1,021,204	1,563,011
2004					3,078		14,434	29,244	558,968	147,609	11,799	915,099	1,680,231
2005							38,946	28,192	359,927	138,517	16,296	1,088,720	1,670,598
2006							6,400	46,832	454,749	83,069	2,487	807,327	1,400,864
2007							25,276	957	729,687	119,207	26,513	1,003,340	1,904,980
2008					741		11,550	160,250	783,330	75,583	31,041	930,923	1,993,418
2009					913		42,300	26,471	892,632	101,614	13,272	708,270	1,785,472
2010					0		13,995	26,338	582,550	136,648	5,168	1,034,480	1,799,179
2011					0		22,630	41,325	194,521	72,631	9,439	873,604	1,214,150
2012					0		5,223	17,806	665,168	98,316	4,536	412,001	1,203,050

Table 6. Recreational releases (numbers) of Spanish mackerel by state, 1981-2012
(NMFS Fisheries Statistics Division, 10/24/2013)

Year	MA	RI	CT	NY	NJ	DE	MD	VA	NC	SC	GA	FL	Total
1981									5,616			56,374	61,990
1982												6,613	6,613
1983											515	4,929	5,444
1984									2,931	1,300		21,797	26,028
1985									27,753	3,862		23,316	54,931
1986								74	280,252	7,879	605	20,469	309,279
1987								13,947	28,136	5,506	2,916	7,197	57,702
1988									17,413	27,019	2,456	18,334	65,222
1989								10,286	64,749	73,983	391	83,682	233,091
1990				257				21,094	76,940	26,929		35,520	160,740
1991	859				2,674	1,092	1,747	28,777	133,601	19,331	57	190,602	378,740
1992	586							18,072	180,235	15,515	3,859	113,062	331,329
1993	584				1,160		2,684	70,081	81,927	15,966		74,052	246,454
1994				1,059	50,743			91,832	241,082	207,055		136,041	727,812
1995				7,297	1,269		1,562	24,467	145,845	14,159	2,594	129,469	326,662
1996								28,951	103,067	83,543	139	167,411	383,111
1997						338		22,658	140,704	62,356		168,815	394,871
1998							1,075	49,429	80,700	32,087	7,351	87,804	258,446
1999				1,415	2,670			36,276	205,870	46,400	495	185,106	478,232
2000	667					608	1,656	82,227	300,384	47,273	16,479	353,042	802,336
2001	2,271			1,657	4,907	825	7,265	30,158	160,591	9,711	3,188	285,738	506,311
2002							4,449	9,923	196,967	9,206	8,641	554,743	783,929
2003							6,994	20,539	164,787	223,116	6,501	445,965	867,902
2004	2,853						753	13,738	121,531	114,157	3,527	213,577	470,136
2005							4,937		174,140	153,584	8,983	367,862	709,506
2006							1,620	8,973	89,912	33,328	6,609	192,010	332,452
2007							13,657	7,837	277,710	83,513	27,643	197,856	608,216
2008							4,672	66,593	541,764	93,009	6,823	353,098	1,065,959
2009					13,363		6,906	24,848	241,540	49,472	627	175,042	511,798
2010							0	29,586	268,356	54,297	128	303,829	656,196
2011							0	28,526	170,926	67,144	10,131	147,399	424,126
2012							0	17,150	234,905	98,371	1,724	88,592	440,742