# Atlantic States Marine Fisheries Commission

## South Atlantic State/Federal Fisheries Management Board

*August 7, 2013*
*1:00 p.m.-2:30 p.m.*
*Alexandria, Virginia*

## 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 *(L. Daniel)* 1:00 p.m.

2. Board Consent 1:00 p.m.
   - Approval of Agenda
   - Approval of Proceedings of May 2013

3. Public Comment 1:05 p.m.

4. Elect Vice Chair **Action** 1:15 p.m.

5. Spot & Atlantic Croaker Trigger Exercises Update (*H.Rickabaugh)* **Action** 1:20 p.m.

6. Spanish Mackerel Draft Addendum I for final approval **Final Action** 1:45 p.m.
   - Review Management Options ( *K. Rootes-Murdy)*
   - Public Comment Summary ( *K. Rootes-Murdy)*
   - Consider final approval of Addendum I

7. Consider FMP Review and State Compliance Reports (*K.Rootes-Murdy*) **Action** 2:00 p.m.
   - Atlantic Croaker
   - Red Drum

8. Red Drum Habitat Draft Addendum I for final approval **Final Action** 2:25 p.m.
   - Review draft addendum( *K. Rootes-Murdy)*
   - Public Comment Summary ( *K. Rootes-Murdy)*
   - Consider final approval of Habitat Addendum I

9. Other Business/Adjourn 2:30 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**
**Wednesday, August 7, 2013**
**1:00 p.m. – 2:30 p.m.**
**Alexandria, Virginia**

| | | |
|---|---|---|
| Chair: Louis Daniel (NC)<br>Assumed Chairmanship:<br>02/10 | Technical Committee Chairs<br>Atlantic Croaker: Chris McDonough (SC)<br>Red Drum: Mike Murphy (FL) | Law Enforcement<br>Committee Rep:<br>Stephen Adams (GA) |
| Vice Chair:<br>VACANT | Advisory Panel Chair:<br>Bill Windley (MD) | Previous Board Meeting:<br>May 23, 2013 |
| Voting Members:<br>NJ, DE, MD, PRFC, VA, NC, SC, GA, FL, NMFS, USFWS, SAFMC (12 votes) | | |

**2. Board Consent**

- Approval of Agenda

**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. Elect Vice Chair to South Atlantic State/Federal Fisheries Management Board (1:15 p.m.- 1:20 p.m.)**

**Background**

- Current Chairman Louis Daniel's tenure ends August 2013.
- The Management Board vice chairmanship is vacant.

**Board actions for consideration at this meeting**

- Elect a vice chair

**5. Spot & Atlantic Croaker Trigger Exercises Update (1:20 p.m.- 1:45 p.m.)**

**Background**

- Trigger exercises were established for both species for each non-assessment year to review trends in the fisheries.
- At the August 2012 meeting, the Board tasked the Atlantic Croaker Technical Committee to develop similar measures to the Spot Trigger Exercises.
- The Atlantic Croaker Technical Committee and Spot Plan Review Team met via conference call three times during May-July to review the 2012 data.
- The Atlantic Croaker Technical Committee and Spot Plan Review Team have adapted a traffic light analysis to accompany the current trigger exercises. The groups feel this

analysis provide a more comprehensive method to monitor the fisheries.

- The 2012 data update does not appear to have tripped the triggers for the past year, but this is based on preliminary data. The PRT is concerned about the trends in landings and length at age data. (**supplemental material**)

**Presentations**

- Update of the Atlantic Croaker & Spot Trigger Exercises by H. Rickabaugh

**Board actions for consideration at this meeting**

- Accept the 2013 Annual Review of Assessment Triggers
- Consider management measures in response to meeting a management trigger for Spot and Atlantic Croaker

**6. Spanish Mackerel Draft Addendum I for final approval (1:45-2:00p.m.) Final Action**

**Background**

- South Atlantic Fishery Management Council discussed allowing for seasonal flexibly in the Spanish mackerel FMP. Specifically to allow for changes in size limits in the pound nets fishery in the summer months of July through September.
- Only one state held public hearings (North Carolina), with no public comments submitted.

**Presentations**

- Review Management Options by K. Rootes-Murdy

**Board actions for consideration at this meeting**

- Review addendum, select management measures, and consider final approval

**7. Consider FMP Review and State Compliance Reports (2:00-2:25 p.m.) Action**

**Background**

- Compliance reports were due July 1, 2013 (**Briefing CD**)
- The Red Drum Plan Review Team reviewed each state report and compiled the Fishery Management Plan Review **(Supplemental materials).**
- The Atlantic Croaker Plan Review Team reviewed each state report and compiled the Fishery Management Plan Review **(Supplemental materials).**

**Presentations**

- Overview of the Fishery Management Plan Review Reports by K. Rootes-Murdy

**Board actions for consideration at this meeting**

- Approval of *de minimis* status for Delaware and New Jersey state Red Drum fishery
- Approval of *de minimis* status for Delaware (commercial), South Carolina (commercial), Georgia (commercial and recreational), and Florida (commercial) state Atlantic Croaker fishery
- Approval of the 2013 Fishery Management Plan Review and State Compliance Reports.

**8. Consider Red Drum Habitat Draft Addendum I (2:25-2:30 p.m.)**

**Background**

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|---|
| • The Habitat Committee updated and revised the red drum habitat section of the FMP<br>• The draft addendum was made available in June 2013 for public comment |
| **Presentations**<br>• Review draft Addendum by K. Rootes-Murdy |
| **Board actions for consideration at this meeting**<br>• Review addendum and consider final approval |

**9. Other Business/Adjourn**

**Atlantic States Marine Fisheries Commission**
**Atlantic Croaker Technical Committee**

# Annual Review of Assessment Triggers 2013

## Introduction

Amendment 1 to the Interstate Fishery Management Plan for Atlantic Croaker directs the Atlantic Croaker Stock Assessment Subcommittee (SASC) to conduct a benchmark stock assessment every five years (ASMFC 2005). In each non-assessment year, the Atlantic Croaker Technical Committee (TC) is required to conduct a set of "trigger" exercises to review Atlantic croaker data. The first trigger is the only hard trigger which, if activated, initiates an assessment in a non-assessment year. If the TC notices substantial changes in one or more of the remaining triggers, the TC can also request that a stock assessment be conducted.

Prior to 2010, the triggers were evaluated on a management area basis, using the mid- and south Atlantic management regions as defined in Amendment 1. The 2010 ASMFC assessment assumed a single, coastwide stock for Atlantic croaker, which was supported by the SEDAR review panel (ASMFC 2010). Following the recommendations of the stock assessment and TC, the South Atlantic State-Federal Fisheries Management Board approved Addendum I to Amendment I at its March 2011 meeting and established the Atlantic croaker stock as a single management unit, rather than the previously divided units (ASMFC 2011). The triggers are evaluated according to this single, coastwide unit.

## Evaluation of Assessment Triggers

1. Relative percent change in landings

    a. A stock assessment will be triggered if the most recent year's commercial landings are less than 70% of the previous two years' average landings.

    Commercial landings data were obtained from the ACCSP Data Warehouse. Annual commercial landings of Atlantic croaker along the U.S. east coast have been variable since at least 1950 (Figure 1). Over the last decade, commercial landings have generally declined. In 2012, approximately 11.2 million pounds were landed by commercial fisheries (Table 1). This value represents 81.3% of the average of the previous two years' commercial landings (Average, 2010 – 2011 = 13.8 million pounds). Therefore, the trigger **is not** activated.

    b. A stock assessment will be triggered if the most recent year's recreational landings are less than 70% of the previous two years' average landings.

    Estimates of recreational fisheries statistics were provided by the MRIP. Recreational harvest of Atlantic croaker (Type A + B1) from New Jersey to the east coast of Florida ranged from a low of 1.35 million pounds in 1982 to a high of 11.1 million pounds in 2001 during 1981 through 2011 (Figure 2). The recreational harvest totaled

2.8 million pounds in 2012 (Table 1). This value represents 75.9% of the average of the previous two years' recreational harvest (Average, 2010 – 2011 = 3.8 million pounds). As such, the trigger **is not** activated.

2. Biological Data Monitoring

   a. The technical committee will compare the most recent year's mean length data from the recreational fishery to the average of the previous two years' mean lengths.

      For the 2013 trigger exercise, the recreational fishery average lengths were computed from the Marine Recreational Information Program (MRIP length frequency data collected from New Jersey to the east coast of Florida during the MRIP angler-intercept survey and represent harvested (Type A + B1) fish. The data, as processed, are weighted to account for the effects of non-random sampling of the catch across strata (see NOAA 2012 for details). MRIP replaces the previously used data collected from MRFSS (see ASMFC 1994 for details).

      The average total length of Atlantic croaker harvested by recreational anglers in 2012 was 10.1 inches (Table 2). The average of the 2010 – 2011 recreational harvest average lengths was 10.5 inches. The average total length in 2012 decreased by 3.81%, relative to the 2010 – 2011 average. The average lengths for the Mid-Atlantic and South Atlantic states differed only slightly, with an average 2012 length in the Mid-Atlantic of 10.1 inches versus 10 inches average length for the South Atlantic states (Table 2). These average lengths reflect a decrease in the Mid-Atlantic compared to 2009 - 10 (5.16%) but an increase in the South Atlantic (3.09%).

   b. The technical committee will compare the most recent year's mean size (length and weight) data from the commercial fishery to the average of the previous two years' mean size (length and weight) data.

      The average total length of Atlantic croaker observed in 2012 was compared to the average of the 2010 and 2011 average lengths for major commercial gears using data provided by New Jersey, Maryland, Virginia, and North Carolina. The average length of Atlantic croaker samples from the commercial fisheries decreased in 2012 relative to the 2010 – 2011 average for all state-gear combinations evaluated except for the Virginia haul seine fishery which observed an increase of 0.6 inches (Table 2). The observed decreases in average length, compared to the previous two-year average, ranged from less than 0.1 to 1.0 inches.

      A similar comparison was performed for average weights, which found that changes in average length did not necessarily correlate with similar changes in average weight. The average weight of Atlantic croaker sampled from Maryland's pound net fisheries and North Carolina's haul seine fishery increased, while all other fisheries reported a decline in the sampled average weight (

Table **3**). The largest relative changes were seen in North Carolina's long haul (-30.02%) and inside gill net (-19.11%) fisheries.

c. The technical committee will monitor the overall age composition (proportion at age) and calculate the mean size at age for the age groups that are present in the state samples.

The proportion, mean length, and mean weight of commercial landings at age for Atlantic croaker were calculated for 2008–2012 using data provided by New Jersey, Maryland, Virginia, and North Carolina (Table 4). Note that lengths and weights were not always available for every aged fish. The majority of Atlantic croaker commercial landings in these states have been comprised of fish age 1 and older (Figure 3-Figure 6). There is evidence of a strong 2006 year-class in the New Jersey (Figure 3), Maryland (Figure 4), Virginia (Figure 5) and North Carolina (Figure 6) age compositions.

The average length and average weight at age of Atlantic croaker sampled from the commercial fisheries was variable during 2007–2012 within each state (Figure 7–Figure 14). The majority of the differences in average length at age within each state were less than 0.75 inches when comparing 2007-2012, with Virginia observing the largest fish average length at age (Figure 11). In comparisons of average weight at age within states among 2007-2012, most of the differences were less than 0.20 pounds. Larger differences in average length and average weight at age among these years are often attributable to variation in sample sizes at age among years.

3. Commercial Fisheries Effort vs. Landings

a. The technical committee will monitor annual commercial fisheries effort and landings by state and gear to evaluate trends. As the reliability of the effort data improves, monitoring of annual effort and landings will be replaced by monitoring of CPUE (by state and gear).

The SASC for the 2010 assessment reviewed the available commercial fisheries effort data from the states and determined the data were insufficient to calculate a CPUE series for the commercial fisheries (ASMFC 2010). That SASC also noted that supplementary information needed to standardize effort data among the states is either unavailable or not consistently provided. The SASC concluded the commercial CPUE data were not adequate indicates of abundance for croaker.

Although the SASC concluded that the CPUE data were unreliable to use in the stock assessment to estimate overall abundance, the TC felt that the trends in effort and landings data were good indicators to monitor changes in the fishery and the populations. Annual commercial landings and associated effort for major gears in Virginia, North Carolina, and Florida were evaluated. Effort is measured as the number of trips and was only available for positive trips; that is, only trips that landed Atlantic croaker were included. Virginia's commercial landings of Atlantic croaker in the anchor and drift gill-net fisheries again decreased from the previous year, while haul seine and pound-net landings increased in 2012 after decreases in 2011 (Figure 15). Effort decreased in all of Virginia's gears from 2010 to 2011 and increased in 2012 for drift net and pound net fisheries. Effort levels have varied for the four

fisheries over the years, with g an overall decline in effort for the past five years for all Virginia gear types except for pound-net fisheries. Landings-per-unit-effort stayed relatively level, with the exception of a sharp increase in the haul seine fishery, which saw a sharp drop in 2011.

Commercial landings and effort showed decreases across North Carolina's gear types (long haul seine, fly net and inside gill net) with the exception of the ocean gill net fishery which showed an uptick from 2011 landings (figure 16).

Both effort and landings in Florida's commercial hook-and-line fishery generally increased from the beginning of the time series to a peak in 2000 and 2006, after which the fishery's landings and efforts decreased and have been variable (Figure 17).

4. Recreational Catch Rates

Amendment 1 specifies that the recreational fishery CPUE index will be calculated based on directed trips (ASMFC 2005). In the 2010 stock assessment, recreational fishery CPUE was calculated using the directed trips method and the method of Stephens and MacCall (2004; ASMFC 2010). However, the MRFSS index was not used in the final configuration of the stock assessment model. The SASC and SEDAR review panel for that assessment were concerned about the reliability of the directed trips-based methods as it may under-represent trips that did not catch Atlantic croaker. The SASC was concerned that the Stephens and MacCall method resulted in unrealistic species associations and a large number of positive trips being rejected in the analysis. The SEDAR review panel recommended that stratifying the data into subareas based on expected species associations would alleviate this problem.

The language in Amendment 1 also states that recreational fishery CPUE indices will be calculated for each state (ASMFC 2005); however, the TC feels the MRFSS data are insufficient for calculating state-specific catch rates.

For the 2011 trigger exercise, recreational fishery catch rates were calculated using the directed trips approach, a modification of the Stephens and MacCall method, and the Jacquard Index, which is a similar approach used during the 2005 stock assessment (K. Drew, ASMFC, pers. comm.). The TC evaluated the methods but was not comfortable presenting a recreational CPUE index that was not endorsed by a peer review panel.

5. Surveys

The SASC for the 2010 assessment carried out a thorough evaluation of fisheries-independent surveys along the U.S. Atlantic Coast that have encountered Atlantic croaker (ASMFC 2010). The purpose was to evaluate how each survey represents and characterizes the Atlantic croaker population. For each survey, the SASC considered the length of the time series, sample timing and spatial coverage, catchability/availability to the survey gear, changes in sampling methodology, and survey design. Out of thirty-one surveys examined, four were selected for use in the assessment model. The surveys chosen were the NMFS Bottom Trawl Survey, VIMS Juvenile Fish and Blue Crab Trawl Survey, SEAMAP-South Atlantic Coastal Survey, and the North Carolina Pamlico Sound Survey, also known as Program 195 (P195). These surveys cover a large area or sample

the core area, have demonstrated regular encounters with Atlantic croaker, and have collected sufficient sample sizes to develop frequency distributions. Table 5 provides a brief description of these surveys and how they were used to develop indices for Atlantic croaker. A summary and time series of additional surveys considered during the stock assessment and used in previous trigger exercises is also included (Table 6).

All four main indices were calculated using the same methods and data subsets that were used for the 2010 ASMFC assessment, with the exception of the NMFS and the VIMS indices. For the 2010 assessment, which considered data through 2008, the NMFS index was calculated using data collected in the fall (inshore) component of the survey and was based on stratification by depth and latitude (ASMFC 2010). Based on a recommendation by the review panel, only observations from the mid- and deep-depth strata were included in the calculations. The modifications to the NMFS Bottom Trawl Survey in 2009 included changes to the survey vessel, trawling gear, tow speed and duration, station allocation, and fishing protocols (Miller et al. 2010; NEFSC 2010). The shallow and mid-depth strata of the inshore series are no longer sampled. Thus data collected in 2009 and later cannot be stratified by depth using the NMFS strata designations. Species-specific calibration factors were estimated to allow conversion of catch rates between the new and old survey vessels (Miller et al. 2010). For this trigger exercise, the 2011 NMFS fall index was calculated based on stratification by latitude only and the recommended calibration factor for Atlantic croaker (1.134) was applied to convert the 2009 – 2011 index values into units of measure equivalent to data collected prior to 2009. With the same level of latitudinal pooling and use of the same strata, the long term trends should be relatively comparable. The next stock assessment will consider any impacts of the change in vessel and protocol on the long term trends.

The fall components of the NMFS and SEAMAP surveys have primarily encountered age-1 Atlantic croaker. The NMFS index varied from year to year with no obvious trend from 1972 to 1993 (Figure 18). After 1993, the index has remained variable but with an overall increasing trend through the end of the time series. Since 2003, the NMFS index exceeded the time-series average, except for 2008. The SEAMAP index has been variable and without trend over the survey time series (Figure 19). The SEAMAP index, which only includes the fall data, saw a drastic increase from 2011 to 2012; however, the SEAMAP index calculated from the entire data set (spring, summer and fall) decreased but still remained higher than the 10 year average (Table 6).

Data from the VIMS and NC P195 surveys were used to develop young-of-year indices for Atlantic croaker. The VIMS index used in the 2010 stock assessment was modified to allow for the estimation of confidence intervals, which was not reliable under the former calculation method. To produce the new index, the delta-lognormal mean of the catches within each stratum were calculated following Fletcher (2008) and using the Cox formulation of the mean (at the stratum level); the variance of the index was estimated using a bootstrap approach. The index varied without trend from the beginning of the time series through 2006 (Figure 20), with small spikes in 1991 and 1997. From 2007 to 2009, the VIMS index exhibited an increasing trend, spiking in 2009. The plot (**Figure 20**) shows both the VIMS index with and without the Bay tows included, which contributed to the large spike in 2009. In 2012 the VIMS index increased significantly from 2011 and was above the time-series average.

The young-of-year index derived from the NC P195 survey varied without trend over the survey time series (Figure 21). The index increased slightly in 2008 followed by a small decrease in 2009. The NC P195 index spiked again in 2010, while the 2011 index decreased to 2009 levels. The 2012 index increase dramatically to 2010 levels, showing high variability over the last 5 year time series.

Summary

According to Amendment 1, the trigger is tripped if the recreational or commercial landings fall below 70% of the previous two years' average landings. Given that neither recreational nor commercial landings tripped in 2012, the TC does not recommend the Board initiate a stock assessment, whether update or benchmark, at this time. However, due to the limitations of the trigger exercises to fully illustrate the trends in the Atlantic Croaker fishery coastwide, the TC would like to broadened the trigger exercises to incorporate the traffic light analysis outlined in TC's memo to the Board.

The TC continues to have concerns about the decrease in landings seen over the past decade but, the fishery-independent indices do not indicate the stock is currently in trouble. Thus, **the TC is not recommending the Board initiate any management measures; however, the TC would support the Board in developing management measures, should the Board decide to begin that process**. Some management options for the Board would include coastwide measures like a minimum size or harvest limits; a maximum coastwide quota based on some level of past landings ($75^{th}$ percentile, one standard deviation above the mean, etc.) or possible use of a fishery-independent index; or allocating a quota among the states.

Finally, **the TC has included a list of research needs for the next stock assessment**, should Board members have the option or ability in the next two years to support such studies. The research needs include:

a. Bait landings composition
b. Shrimp trawl bycatch research (NC, other states, federal)
c. Genetic studies for stock distribution (north/south break?)
d. Movement (tagging or telemetry research)
e. Effort (fishing pressure) by gear description

**References**


ASMFC (Atlantic States Marine Fisheries Commission). 1994. MRFSS user's manual: a guide to use of the National Marine Fisheries Service Marine Recreational Fisheries Statistics Survey Database. ASMFC, Special Report No. 37, Washington, D.C.

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Miller, T.J., C. Das, P.J. Politis, A.S. Miller, S.M. Lucey, C.M. Legault, R.W. Brown, and P.J. Rago. 2010. Estimation of *Albatross IV* to *Henry B. Bigelow* calibration factors. NEFSC Reference Document 10-05. 233 p.

NEFSC (Northeast Fisheries Science Center). 2010. Resource survey report: autumn bottom trawl survey—2009. NOAA Fisheries Service, NEFSC, Woods Hole, MA. 39 p. Available (October 2010): http://www.nefsc.noaa.gov/esb/rsr/fbts/fbts_2009/large_file.pdf

NOAA (National Oceanic and Atmospheric Adminstration). 2012. Marine Recreational Information Program: Implementation Plan 2012-2013 Update (October 2012): http://www.st.nmfs.noaa.gov/Assets/recreational/pdf/2012-13_MRIP_Implementation_Plan_FINAL.pdf

Stephens, A., and A. MacCall. 2004. A multispecies approach to subsetting logbook data for purposes of estimating CPUE. Fisheries Research (Amsterdam) 70(2–3):299–310.

**Table 1.** Comparison of Atlantic croaker commercial landings and recreational harvest estimates from the most recent year, 2012, to the average of the estimates from the previous two years, 2010 and 2012.

| Fisheries Data | Pounds | | 2012 as % of 2010–2011 Avg. |
|---|---|---|---|
| | Avg., 2010–2011 | 2012 | |
| Commercial Landings | 13,815,999 | 11,230,827 | 81.3 |
| | | | |
| Recreational Harvest | 3,783,973 | 2,718,328 | 75.9 |

**Table 2.** Comparison of the average total length (inches) of Atlantic croaker observed in the most recent year, 2012, to the average of the average lengths of the previous two years, 2010 and 2011, by fishery, region or state, and gear.

| Fishery | State | Gear | Average Length (in) | | Percent Change (%) |
|---|---|---|---|---|---|
| | | | Avg., 2010-2011 | 2012 | |
| Recreational | NJ–East FL | All | 10.5 | 10.1 | -3.81 |
| Recreational | M. Atlantic (NJ-VA) | All | 10.65 | 10.1 | -5.16 |
| Recreational | S. Atlantic (NC-E. FL) | All | 9.7 | 10.0 | 3.09 |
| Commercial | New Jersey | Gill Net | 11.8 | 11.3 | -4.00 |
| Commercial | New Jersey | Trawl | 11.2 | 9.8 | -12.11 |
| Commercial | Maryland | Pound Net | 11.3 | 10.8 | -4.11 |
| Commercial | Virginia | Haul Seine | 10.2 | 10.8 | 6.25 |
| Commercial | Virginia | Pound Net | 12.4 | 11.8 | -4.87 |
| Commercial | Virginia | Sink/Anchor Gill Net | 12.1 | 11.7 | -3.04 |
| Commercial | North Carolina | Long Haul | 10.1 | 9.1 | -9.70 |
| Commercial | North Carolina | Inside Gill Net | 10.5 | 9.8 | -7.09 |
| Commercial | North Carolina | Ocean Gill Net | 12.3 | 11.9 | -2.85 |
| Commercial | North Carolina | Fly Net | 11.2 | 10.7 | -4.21 |

**Table 3.** Comparison of the average weight (pounds) of Atlantic croaker observed in the most recent year, 2012, to the average of the average weights of the previous two years, 2010 and 2011, by fishery, state, and gear.

| Fishery | State | Gear | Average Weight (lb) | | Percent Change (%) |
|---|---|---|---|---|---|
| | | | Avg., 2010-2011 | 2012 | |
| Commercial | New Jersey | Gill Net | 0.86 | 0.76 | -11.63 |
| Commercial | New Jersey | Trawl | 0.69 | 0.42 | -39.13 |
| Commercial | Maryland | Pound Net | 0.74 | 0.79 | 6.76 |
| Commercial | Virginia | Haul Seine | 0.48 | 0.62 | 28.75 |
| Commercial | Virginia | Pound Net | 0.90 | 0.81 | -9.89 |
| Commercial | Virginia | Sink/Anchor Gill Net | 0.80 | 0.76 | -4.15 |
| Commercial | North Carolina | Long Haul | 0.46 | 0.33 | -29.96 |
| Commercial | North Carolina | Inside Gill Net | 0.57 | 0.46 | -19.09 |
| Commercial | North Carolina | Ocean Gill Net | 0.78 | 0.71 | -8.59 |
| Commercial | North Carolina | Fly Net | 0.60 | 0.52 | -13.93 |

**Table 4.** Number of Atlantic croaker age samples collected from commercial landings, by state, 2007–2012.

| State | Number Age Samples | | | | | |
|---|---|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| New Jersey | 338 | 497 | 558 | 749 | 261 | 614 |
| Maryland | 277 | 306 | 222 | 344 | 296 | 377 |
| Virginia | 344 | 546 | 512 | 451 | 425 | 393 |
| North Carolina | 336 | 739 | 709 | 703 | | |
| SEAMAP | | | | | | |

**Table 5.** Summary of information describing the fisheries-independent surveys and how their data were subset to develop indices for Atlantic croaker.

| Index | Agency | Program | Survey Design | Sampling Area | Subset Used for Index | | |
|---|---|---|---|---|---|---|---|
| | | | | | Season | Area | Size/Age |
| NMFS | NEFSC | Bottom Trawl Survey | Stratified random | Cape Hatteras to Cape Cod, inshore (fall) | Fall | strata 3180–3440, excluding shallow strata (NJ-NC) | Age 1+ |
| SEAMAP | SCDNR | South Atlantic Coastal Survey (trawl) | Stratified random | Cape Hatteras to Cape Canaveral, coastal waters | Fall | | Age 1+ |
| VIMS | VIMS | Juvenile Fish and Blue Crab Trawl Survey | Mixed | Chesapeake Bay and tributaries | Spring | | YOY |
| NC P195 | NCDMF | Pamlico Sound Survey (Program 195) | Stratified random | Pamlico Croatan, Roanoke Sounds, and lower Neuse and Pamlico rivers | Spring | excludes Pungo R. stratum | YOY |

**Table 6.** Time series of all indices considered for use in the Atlantic Croaker 2010 stock assessment.

| Year | SEAMAP all Weight | SEAMAP Fall Weight | NMFS Fall Number | VIMS Spring DLN | VIMS Spring DLN-Rivers only | NCDMF 120 Numbers | NCDMF 195-Spring Numbers | MDDNR CBT GM | MDDNR BCT GM | FLFWCC 21.3m seine Numbers | FLFWCC 183m seine Numbers | FLFWCC 6.1m trawl Numbers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1972 | x | x | 0.18 | x | x | x | x | x | x | x | x | x |
| 1973 | x | x | 11.18 | x | x | 78.04 | x | x | x | x | x | x |
| 1974 | x | x | 18.85 | x | x | 38.92 | x | x | x | x | x | x |
| 1975 | x | x | 57.25 | x | x | 30.05 | x | x | x | x | x | x |
| 1976 | x | x | 109.55 | x | x | 34.27 | x | x | x | x | x | x |
| 1977 | x | x | 65.12 | x | x | 3.62 | x | x | x | x | x | x |
| 1978 | x | x | 45.77 | x | x | 24.38 | x | x | x | x | x | x |
| 1979 | x | x | 5.42 | x | x | 48.24 | x | x | x | x | x | x |
| 1980 | x | x | 5.70 | x | x | 64.28 | x | x | x | x | x | x |
| 1981 | x | x | 45.48 | x | x | 16.52 | x | x | x | x | x | x |
| 1982 | x | x | 12.43 | x | x | 48.33 | x | x | x | x | x | x |
| 1983 | x | x | 24.73 | x | x | 92.65 | x | x | x | x | x | x |
| 1984 | x | x | 146.80 | x | x | 60.32 | x | x | x | x | x | x |
| 1985 | x | x | 70.83 | x | x | 27.74 | x | x | x | x | x | x |
| 1986 | x | x | 75.79 | x | x | 21.95 | x | x | x | x | x | x |
| 1987 | x | x | 94.12 | x | x | 52.15 | 105.77 | x | x | x | x | x |
| 1988 | x | x | 7.69 | 0.95 | 0.27 | 25.28 | 75.88 | x | x | x | x | x |
| 1989 | x | x | 115.52 | 14.14 | 1.43 | 24.15 | 125.80 | 1.01 | 0.83 | x | x | x |
| 1990 | 12.18 | 7.72 | 64.17 | 6.40 | 0.60 | 19.01 | 355.53 | 0.11 | 0.18 | x | x | x |
| 1991 | 29.71 | 24.53 | 2.24 | 28.39 | 4.93 | 8.60 | 266.03 | 3.09 | 4.06 | x | x | x |
| 1992 | 25.69 | 4.32 | 19.42 | 2.80 | 2.17 | 20.04 | 65.90 | 0.91 | 1.28 | x | x | x |
| 1993 | 13.36 | 18.68 | 3.72 | 7.22 | 3.27 | 55.23 | 437.62 | 2.02 | 3.67 | x | x | x |
| 1994 | 13.15 | 14.64 | 631.30 | 0.52 | 0.26 | 27.60 | 164.59 | 3.52 | 4.25 | x | x | x |
| 1995 | 9.15 | 5.08 | 97.49 | 2.06 | 1.25 | 42.58 | 157.35 | 3.01 | 0.74 | x | x | x |
| 1996 | 5.32 | 5.14 | 192.34 | 0.03 | 0.01 | 14.80 | 65.37 | 1.46 | 2.15 | 0.73 | x | x |
| Continued | | | | | | | | | | | | |

| Year | SEAMAP Fall Weight | SEAMAP Fall Weight | NMFS Fall Number | VIMS Spring DLN | VIMS Spring DLN-Rivers only | NCDMF 120 Numbers | NCDMF 195-Spring Numbers | MDDNR CBT GM | MDDNR BCT GM | FLFWCC 21.3m seine Numbers | FLFWCC 183m seine Numbers | FLFWCC 6.1m trawl Numbers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 4.18 | 2.30 | 72.06 | 65.51 | 8.67 | 59.25 | 386.78 | 3.20 | 5.32 | 0.11 | x | x |
| 1998 | 11.51 | 4.65 | 158.67 | 12.68 | 8.42 | 97.49 | 699.99 | 4.88 | 30.05 | 0.40 | x | x |
| 1999 | 11.10 | 17.48 | 669.35 | 4.98 | 2.46 | 22.29 | 744.69 | 2.24 | 4.18 | 1.47 | x | x |
| 2000 | 10.10 | 4.19 | 403.93 | 1.17 | 0.70 | 61.53 | 169.42 | 0.97 | 2.76 | 0.76 | x | x |
| 2001 | 11.28 | 2.66 | 51.62 | 1.55 | 0.21 | 28.98 | 112.28 | 0.40 | 0.86 | 19.59 | 0.49 | x |
| 2002 | 10.56 | 9.24 | 170.81 | 7.65 | 4.61 | 23.22 | 77.39 | 2.28 | 3.50 | 4.81 | 1.12 | 20.13 |
| 2003 | 14.85 | 14.12 | 336.07 | 0.90 | 0.07 | 28.82 | 171.08 | 0.85 | 0.81 | 4.27 | 1.24 | 26.18 |
| 2004 | 21.54 | 15.39 | 558.17 | 4.36 | 2.90 | 44.80 | 445.92 | 0.68 | 3.51 | 5.22 | 0.84 | 21.72 |
| 2005 | 18.64 | 23.83 | 376.15 | 2.72 | 1.59 | 49.38 | 225.36 | 0.41 | 0.44 | 34.02 | 0.86 | 82.50 |
| 2006 | 18.68 | 12.08 | 479.58 | 9.46 | 5.79 | 9.41 | 129.25 | 1.93 | 2.10 | 6.64 | 1.13 | 26.69 |
| 2007 | 11.93 | 9.20 | 1525.93 | 6.36 | 4.18 | 47.88 | 111.71 | 0.53 | 0.54 | 2.01 | 1.25 | 16.26 |
| 2008 | 15.82 | 12.02 | 160.63 | 28.06 | 22.21 | 14.89 | 300.20 | 0.96 | 4.51 | 8.28 | 1.64 | 46.73 |
| 2009 | 16.33 | 8.67 | 968.85 | 114.71 | 7.32 | 13.05 | 79.52 | 1.46 | 0.67 | 5.02 | 1.32 | 16.03 |
| 2010 | 16.33 | 20.39 | 354.53 | 29.07 | 6.63 | 59.28 | 1185.43 | 0.97 | 0.59 | 8.05 | 1.33 | 107.71 |
| 2011 | 40.30 | 6.20 | 730.11 | 4.43 | 1.36 | 4.65 | 89.87 | 1.05 | 1.15 | 2.88 | 3.18 | 15.89 |
| 2012 | 28.69 | | 867.60 | 53.11 | 38.51 | 14.33 | 1,149.97 | 1.52 | 3.76 | 2.7730 | 0.73 | 13.20 |

**Table 6. (continued)**

| Year | NJ DR seine Numbers | NJ DB trawl Numbers | NJ OT Aug Numbers | NJ OT Oct Numbers | DE Juvenile GM | DE Adult Numbers |
|---|---|---|---|---|---|---|
| 1972 | x | x | x | x | x | x |
| 1973 | x | x | x | x | x | x |
| 1974 | x | x | x | x | x | x |
| 1975 | x | x | x | x | x | x |
| 1976 | x | x | x | x | x | x |
| 1977 | x | x | x | x | x | x |
| 1978 | x | x | x | x | x | x |
| 1979 | x | x | x | x | x | 0.70 |
| 1980 | 0 | - | - | - | 0.20 | 0.40 |
| 1981 | 0 | - | - | - | 0.19 | 0.70 |
| 1982 | 0 | - | - | - | 0.00 | 0.00 |
| 1983 | 0 | - | - | - | 0.00 | 0.30 |
| 1984 | 0 | - | - | - | 2.17 | 0.00 |
| 1985 | 0.07 | - | - | - | 7.15 | x |
| 1986 | 0.11 | - | - | - | 2.18 | x |
| 1987 | 0 | - | - | - | 1.24 | x |
| 1988 | 0 | - | - | - | 0.00 | x |
| 1989 | 0.06 | - | 0 | 0 | 4.94 | x |
| 1990 | 0 | - | 0 | 0 | 0.06 | 0.10 |
| 1991 | 0.07 | 0.09 | 0.32 | 0.19 | 2.00 | 2.90 |
| 1992 | 0.04 | 0.95 | 0.08 | 0.25 | 15.01 | 0.90 |
| 1993 | 0.24 | 0.75 | 0.09 | 0.27 | 13.22 | 1.30 |
| 1994 | 0.09 | 0.33 | 0.49 | 0.18 | 6.04 | 4.00 |
| 1995 | 0.46 | 2.31 | 1.41 | 1.24 | 22.52 | 6.70 |
| 1996 | 0.45 | 2.23 | 0.31 | 0.91 | 42.92 | 24.37 |
| Continued | | | | | | |

| Year | NJ DR seine Numbers | NJ DB trawl Numbers | NJ OT Aug Numbers | NJ OT Oct Numbers | DE Juvenile GM | DE Adult Numbers |
|---|---|---|---|---|---|---|
| 1997 | 0.16 | 2.79 | 0.84 | 0.54 | 24.05 | 57.72 |
| 1998 | 0.48 | 7.67 | 0.25 | 0.22 | 27.66 | 69.64 |
| 1999 | 0.21 | 4.95 | 1.12 | 0.93 | 45.30 | 81.54 |
| 2000 | 0.39 | 2.55 | 2.51 | 1.08 | 15.84 | 34.55 |
| 2001 | 0.24 | 2.75 | 1.17 | 1.66 | 60.72 | 11.24 |
| 2002 | 0.9 | 29.02 | 4.17 | 10.07 | 88.82 | 226.68 |
| 2003 | 0.02 | 0.25 | 0.69 | 3.54 | 4.64 | 131.63 |
| 2004 | 0.16 | 0.67 | 5.07 | 13.32 | 17.19 | 30.35 |
| 2005 | 0.14 | 1.51 | 2.9 | 10.78 | 5.54 | 17.23 |
| 2006 | 0.52 | 28.4 | 0.7 | 1.13 | 11.77 | 193.10 |
| 2007 | 0.33 | 0.95 | 1.57 | 5.06 | 4.47 | 7.14 |
| 2008 | 0.43 | 17.74 | 0.42 | 6.62 | 7.50 | 42.00 |
| 2009 | 0.09 | 0.69 | 1.59 | 0.09 | 16.50 | 107.00 |
| 2010 | 0.06 | 0.5 | 1.45 | 1.3 | 17.60 | 9.00 |
| 2011 | 0 | 0.38 | 16.16 | 2.92 | 4.50 | 13.00 |
| 2012 | 0.52 | 5.08 | 1.08 | 7.97 | 4.30 | 99.00 |

*August OT was not completed until 9/14/11, due to Hurricane Irene

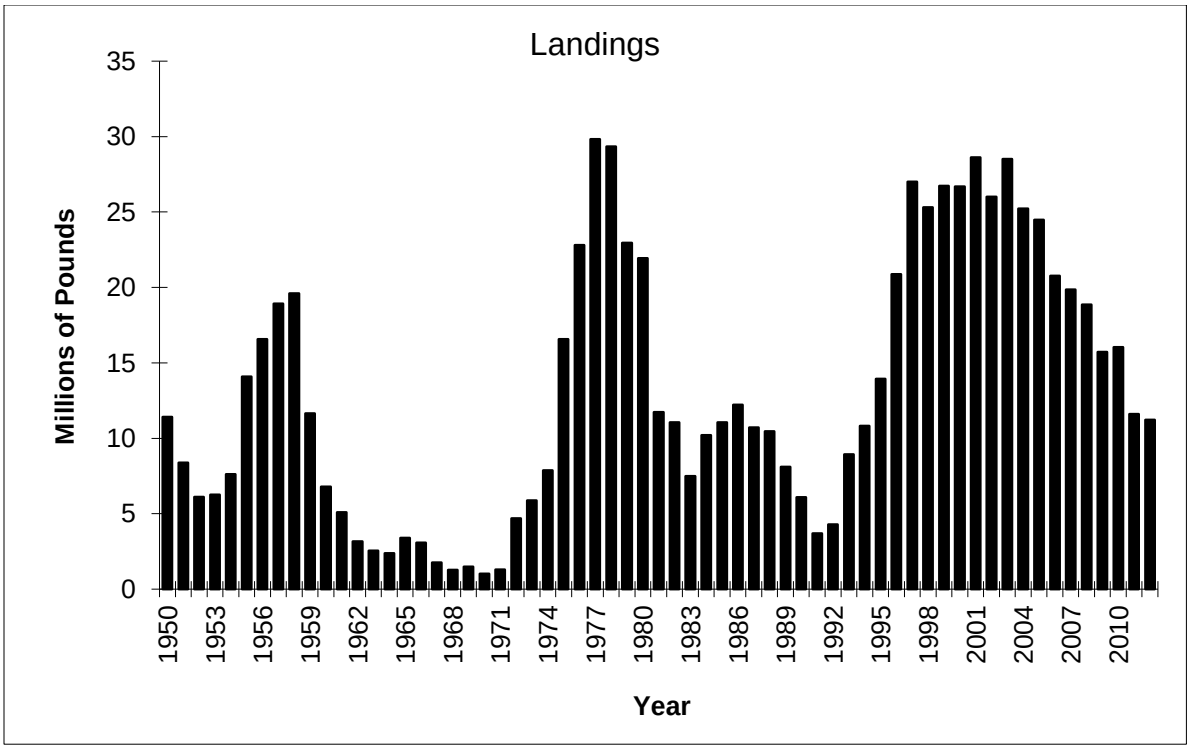



**Figure 1.** Annual commercial landings (pounds) of Atlantic croaker along the U.S. east coast, 1950–2012.

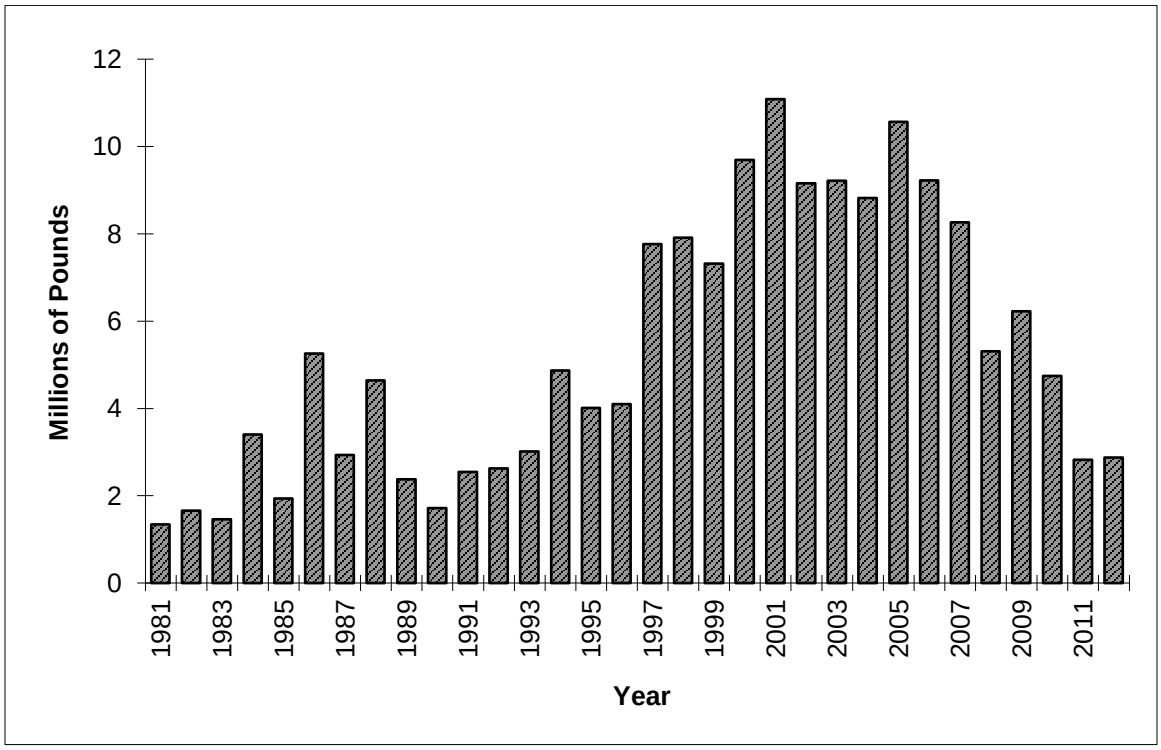



**Figure 2.** Annual recreational harvest (pounds; Type A + B1) of Atlantic croaker along the U.S. east coast, 1981–2012.

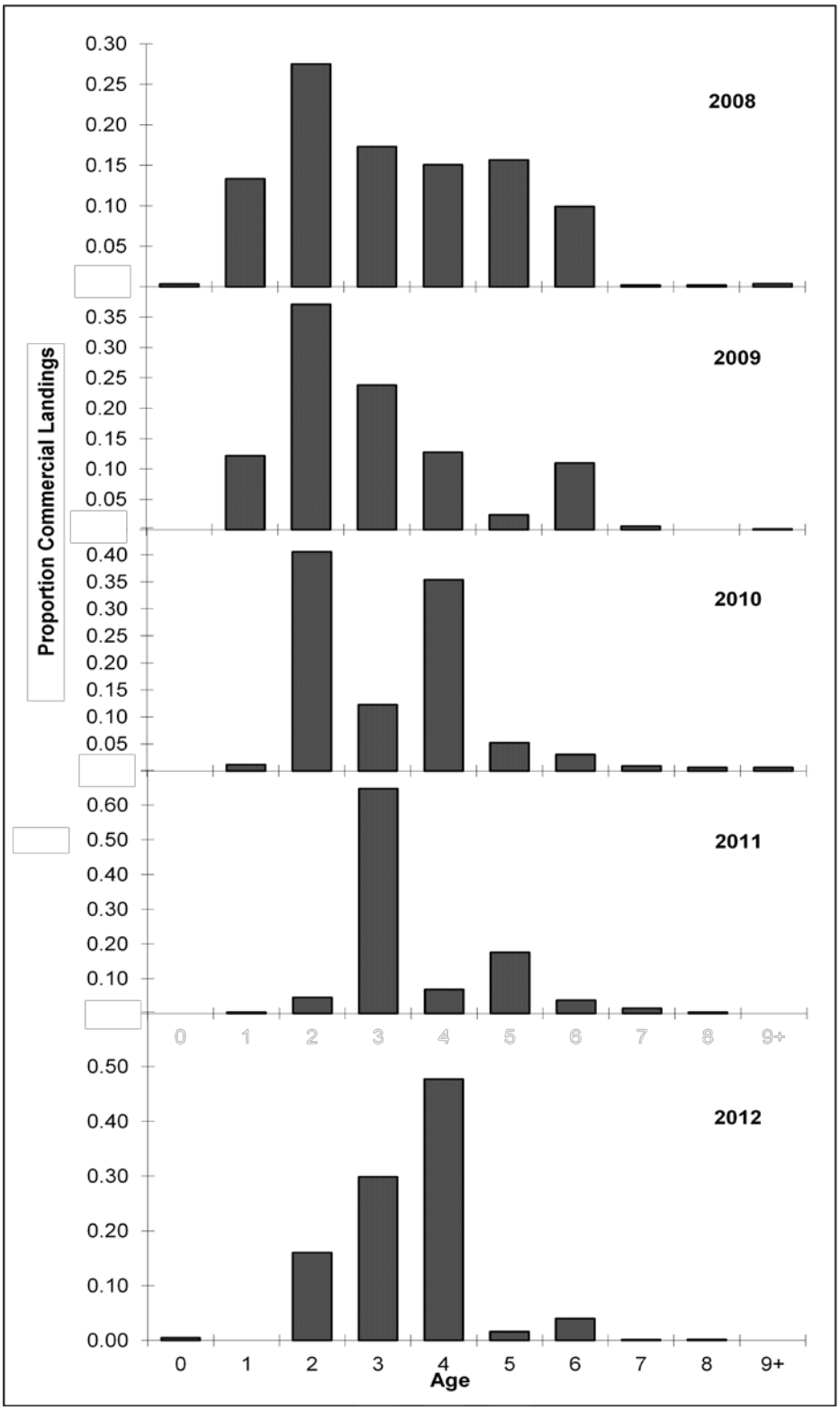



**Figure 3.** Proportion of Atlantic croaker commercial landings (pounds) at age for New Jersey pooled over all gears, 2008–2012.

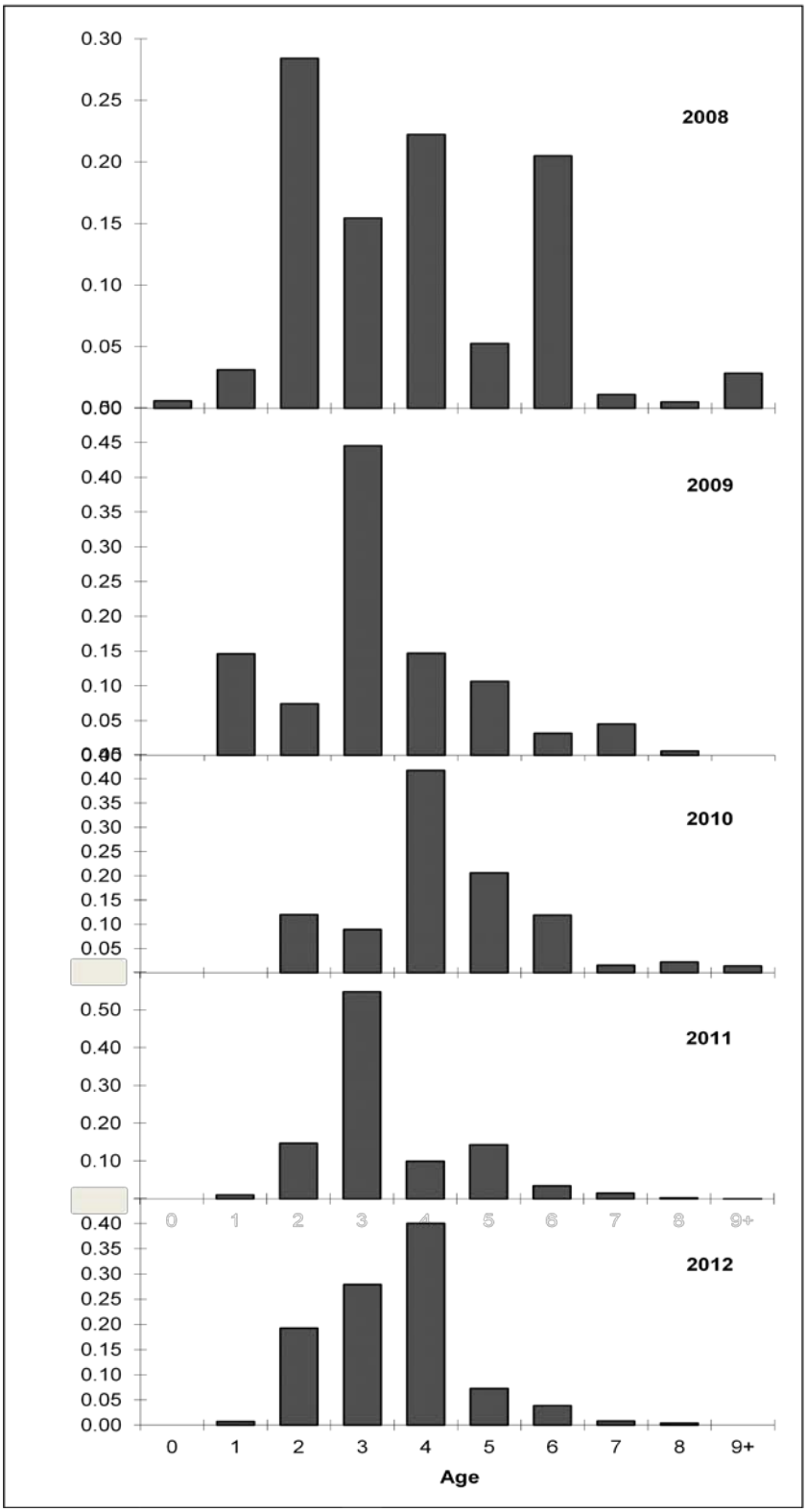



**Figure 4.** Proportion of Atlantic croaker commercial landings (pounds) at age for Maryland pooled over all gears, 2008–2012.

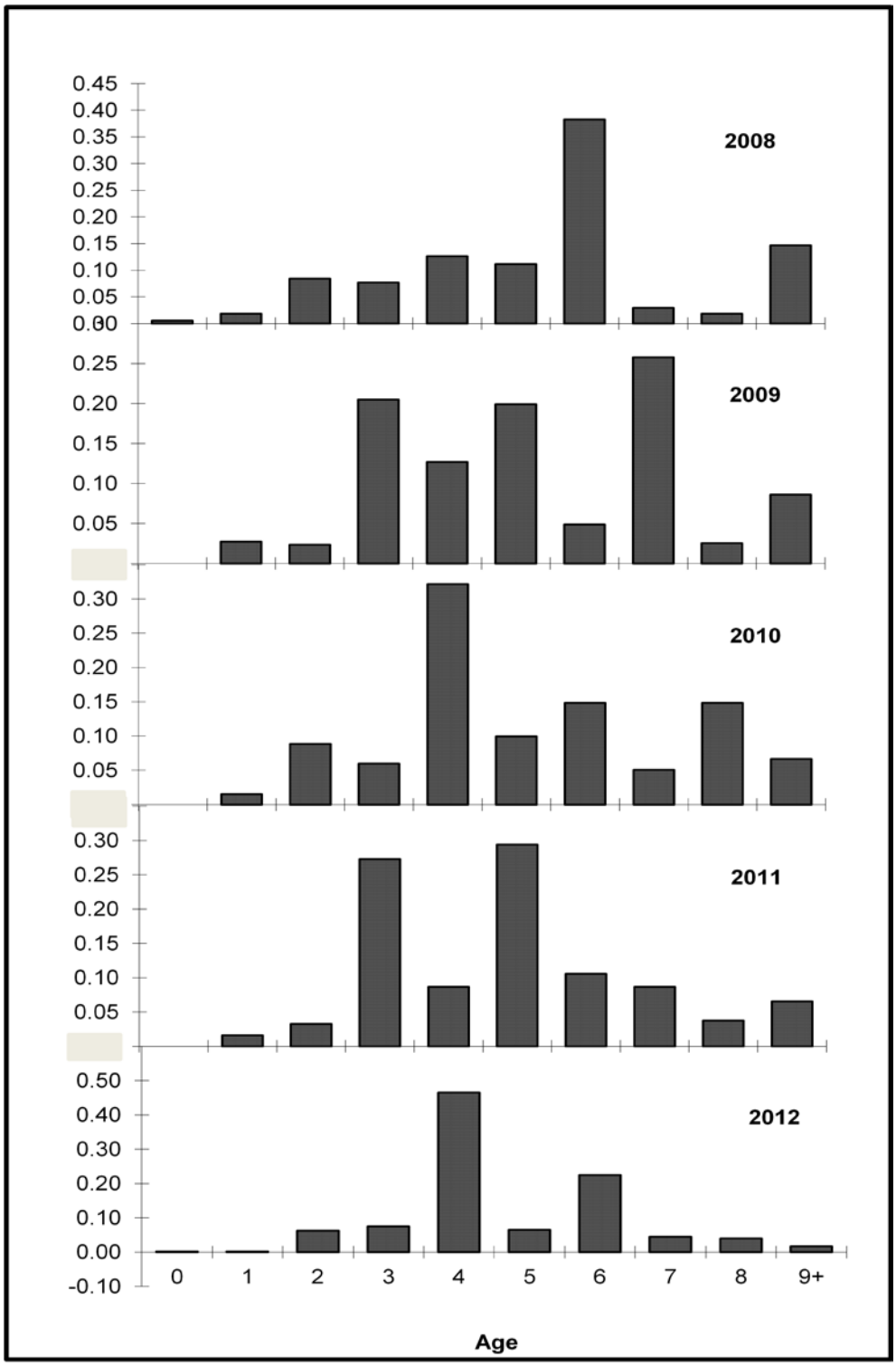



**Figure 5.** Proportion of Atlantic croaker commercial landings (pounds) at age for Virginia pooled over all gears, 2008–2012.

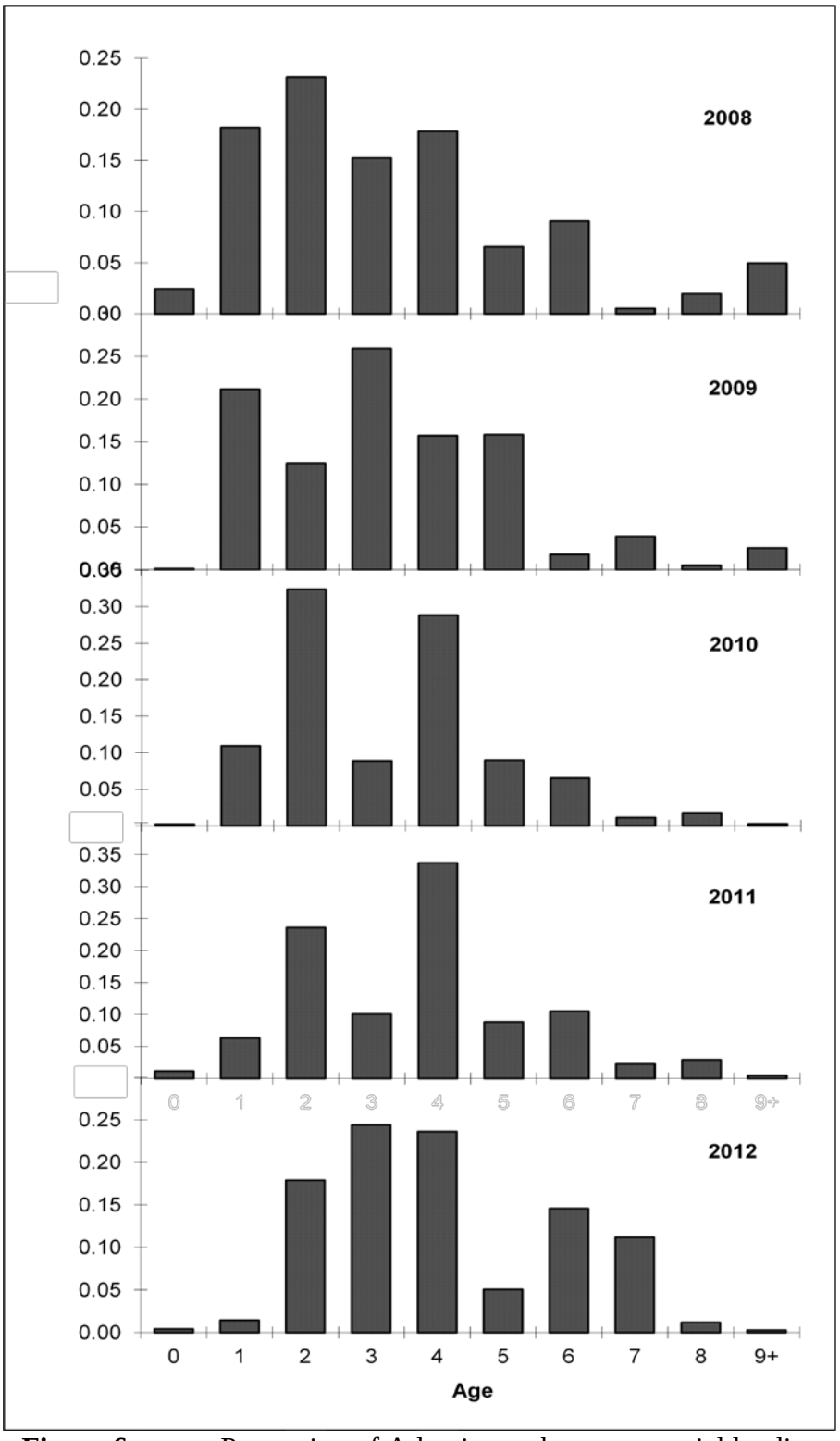



**Figure 6.** Proportion of Atlantic croaker commercial landings (pounds) at age for North Carolina pooled over all gears, 2008–2012.

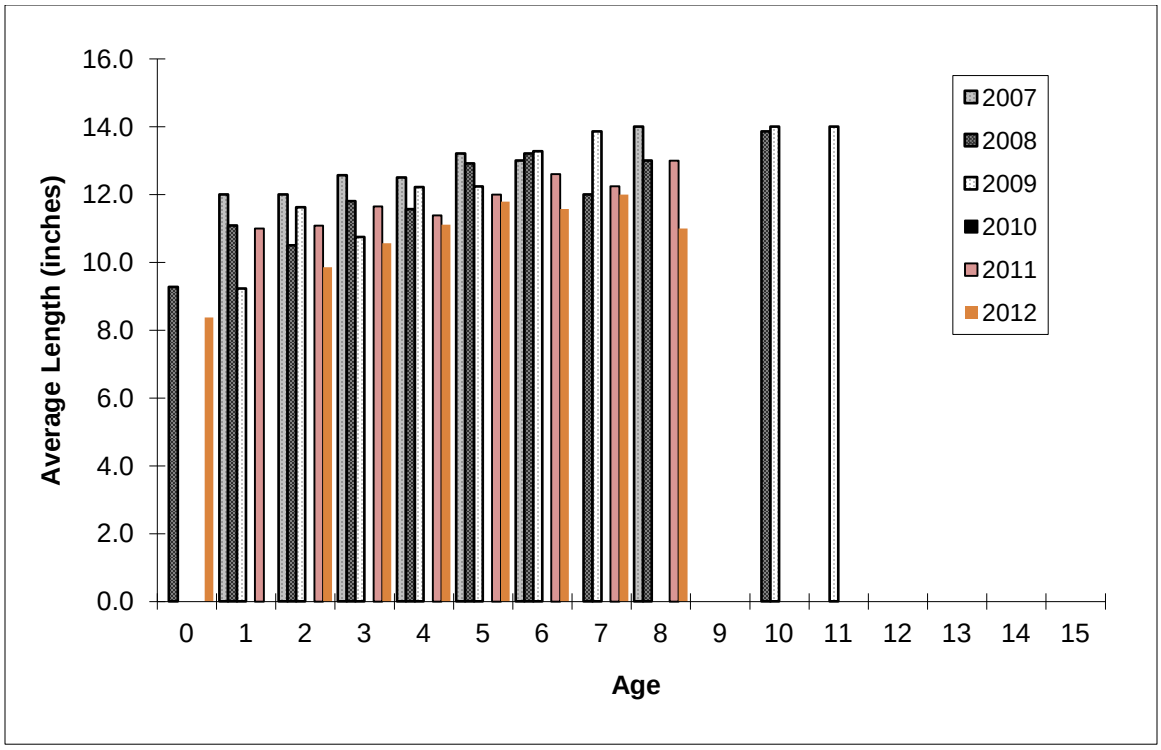



**Figure 7.** Average total length (inches) at age of Atlantic croaker sampled from New Jersey's commercial landings pooled over all gears, 2007–2012.

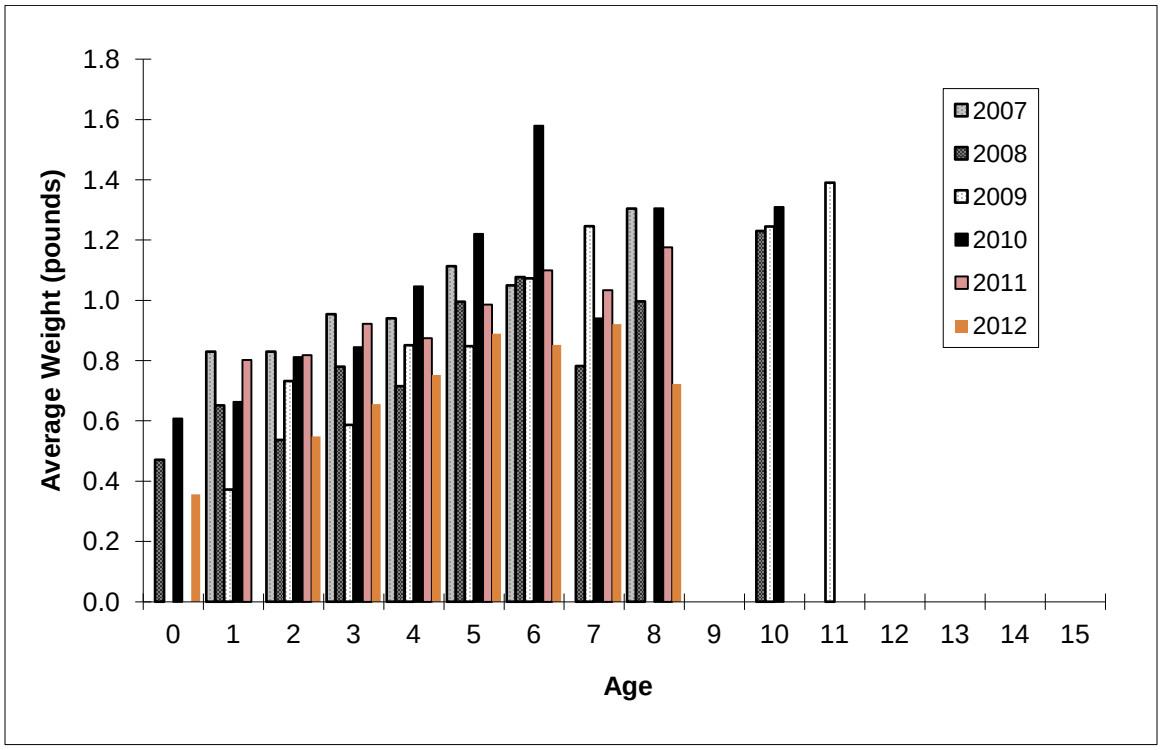



**Figure 8.** Average weight (pounds) at age of Atlantic croaker sampled from New Jersey's commercial landings pooled over all gears, 2007–2012.

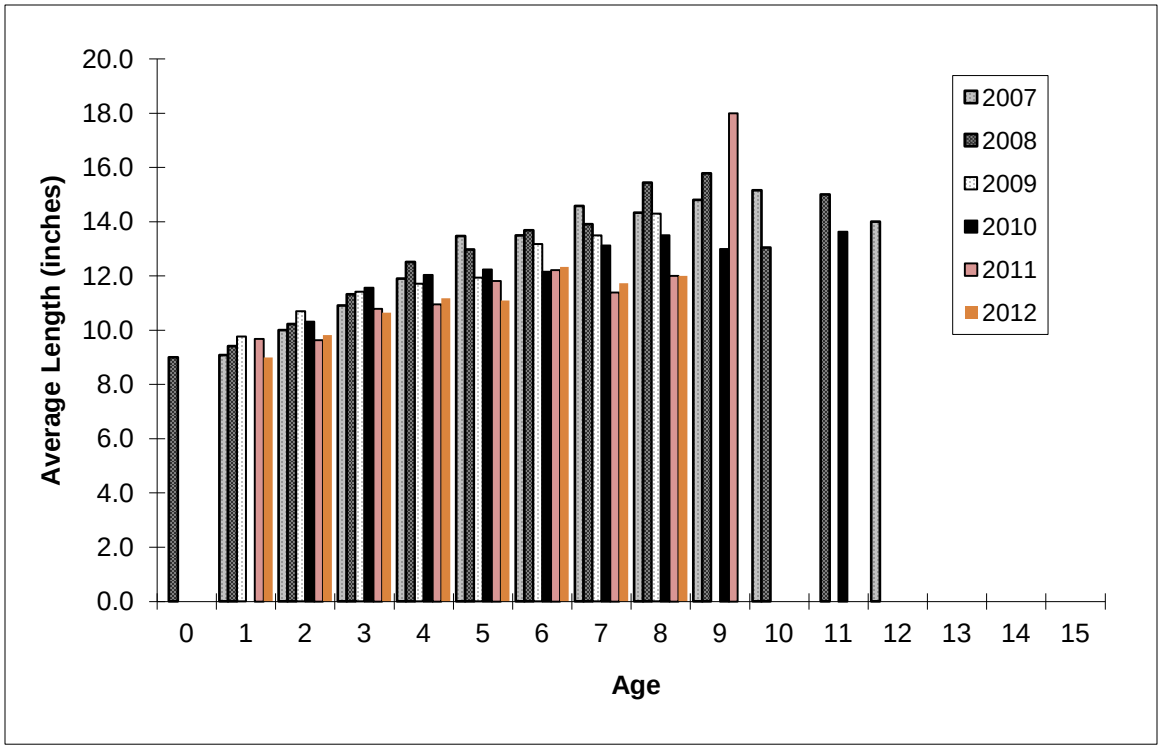



**Figure 9.** Average total length (inches) at age of Atlantic croaker sampled from Maryland's commercial pound-net landings, 2007–2012.

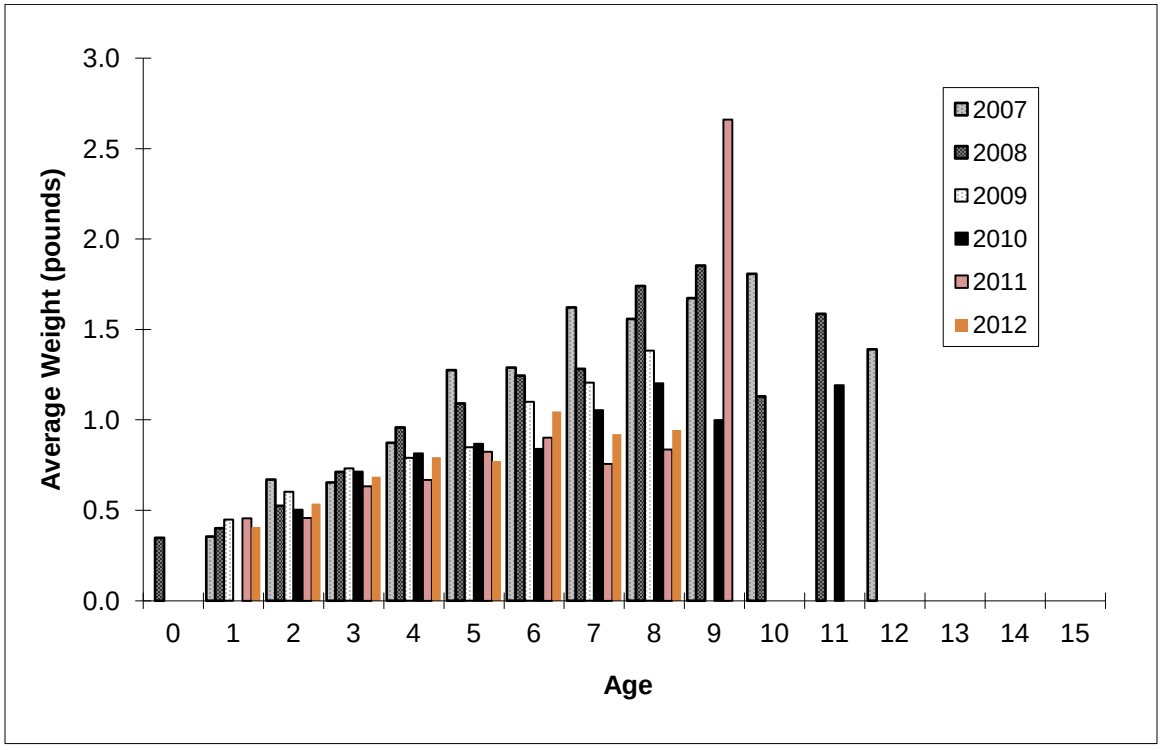



**Figure 10.** Average weight (pounds) at age of Atlantic croaker sampled from Maryland's commercial pound-net landings, 2007–2012.

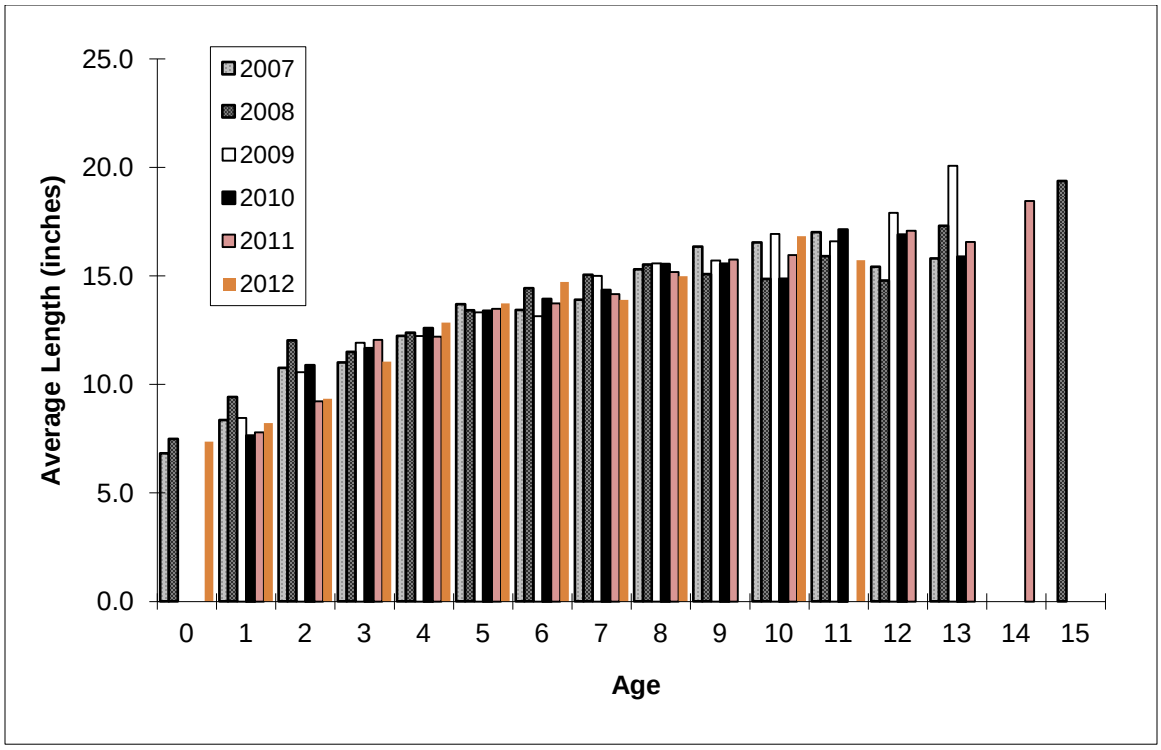



**Figure 11.** Average total length (inches) at age of Atlantic croaker sampled from Virginia's commercial landings pooled over all gears, 2007–2012.

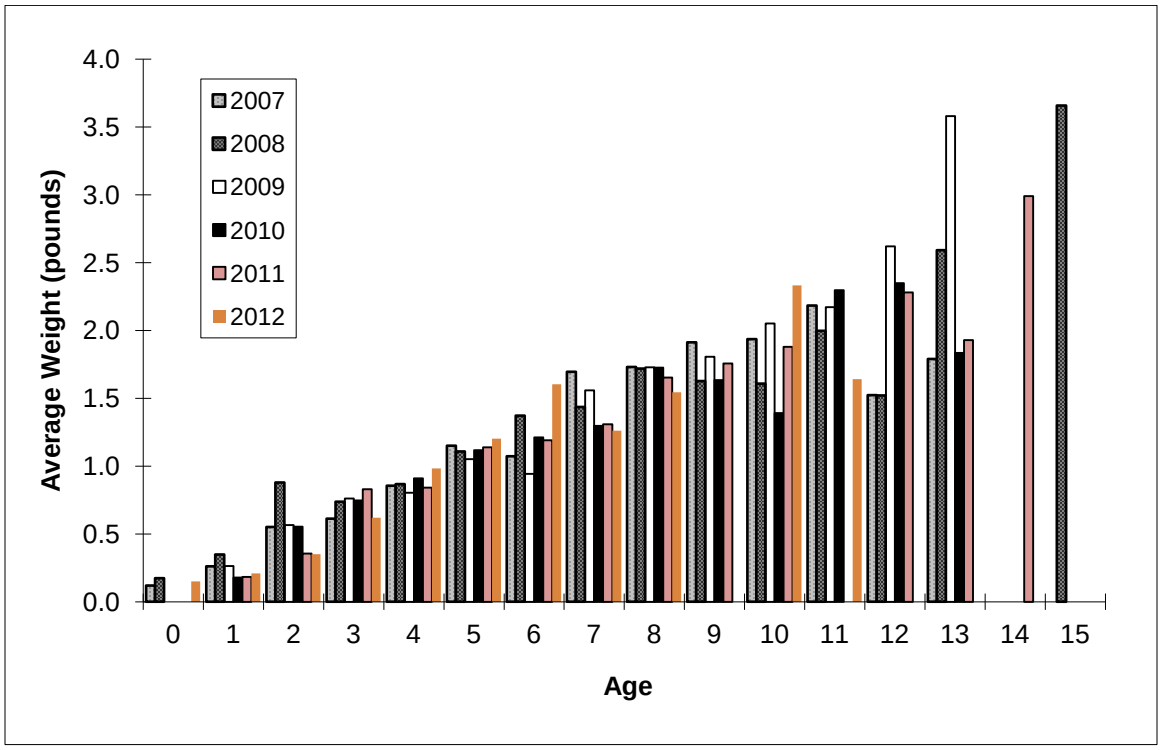



**Figure 12.** Average weight (pounds) at age of Atlantic croaker sampled from Virginia's commercial landings pooled over all gears, 2007–2012.

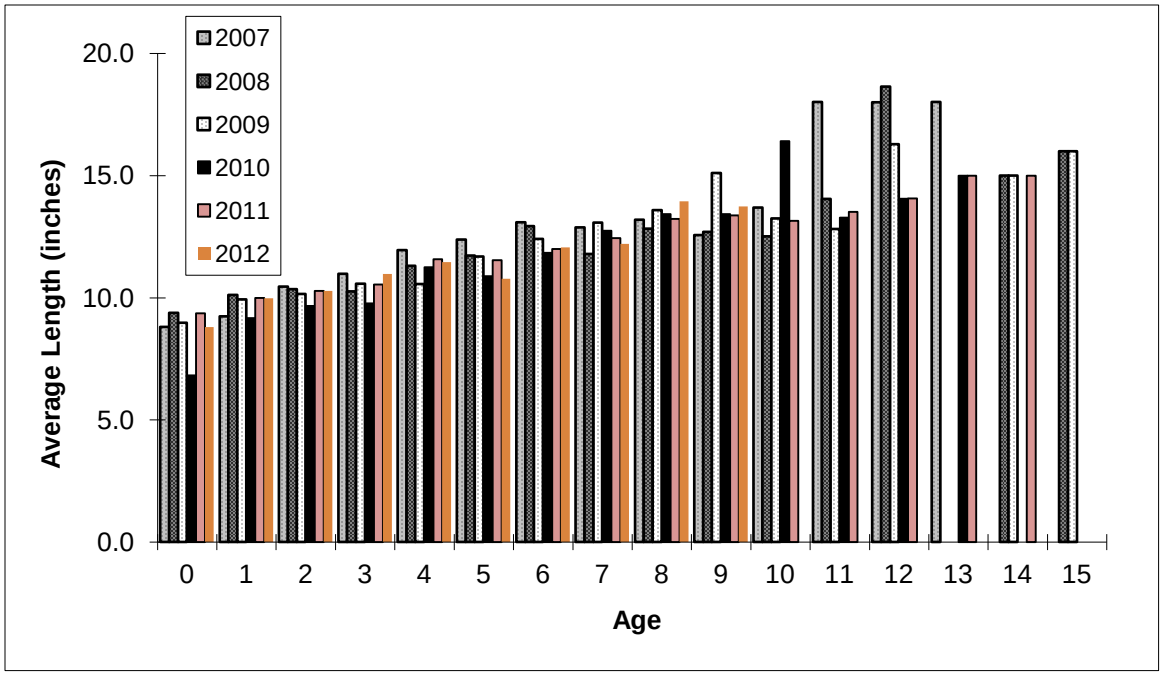



**Figure 13.** Average total length (inches) at age of Atlantic croaker sampled from North Carolina's commercial landings pooled over all gears, 2007–2012.

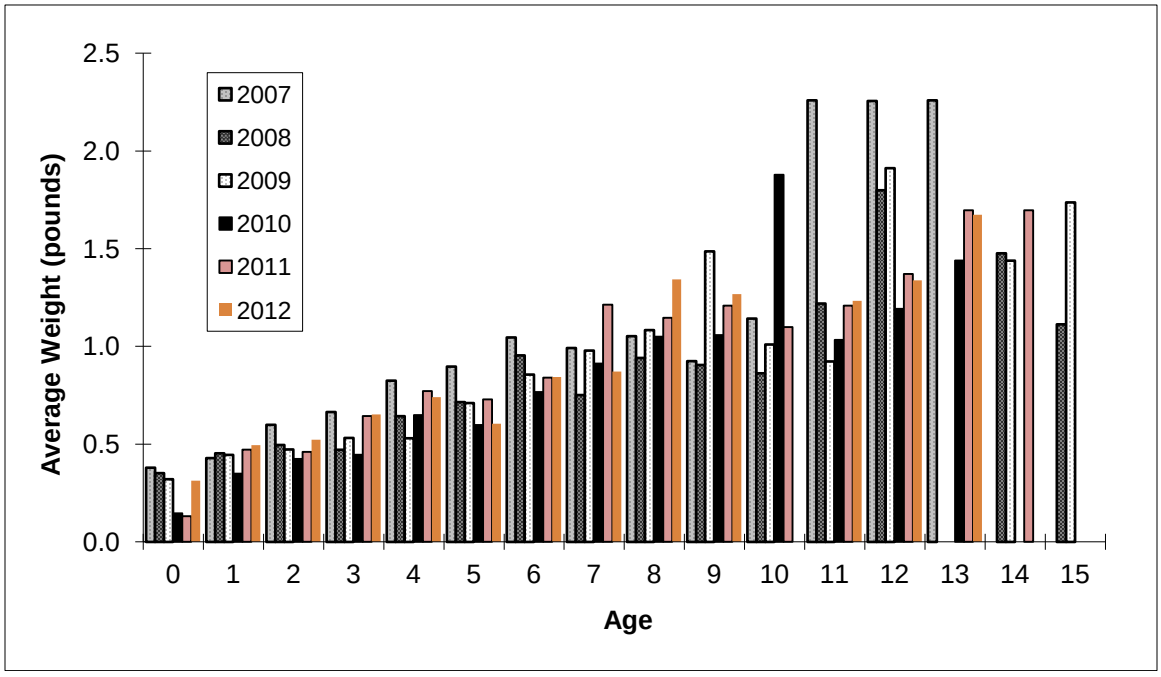



**Figure 14.** Average weight (pounds) at age of Atlantic croaker sampled from North Carolina's commercial landings pooled over all gears, 2007–2012.

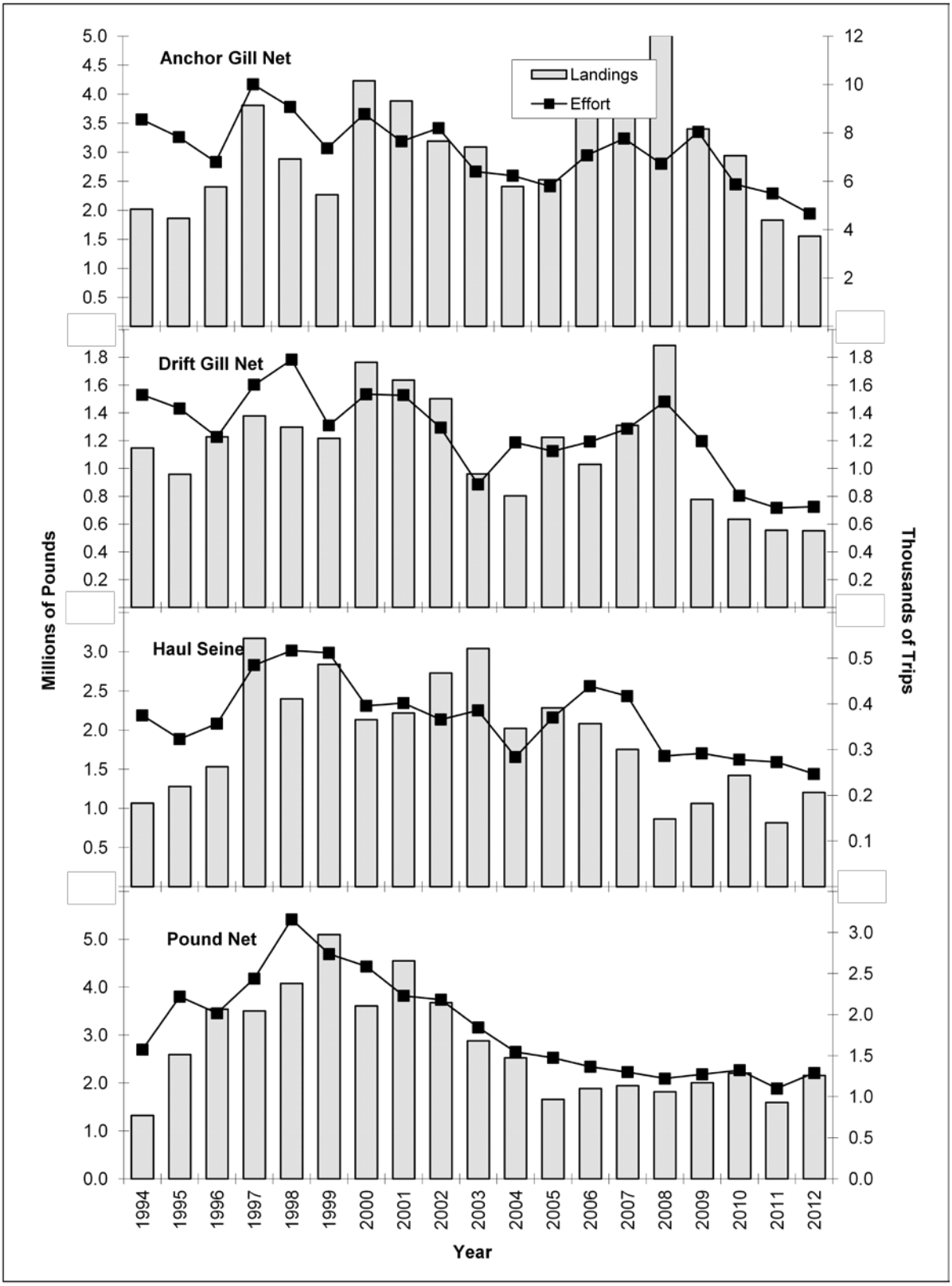



**Figure 15.** Annual landings (pounds) and effort (trips) in Virginia's Atlantic croaker commercial fisheries, by gear, 1994–2012.

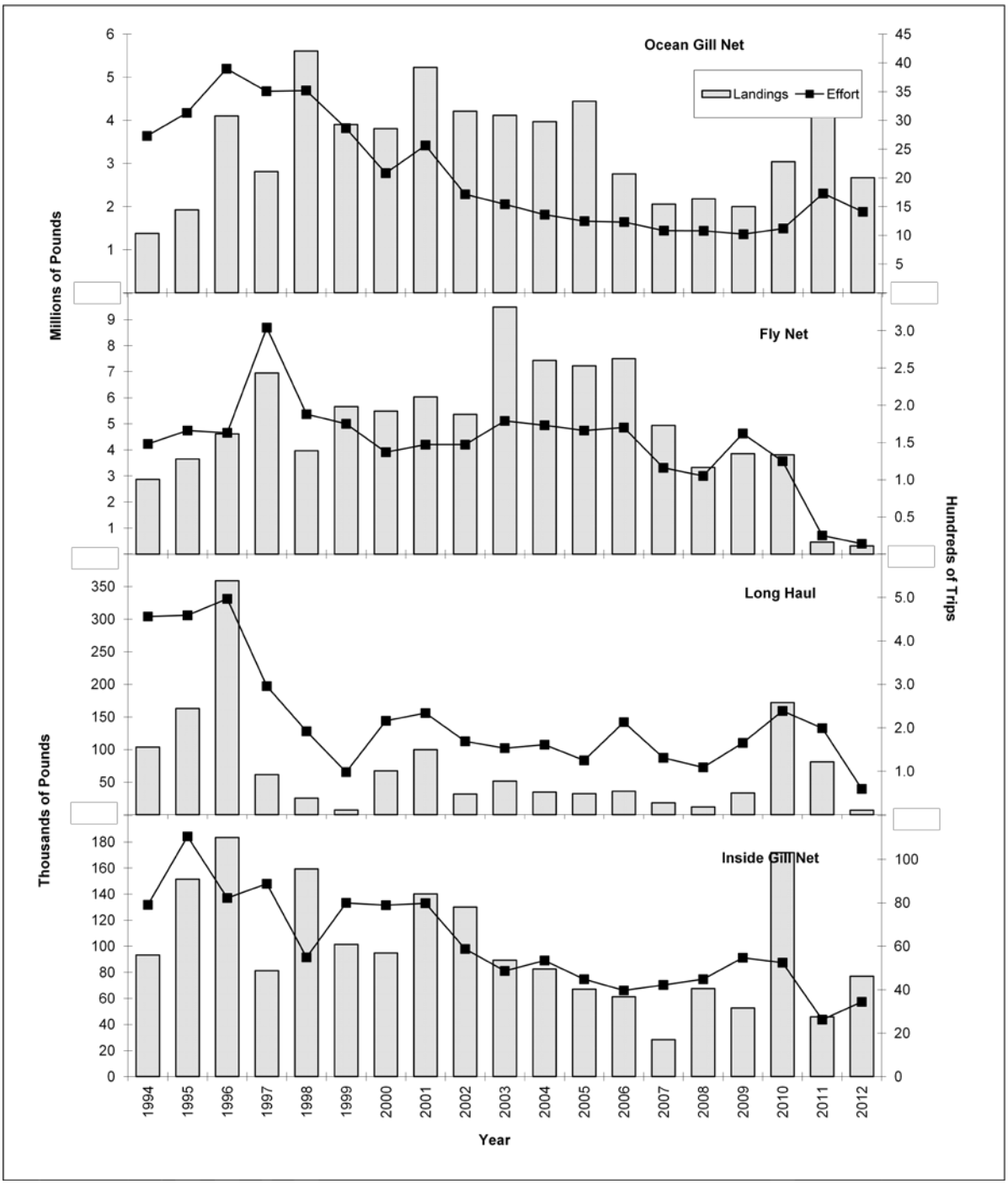



**Figure 16.** Annual landings (pounds) and effort (trips) in North Carolina's Atlantic croaker commercial fisheries, by gear, 1994–2012.

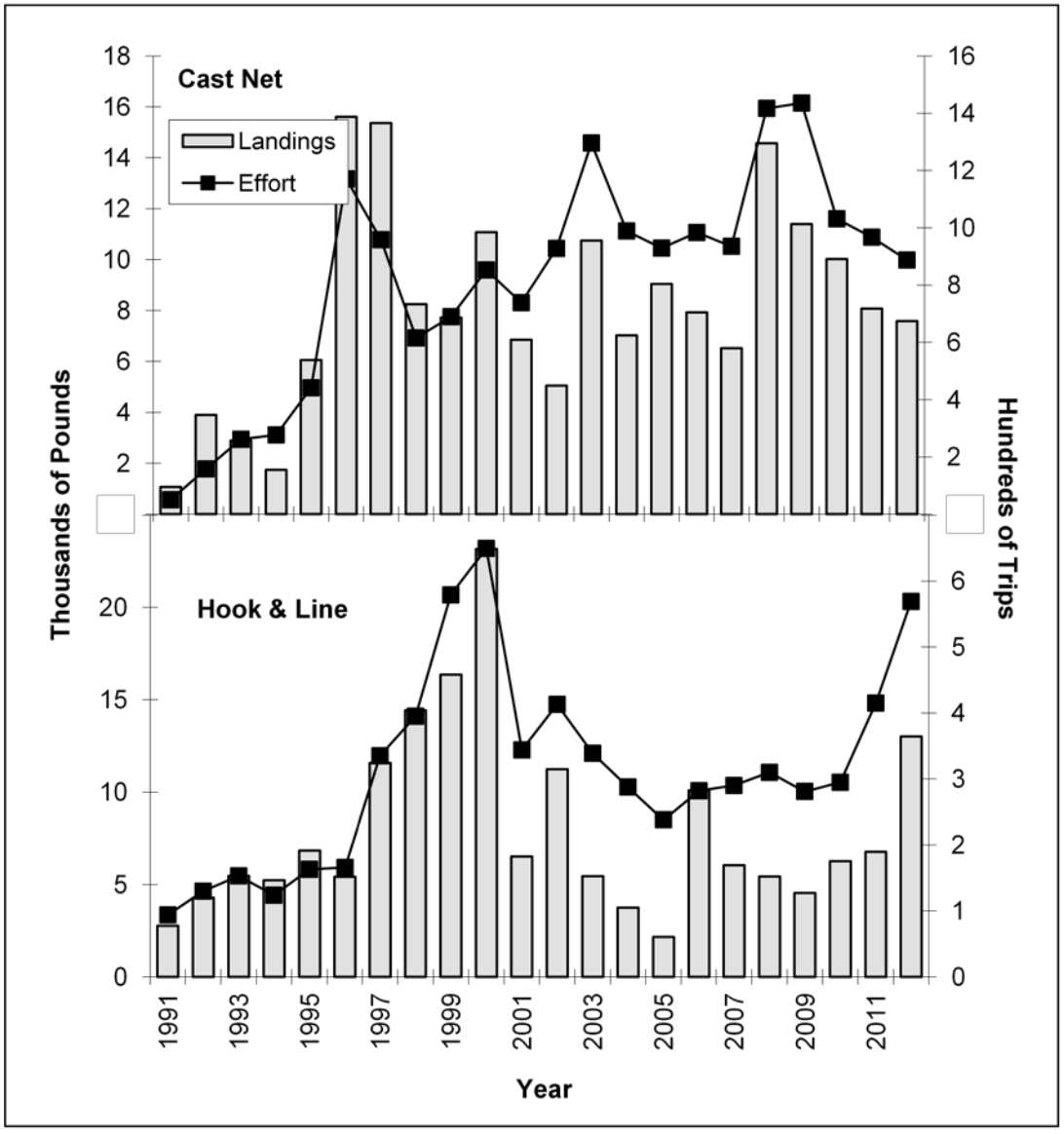



**Figure 17.** Annual landings (pounds) and effort (trips) in Florida's Atlantic croaker commercial fisheries, by gear, 1991–2012.

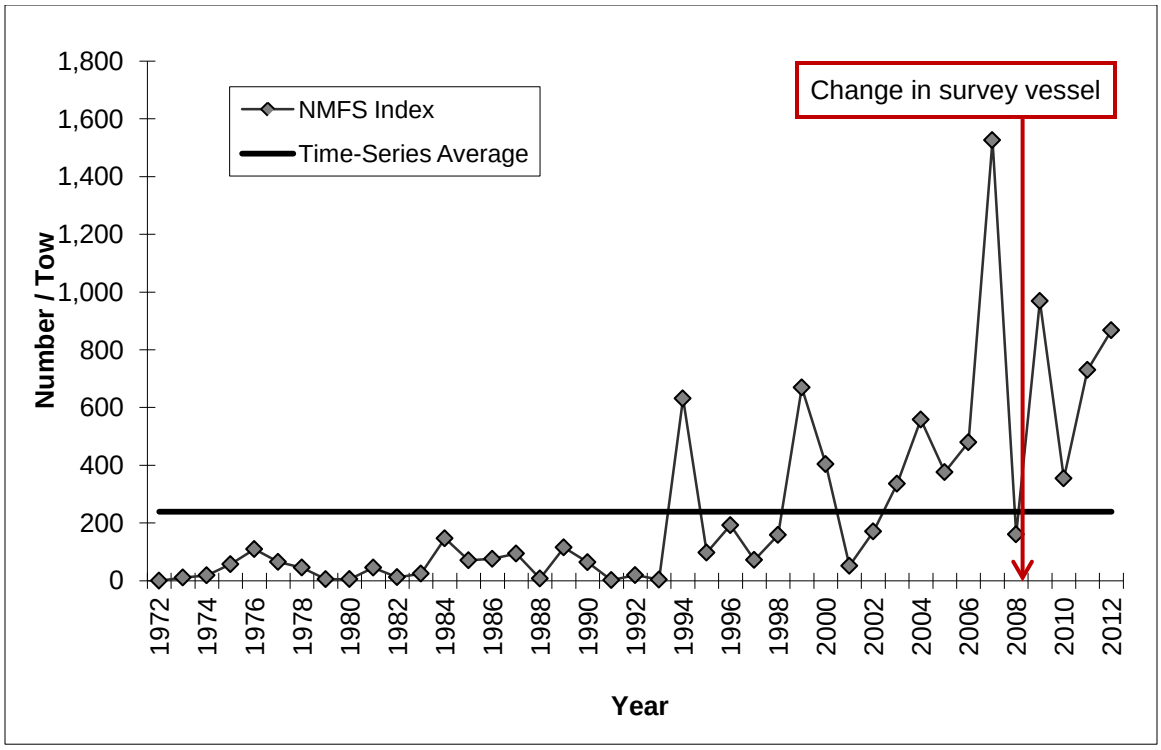



**Figure 18.** Annual index of relative abundance for Atlantic croaker derived from the NMFS Bottom Trawl Survey, Fall data,1972–2012.

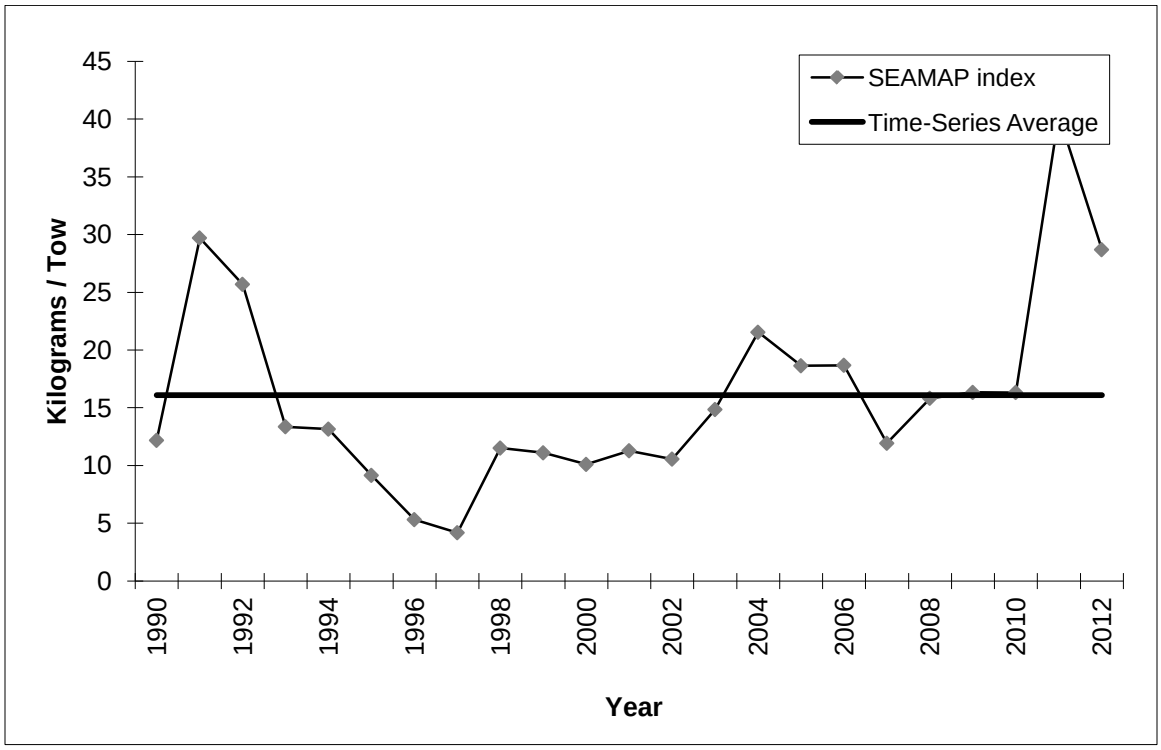



**Figure 19.** Annual index of relative abundance for Atlantic croaker derived from the SEAMAP-South Atlantic Coastal Survey, Fall data, 1990–2012.

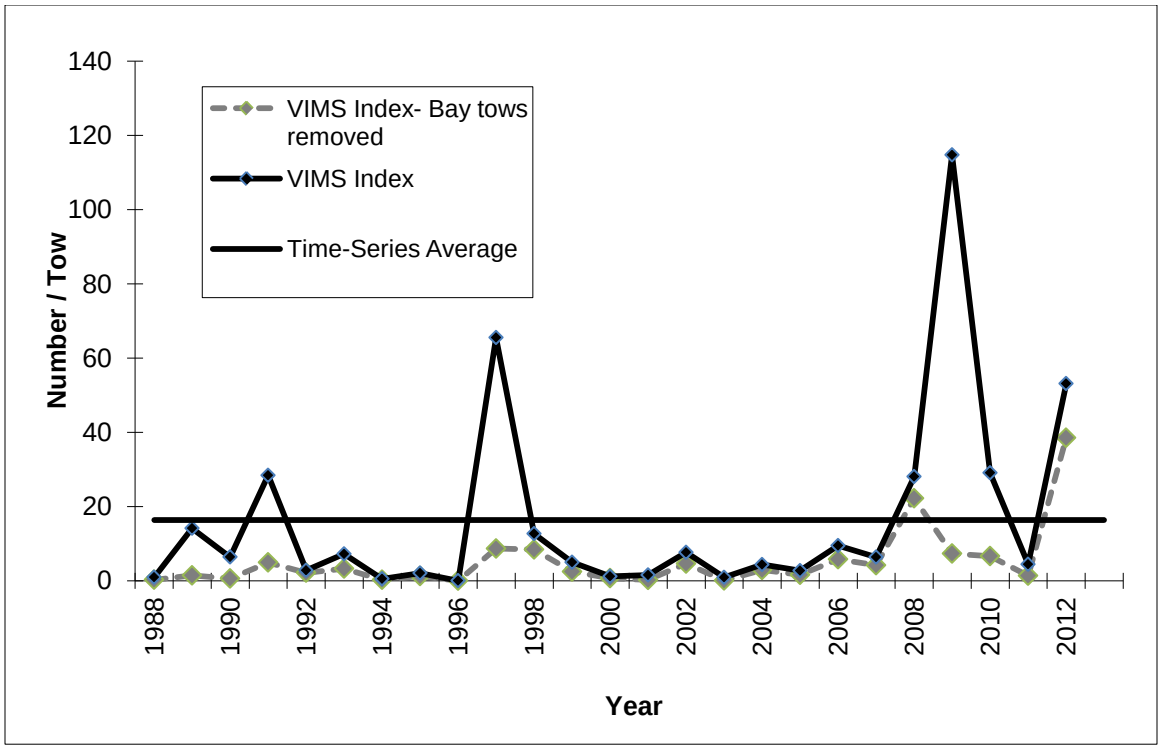



**Figure 20**. Annual young-of-year index for Atlantic croaker derived from the VIMS Juvenile Fish and Blue Crab Trawl Survey, 1988–2012.

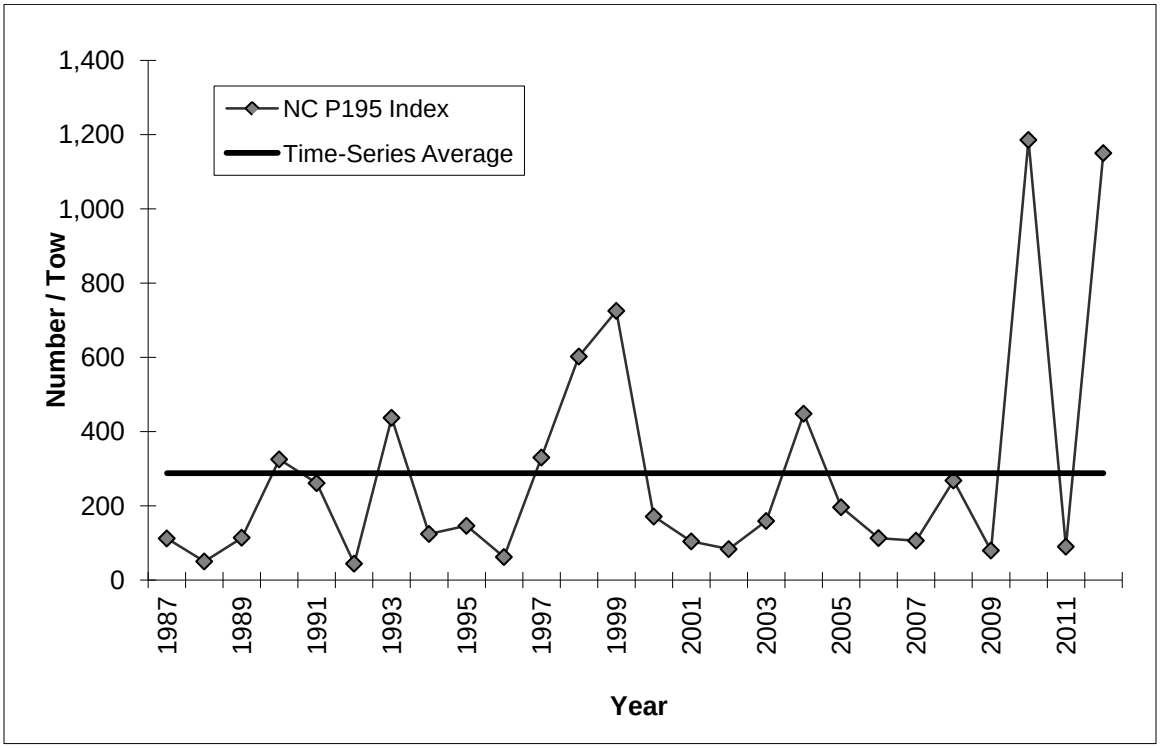



**Figure 21.** Annual young-of-year index for Atlantic croaker derived from the North Carolina Pamlico Sound Survey (Program 195), 1987–2012.

# Atlantic States Marine Fisheries Commission

1050 N. Highland Street • Suite 200A-N • Arlington, VA 22201
703.842.0740 • 703.842.0741 (fax) • www.asmfc.org


# MEMORANDUM

**July 30, 2013**

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

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

**RE:** **Spot Management Triggers Update for 2012 Fishing year**

The Spot Plan Review Team (PRT) met three times over May, June, and July 2013 via conference call to review the Spot Management Triggers, as included in the Omnibus Amendment, for the 2012 fishing year. Although the Commercial and Recreational Landings both fell below the 10$^{th}$ percentile, the management trigger was **not tripped**, as none of the fishery-independent indices fell below the 10$^{th}$ percentile. However, the commercial landings for Spot has dipped below the 10$^{th}$ percentile five of the past eight years, and the recreational landings have dipped below the 10$^{th}$ percentile twice in the past 3 years. These values continue an overall decreasing trend in commercial and recreational landings over the past decade.

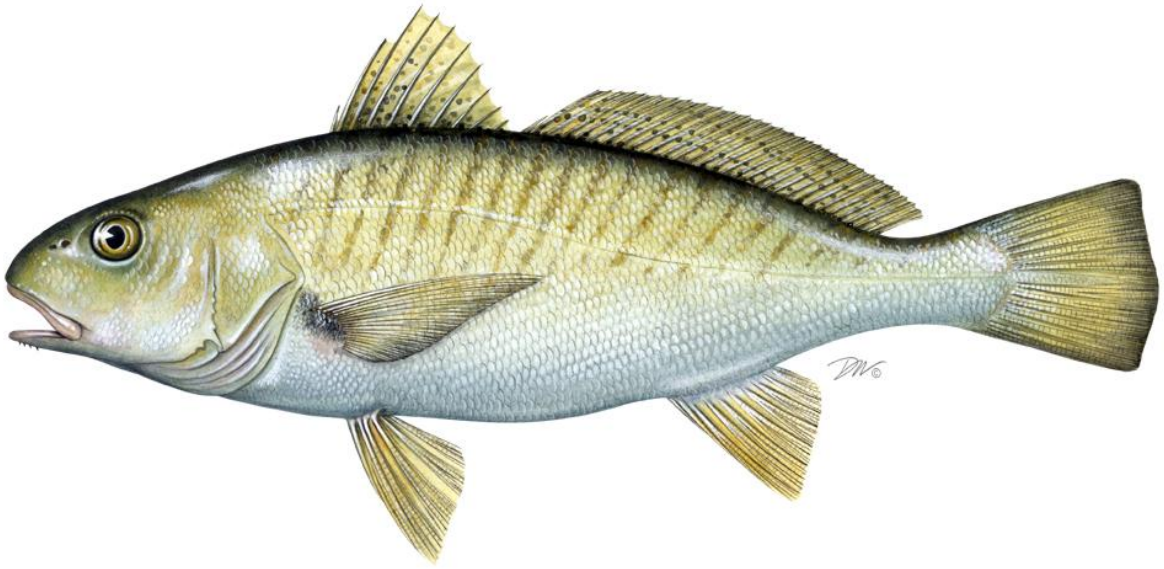
The Spot Plan Review Team remains concerned about the trend seen in the commercial and recreational landings data. Similar to the Atlantic Croaker management triggers, the PRT feels the current Spot triggers do not fully reflect the trends in the fishery and would like to have the traffic light approach -recently used in analyzing the Atlantic Croaker fishery- incorporated into the trigger exercises. To aid in better highlighting trends not captured by the triggers, the PRT would like to show the board other metrics such as changes in average length, comparative citations between Virginia and North Carolina. While the group is unsure of what else to include in the trigger exercises outside of what has been listed, there is enough concern that **guidance from the board is needed**, especially with regards to reactive changes in landings in trigger data that may cause a classification of a trigger being 'tripped' in hindsight & vice-versa. The PRT finds this of high importance as there are no current management measures set up for the Board to take based on the results of the trigger exercises.

M13-065

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

# ATLANTIC CROAKER
## *(Micropogonias undulatus)*

2012 FISHING YEAR




**Atlantic Croaker Plan Review Team**
Joe Grist, Virginia Marine Resources Commission
Wilson Laney, Ph.D., United States Fish and Wildlife Service
Chris McDonough, South Carolina Department of Natural Resources
Jason Rock, North Carolina Department of Marine Fisheries
Kirby Rootes-Murdy, Atlantic States Marine Fisheries Commission, Chair

## Table of Contents

## I. Status of the Fishery Management Plan

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

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

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

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

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

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

through South Carolina; and the mid-Atlantic region, including the states North Carolina through New Jersey.

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

Amendment 1 did not require any specific measures restricting recreational or commercial harvest of Atlantic croaker. States with more conservative measures were encouraged to maintain those regulations (Table 1). Through adaptive management, the Management Board may revise Amendment 1, and regulatory and/or monitoring requirements could be included in the resulting addendum, along with procedures for determining de minimis status and implementing alternative management programs via conservation equivalency.

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

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

## II. Status of the Stock

Stock status is based on the data and results of the 2010 stock assessment (ASMFC 2010). Results include revised biological reference points (below). These reference points are ratio-based and apply to the entire coastwide resource (unlike those in Amendment 1). Overfishing is occurring if $F/F_{MSY}$ is greater than 1 and the stock is considered overfished if $SSB/(SSB_{MSY}(1-M))$ is less than 1.

| | Overfishing Definition | Overfished Definition |
|---|---|---|
| Target | $F/(F_{MSY}*0.75) = 1$ | $SSB/SSB_{MSY} = 1$ |
| Threshold | $F/F_{MSY} = 1$ | $SSB/(SSB_{MSY}(1-M)) = 1$ |

Atlantic croaker is not experiencing overfishing. Biomass has been increasing and fishing mortality decreasing since the late 1980s. Biomass conclusions are based on information from the data compiled for the assessment, namely increasing indices of relative abundance and expanding age structure in the catch and indices. Model estimated values of fishing mortality (F), spawning stock biomass (SSB), and biological reference points are too uncertain to be used to determine stock status. However, the ratio of F to $F_{MSY}$ (the F needed to produce maximum sustainable yield) is reliable and can be used to determine that overfishing is not occurring. It is not possible to be confident with regard to stock status, particularly a biomass determination, until the discards of Atlantic croaker from the South Atlantic shrimp trawl fishery can be adequately estimated and incorporated into the stock assessment.

Absolute estimates of total F are unavailable because of model uncertainty; however, the general trend in total F from the model is considered reliable due to support from the data. The trend in total F decreases substantially during the first five years of the time series (1988-1992) and shows an overall decline over the remainder of the time series, except for occasional, brief spikes (Figure 1). Retrospective analysis of the model showed that estimates of F decreased as more years of data were used. A series of sensitivity runs conducted over a range of plausible values of shrimp-trawl fishing mortality found that the ratio of directed fishing mortality to $F_{MSY}$ was less than one in all cases, indicating overfishing was not occurring.

Absolute estimates of SSB are unavailable because of model uncertainty; however, the general trend in SSB from the model is considered reliable due to support from the data. Spawning stock biomass shows a nearly consistent increasing trend since 1998 (Figure 2). Sensitivity runs of the model, including rough estimates of shrimp trawl discards, do not change the overall trend in SSB. Retrospective analysis of the model showed that estimates of SSB increased as more years of data were used.

Recruitment, estimated in the model as age-1 abundance, has been variable but generally increasing over the time series. Figure 2 shows the trend in recruitment; absolute values are omitted because of uncertainty in abundance estimates. The model estimated the production of strong year classes in 1997, 2001, and 2007.

## III. Status of the Fishery

Total Atlantic croaker harvest from New Jersey through the east coast of Florida in 2012 is estimated at 14.6 million pounds (Tables 2 and 3, Figure 3). This represents a 35 percent decline in total harvest since the peak at 41.2 million pounds in 2001 (61% commercial decline, 73% recreational decline). The commercial and recreational fisheries harvested 80 and 20 percent of the total, respectively. The vast majority of landings are from the Mid-Atlantic region (97% in 2012), and the recent decline in total landings is a result of both commercial and recreational landings declines in that region, although some states showed increases in either or both sectors (Figure 4). Commercial and recreational landings in the South Atlantic region have been generally stable over the last decade; however, 2010 showed large decreases in the recreational

harvest of the South Atlantic states' fisheries, though nothing of the same magnitude as in the Mid-Atlantic states. Recreational and commercial harvests in the South Atlantic region rebounded to previous levels in 2011 and held stable in 2012.

Atlantic coast commercial landings of Atlantic croaker exhibit a cyclical pattern, with low domains in the 1960s to early 1970s and the 1980s to early 1990s, and high domains in the mid-to-late 1970s and the mid-1990s to the present (Figure 3). This cyclical pattern was noted in the recent 2010 stock assessment, noting that the 50-year time series follows this pattern and that the current trend has been towards a low. Commercial landings increased from a low of 3.7 million pounds in 1991 to 30.1 million pounds in 2001 (Table 2); however, landings have declined consistently since 2003 to 11.6 million pounds in 2012, which registers below the 1960-2011 average of 13.6 million pounds. Within the management unit, the majority of 2012 commercial landings came from Virginia (59%) and North Carolina (27%). Maryland had the next highest level, with 8% of the coastwide landings.

From 1981-2012, recreational landings of Atlantic croaker from New Jersey through Florida have varied between 2.8 million fish (1.3 million pounds) and 13.2 million fish (11.1 million pounds; Tables 3 and 4, Figure 5). Landings general increased until 2001, held stable from 2001-2006 before exhibiting a declining trend from 2007 through 2012. The 2012 landings are estimated at 5.4 million fish and 2.9 million pounds, continuing the decline from 2009. Virginia was responsible for 65% of the 2012 recreational landings, in numbers of fish, followed by Maryland (13%), and Florida (11%). The number of recreational releases has increased over the time series, with a short decline from 2009-2011 (Figure 5). In 2012, anglers released 10.5 million fish, which is less than the ten-year (2002-2011) average of 11.9 million fish (Table 5). Anglers released an estimated 66% of the croaker catch in 2012 (Figure 5).

## IV. Status of Assessment Advice

A statistical catch-at-age (SCA) model was used in the last Atlantic croaker stock assessment (ASMFC 2010). This model combines the catch-at-age data from the commercial and recreational fisheries with information from fishery-independent surveys and biological information such as growth rates and natural mortality rates to estimate the size of each age class and the exploitation rate of the population. The assessment was peer reviewed by a panel of experts in conjunction with the Southeast Data, Assessment, and Review (SEDAR) process.

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

## V. Status of Research and Monitoring

There are no research or monitoring programs required of the states except for the submission of an annual compliance report. The following fishery-dependent (other than catch and effort data) and fishery-independent monitoring programs were reported in the 2013 compliance reports.

Fishery-Dependent Monitoring

- New Jersey: commercial fishery biological sampling since 2006 (660 length measurements and 619 otolith ages in 2012)
- Maryland: commercial pound net fishery biological sampling (1,842 length measurements, 255 otoliths collected in 2012), at-sea sampling supplemented with dealer sampling beginning in 2009 (571 length and weight measurements in 2012); Maryland Charter Boat CPUE (1993-present; 2012 CPUE continued decline from 2010 but still above time-series mean)
- Virginia: commercial fishery biological sampling (7,121 length and weight measurements, 400 otolith ages, and 672 sex determinations in 2012)
- North Carolina: commercial fishery biological sampling since 1982 for length (2011 n = 7,098), weight (2011 n = 14,829), otolith, sex determination, and reproductive condition
- South Carolina: recreational fishery biological sampling via state finfish survey (137 length measurements in 2012)
- Georgia: recreational fishery biological sampling via carcass collections (1 fish in 2012)
- Florida: commercial fishery biological sampling (43 length measurements in 2012)

Fishery-Independent Monitoring

- New Jersey: nearshore ocean (within 12 nm) juvenile trawl surveys (1988-present; 2012 CPUE well above time-series average; nearshore Delaware Bay juvenile trawl survey (1991-present; 2012 CPUE low but near time-series average); Delaware River juvenile seine survey (1980-present; 2012 CPUE high and above time-series average)
- Delaware: offshore Delaware Bay adult finfish trawl survey (1966-present; 2012 n = 8,885; 662% increase in catch per nm towed over 2011 but still below time-series mean); nearshore Delaware Bay and River juvenile finfish trawl survey (1980-present; 2012 index (geometric mean) declined 4% from 2011 and fell below time-series mean)
- Maryland: Atlantic coast bays juvenile otter trawl survey (standardized from 1989-present); Chesapeake Bay juvenile trawl survey (standardized from 1989-present; 2012 CPUE increased from 2011, recording the seventh highest value in 24 year time series); incidental catches in Maryland coastal bays juvenile seine survey (1972-present) and Chesapeake Bay juvenile seine survey (1959-present; 2012 indices increased or were stable relative to 2011)
- Virginia: VIMS Juvenile Finfish and Blue Crab Trawl Survey (1988-present; 2012 index representing the 2011 year class, is the third highest on record, from 1988 to 2012, for both the 'mean all' and 'mean rivers' indices.)
- North Carolina: Pamlico Sound juvenile trawl survey (1987-present; 2012 juvenile abundance index was the second highest recorded in NC and was well above time-series mean)
- South Carolina: estuarine electroshock survey for juveniles (1991-present; 2012 CPUE decreased 50% , marking the fourth year in a row of being below the long term mean); SEAMAP shallow water (15-30 ft) trawl survey from Cape Hatteras to Cape Canaveral (1989-present; 2012 CPUE decreased 31.1% but remained above time-series mean); inshore estuarine trammel net survey for adults (May-September, 1991-present; 2012

CPUE increased 53% from 2011 and catch effort in 2012 was just below the long term mean)
- Georgia: Marine Sportfish Population Health Survey (trammel and gill net, 2002-present; 2012 n = 158); Ecological Monitoring Survey (trawl, 2003-present; 2012 n = 7,508; CPUE declined by 50% from 2011)
- Florida: juvenile seine survey (1996-present; 2012 index continued variable trend with a decrease from 2011); juvenile trawl survey (2002-present; 2012 index continued variable trend with a decrease from 2011); adult haul seine survey (2001-present; 2012 index value decreased from 2011)

The Northeast Fishery Science Center's groundfish trawl survey also samples croaker from New Jersey to Cape Hatteras. Researchers from various agencies and institutions have conducted numerous studies on Atlantic croaker. Research topics include, but are not limited to: environmental effects on recruitment, population modeling, genetic stock identification, geographic variation in life history/populations dynamics, scale-otolith age comparisons, habitat preference, and bycatch reduction gear research.

*Ageing Workshop*
An Atlantic Croaker Ageing Workshop was held in October 2008. Conducting a workshop to standardize the otolith sectioning and ageing procedures and the current age dataset had been a longstanding research need for Atlantic croaker, especially prior to the 2010 benchmark assessment. Representatives from New Jersey, Maryland, Virginia, North Carolina, South Carolina, Georgia and the Gulf Council attended the workshop. The resulting standardized ageing procedure was published in an ASMFC reference document, with some states having already incorporated ageing instructions into their references.

## VI. Status of Management Measures and Issues

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

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

In the annual compliance reports, the following states requested *de minimis* status: Delaware (commercial fishery), South Carolina (commercial fishery), Georgia (commercial and recreational fisheries), and Florida (commercial fishery). The commercial and recreational *de minimis* criteria for 2011 are based on 1% of the average coastwide 2010-2012 landings in each fishery: 129,039 pounds for the commercial fishery and 35,135 pounds for the recreational fishery. The Delaware commercial fishery qualifies for *de minimis* status with an average of 6,727 pounds. The South Carolina commercial fishery qualifies for *de minimis* status with an average of 36 pounds. The Georgia commercial and recreational fisheries qualify for *de minimis* status with averages of less than 1,000 pounds (confidential) and 15,039 pounds, respectively. The Florida commercial fishery qualifies for *de minimis* status with an average of 50,386 pounds.

*Bycatch Reduction*

Atlantic croaker is subject to both direct and indirect fishing mortality. Historically, croaker ranked as one of the most abundant species in the bycatch of the south Atlantic shrimp trawl fishery. As a result, the original FMP recommended that bycatch reduction devices (BRDs) be developed and required in the shrimp trawl fishery. Since then the states of North Carolina through Florida have all enacted requirements for the use of BRDs in shrimp trawl nets in state waters, and croaker bycatch from this fishery has been reduced (ASMFC 2010). However, monitoring of bycatch and discards from this fishery is inadequate and results in the major source of uncertainty for assessing this stock, as well as other important Mid- and South Atlantic species. Most of the discarded croakers are age-0 and thus likely have not yet reached maturity (ASMFC 2010). North Carolina Department of Marine Fisheries has secured funding for a two-year study, beginning in 2012, to collect bycatch data from state shrimp trawlers. These data will be valuable for incorporating estimates of removals in the next stock assessment.

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

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

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

Atlantic croaker are also subject to recreational discarding. The number of Atlantic croaker released alive by recreational anglers has generally increased over time. Ten percent of croakers released alive were estimated to die as a result of being discarded for the last stock assessment (ASMFC 2010). The use of circle hooks and appropriate handling techniques can help to reduce mortality of released fish.

*Trigger Exercises*

Amendment 1 requires the Technical Committee to conduct stock assessments every five years unless prompted by the annual trigger exercise. The primary hard trigger is based on landings data; however, catch-per-unit-effort (CPUE) will become the premier trigger when the quality and quantity of these data improve. A stock assessment will be triggered if the most recent year's commercial or recreational landings are less than 70% of the previous two years' average landings (ASMFC 2005b).

In 2011, the recreational landings dropped to 75.9% of the previous two-year average, therefore not triggering a stock assessment update or benchmark. The Atlantic Croaker Technical Committee reviewed the triggers, as well as discussed development of new triggers as tasked by the Board via three conference calls in May, June, and July. While the commercial and recreational landings, along with the estimates of landings per unit effort, have shown decreases, the fishery-independent indices have not indicated major issues with the stock. Based on the available data and benefits and disadvantages of performing an update to the stock assessment, the Technical Committee recommended the Board not perform an assessment but rather allow the Technical Committee to build other approaches into the trigger exercises, such as using a traffic light methodology. The 2013 Atlantic Croaker Trigger Report further details the Technical Committee's this approach and subsequent recommendations.

## VII. Implementation of FMP Compliance Requirements for 2012

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

## VIII. Recommendations

**Management and Regulatory Recommendations**

- Encourage the use of circle hooks to minimize recreational discard mortality.
- Consider approval of the *de minimis* requests from Delaware, South Carolina, Georgia, and Florida.
- Consider the basic research and monitoring information needed for informed management in light of the budgetary constraints limiting all state governments
- Support the Technical Committee's recommendation to develop new assessment/management triggers for use in management by the Board

**Research and Monitoring Recommendations**

High Priority

- Develop and implement compatible and coordinated sampling programs for the South Atlantic shrimp trawl fishery in order to monitor and characterize Atlantic croaker bycatch in this fishery.
- Continue fisheries-independent surveys throughout the species range, with increased focus on collecting subsamples in the southern range
- Encourage fishery-dependent biological sampling, with increased focus in the southern range and expanding the commercial and recreational fishery samples to afford a full age-length key
- Determine migratory patterns and mixing rates through cooperative, multi-jurisdictional tagging studies; further studies on relative degree of genetic separation between fish in the northern and southern range of species; and continue research and analysis of otolith microchemistry data.
- Collect bio-profile information and conduct studies on growth rates, age structure, estimates of fecundity, and maturity schedule throughout the species range with a standardized protocol.
- Evaluate bycatch and discard estimates from commercial and recreational fisheries, and extend coverage of scrap fishery sampling to other states.
- Develop fishery-independent size, age, and sex specific relative abundance estimates to monitor long-term changes in croaker abundance.
- Maintain funding for current surveys and monitoring to provide needed information for stock monitoring and assessment

Medium Priority

- Develop age-size data that are representative of all seasons and areas in the fisheries on an annual basis.
- Improve catch and effort statistics from the commercial and recreational fisheries and develop more rigorous methods to standardize catch-per-unit-effort.
- Collect data on fishing attributes necessary to develop gear-type-specific fishing effort estimates.
- Evaluate commercial and recreational mortality under varying environmental factors and fishery practices and include in updated assessment.
- Update studies on the effectiveness of bycatch reduction devices (BRDs) in reducing croaker bycatch.
- Validate otolith aging methods with appropriate methods, e.g., tagging, chemical marking.
- Evaluate the optimum utilization (economic and biological) of a long-term fluctuating population such as croaker.
- Identify essential habitat requirements.
- Determine species interactions and predator/prey relationships for croaker (prey) and other more highly valued fisheries (predators).
- Determine the impacts of any dredging activity (i.e. for beach re-nourishment) on all life history stages of croaker.
- Investigate environmental covariates in stock assessment models.
- Examine socio-economic aspects of the fishery.

- Recover historical data in order to have landings data from NOAA at a finer scale
- Re-examine historical ichthyoplankton studies of the Chesapeake Bay for an indication of the magnitude of estuarine spawning.

## IX. References

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

ASMFC. 2005a. Atlantic Croaker Stock Assessment & Peer Review Reports. Washington (DC): ASMFC. 370 p.

ASMFC. 2005b. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Croaker. Washington (DC): ASMFC. Fishery Management Report No. 44. 92 p.

ASMFC. 2010. Atlantic Croaker 2010 Benchmark Stock Assessment. Washington (DC): ASMFC. 366 p.

## X. Figures

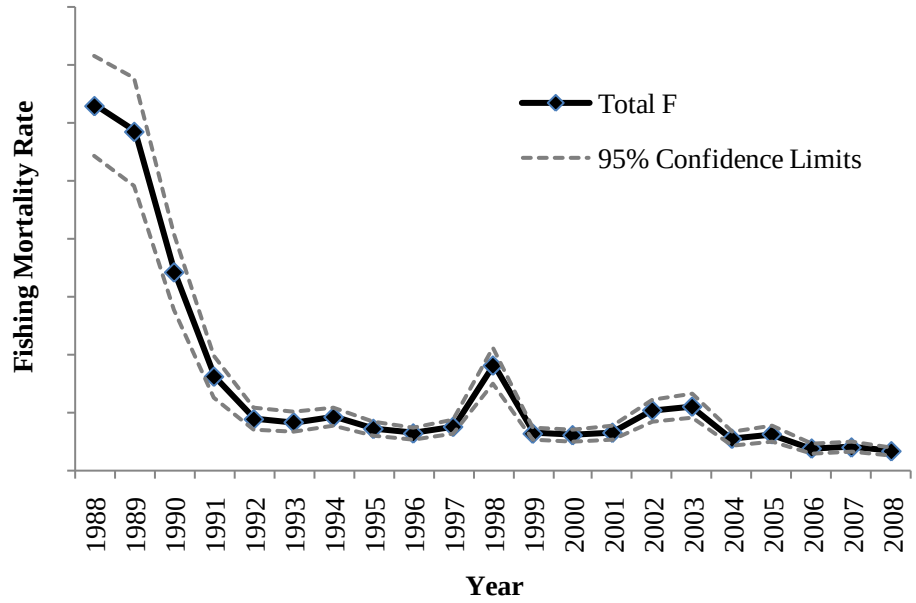



**Figure 1. Trend in estimated total fishing mortality rate (F) of Atlantic croaker**
(Absolute estimates of F are unreliable because of uncertainty regarding the estimation of Atlantic croaker discards in the shrimp trawl fishery, and the application of estimates in modeling. Source: ASMFC 2010.)

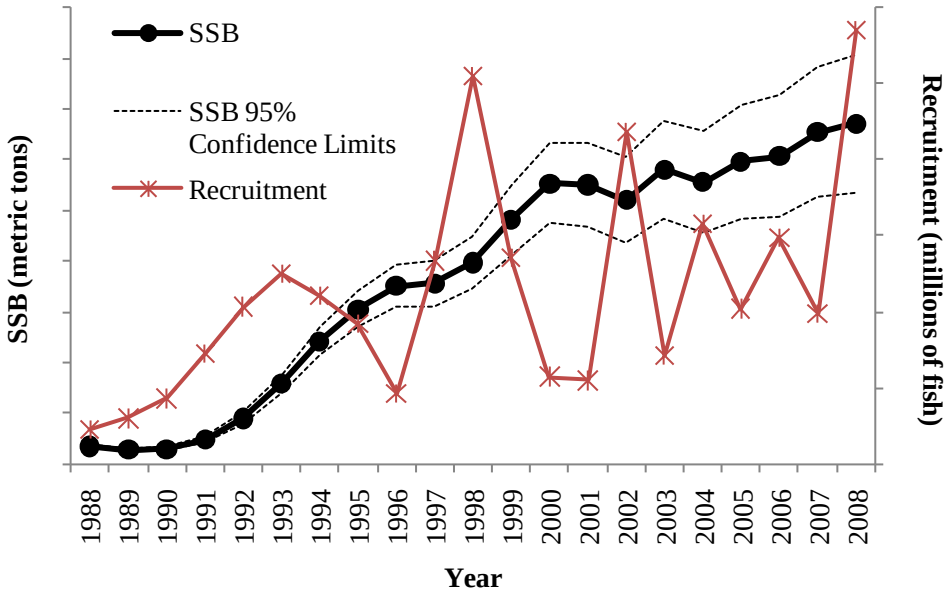



**Figure 2. Trends in estimated spawning stock biomass (SSB, metric tons) and age-1 recruitment (numbers of fish) of Atlantic croaker**
(Absolute estimates of stock size are unreliable because of uncertainty regarding the estimation of Atlantic croaker discards in the shrimp trawl fishery, and the application of estimates in modeling. Source: ASMFC 2010.)

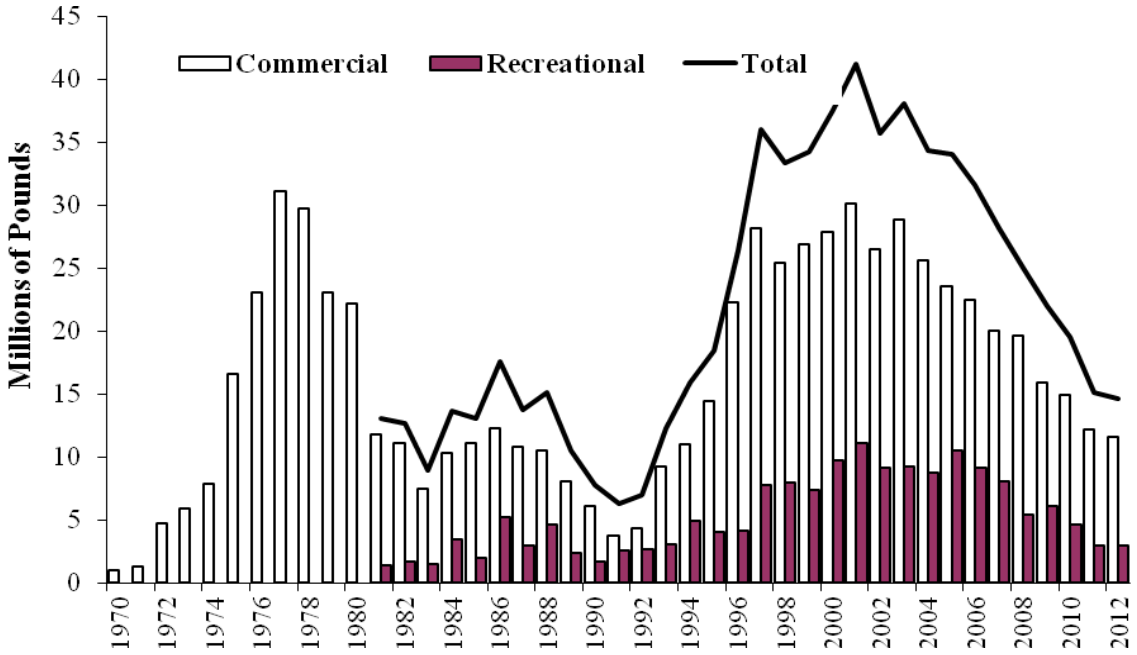



**Figure 3. Atlantic croaker commercial, recreational, and total landings (pounds)**
(See Tables 2 and 3 for values and source information. Commercial landings estimate for 2012 is preliminary. Reliable recreational landings estimates are not available before 1981.)

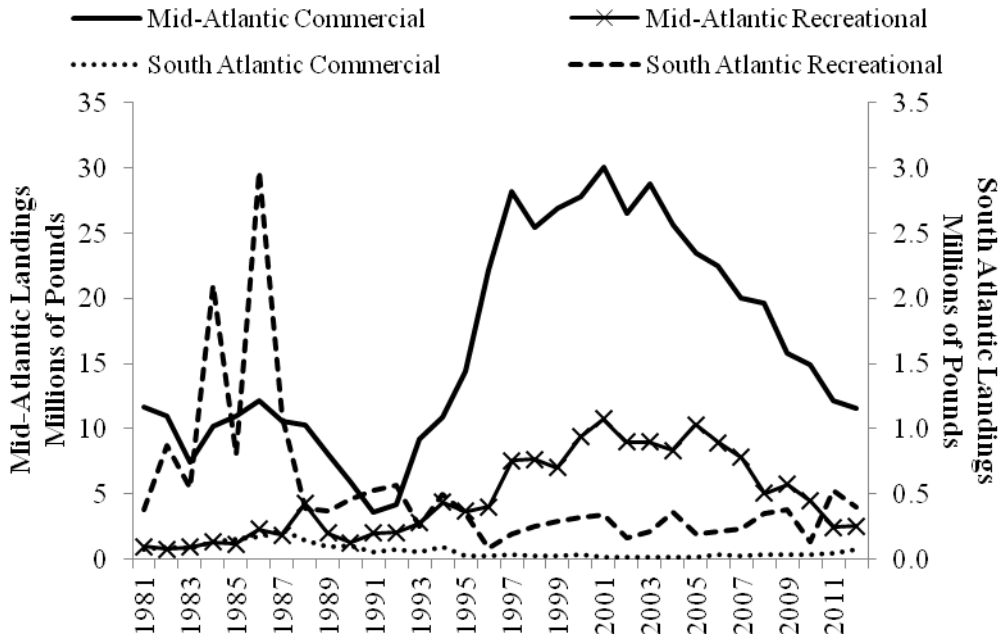



**Figure 4. Mid-Atlantic (NJ-NC) and South Atlantic (SC-FL) landings (pounds)**
(See Tables 2 and 3 for values and source information.)

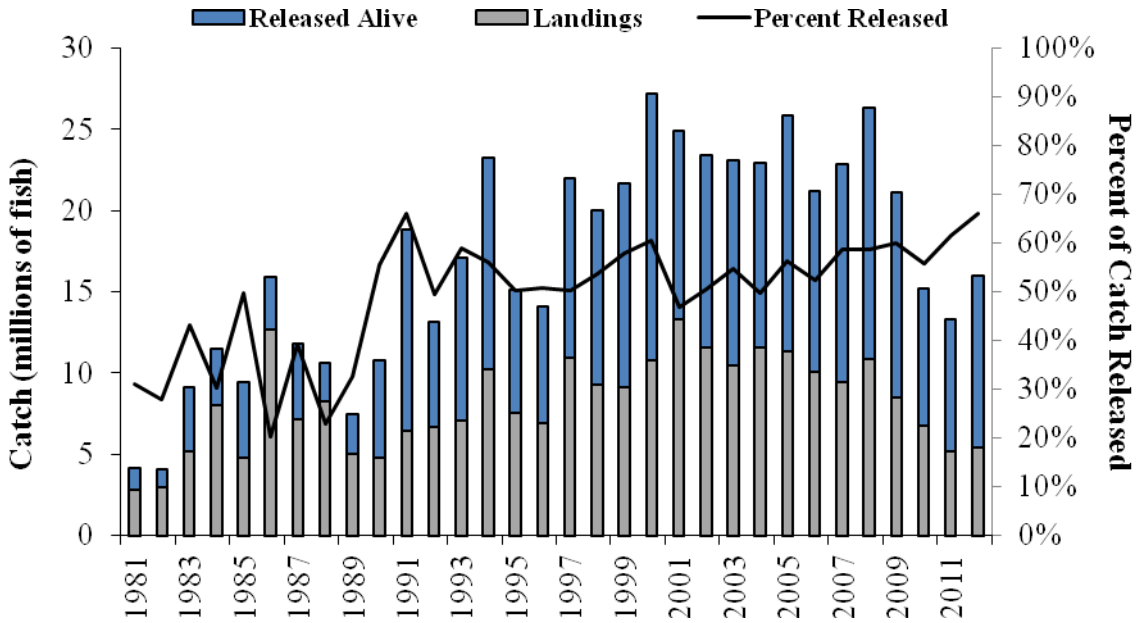



**Figure 5. Recreational catch (landings and alive releases, in numbers) and the percent of catch that is released, 1981-2012**
(See Tables 4 and 5 for values and source information.)

## XI. Tables

**Table 1. Summary of state regulations for Atlantic croaker in 2012***

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

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

**Table 2. Commercial harvest (pounds) of Atlantic croaker by state, 1981-2012**
(Estimates for 2012 are preliminary. Sources: state compliance reports; personal communication with ACCSP, Arlington, VA.)

| Year | NJ | DE | MD | PRFC | VA | NC | SC | GA | FL | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 23,500 | 0 | 2,104 | 648 | 429,800 | 11,205,342 | 2,441 | 1,038 | 72,112 | 11,736,985 |
| 1982 | 100 | 0 | 7,091 | 188 | 119,300 | 10,824,953 | 386 | 2,177 | 95,357 | 11,049,552 |
| 1983 | 200 | 0 | 417 | 1,549 | 150,400 | 7,249,680 | 3,200 | 1,097 | 81,737 | 7,488,280 |
| 1984 | 57,700 | 0 | 27,072 | 73,701 | 817,700 | 9,170,775 | 3,793 | 434 | 131,375 | 10,282,550 |
| 1985 | 48,800 | 100 | 9,510 | 19,854 | 2,171,821 | 8,714,432 | 1,256 |  | 153,803 | 11,119,576 |
| 1986 | 106,000 | 500 | 135,922 | 99,373 | 2,367,000 | 9,424,828 | 924 |  | 173,531 | 12,308,078 |
| 1987 | 357,600 | 800 | 119,409 | 102,691 | 2,719,500 | 7,289,191 | 698 | 553 | 217,932 | 10,808,374 |
| 1988 | 30,100 | 200 | 98,855 | 12,796 | 1,749,200 | 8,434,415 | 2,614 | 304 | 140,033 | 10,468,517 |
| 1989 | 137,100 | 0 | 89,173 | 5,579 | 949,649 | 6,824,088 | 1,950 |  | 95,021 | 8,102,560 |
| 1990 | 644 | 42 | 2,473 | 5,115 | 201,353 | 5,769,512 | 1,190 |  | 104,402 | 6,084,731 |
| 1991 | 31,292 | 700 | 6,183 | 996 | 164,126 | 3,436,960 | * |  | 56,739 | 3,696,996 |
| 1992 | 51,600 | 800 | 17,050 | 17,692 | 1,339,353 | 2,796,612 |  |  | 79,040 | 4,302,147 |
| 1993 | 183,414 | 2,500 | 114,159 | 262,482 | 5,326,293 | 3,267,652 | * |  | 52,031 | 9,208,531 |
| 1994 | 117,256 | 3,000 | 158,918 | 240,271 | 5,759,975 | 4,615,754 | * |  | 96,018 | 10,991,192 |
| 1995 | 334,654 | 13,000 | 489,506 | 606,184 | 6,949,639 | 6,021,284 | * |  | 22,879 | 14,437,146 |
| 1996 | 621,889 | 9,681 | 792,326 | 1,427,285 | 9,409,904 | 9,961,834 |  |  | 26,045 | 22,248,964 |
| 1997 | 1,994,446 | 10,509 | 1,088,969 | 1,518,196 | 12,832,221 | 10,711,667 | * |  | 36,577 | 28,192,585 |
| 1998 | 1,029,332 | 10,368 | 1,006,529 | 610,885 | 11,898,586 | 10,865,897 |  |  | 26,418 | 25,448,015 |
| 1999 | 2,071,046 | 14,729 | 948,191 | 1,190,138 | 12,481,326 | 10,185,507 |  |  | 26,824 | 26,917,761 |
| 2000 | 2,130,465 | 11,121 | 902,379 | 1,812,130 | 12,822,400 | 10,122,627 |  |  | 37,953 | 27,839,075 |
| 2001 | 1,389,837 | 22,736 | 1,488,815 | 1,963,294 | 13,214,731 | 12,017,424 |  | * | 14,831 | 30,111,668 |
| 2002 | 1,828,484 | 10,732 | 894,879 | 1,421,094 | 12,133,834 | 10,189,153 | * | * | 17,191 | 26,495,367 |
| 2003 | 1,575,738 | 16,561 | 713,205 | 1,128,003 | 10,937,167 | 14,429,197 | 140 | * | 16,402 | 28,816,413 |
| 2004 | 2,067,992 | 32,729 | 1,354,982 | 1,631,596 | 8,550,574 | 11,993,003 | * | * | 11,413 | 25,642,289 |
| 2005 | 1,847,753 | 39,931 | 972,800 | 481,912 | 8,248,441 | 11,903,292 | 41 | * | 16,520 | 23,510,690 |
| 2006 | 1,617,144 | 19,277 | 466,833 | 670,276 | 9,293,410 | 10,396,554 | 160 | * | 30,272 | 22,493,926 |
| 2007 | 1,358,000 | 13,651 | 474,388 | 188,567 | 10,697,251 | 7,301,295 | * |  | 27,028 | 20,060,180 |
| 2008 | 946,062 | 10,465 | 592,211 | 337,062 | 11,925,676 | 5,791,874 | 116 | * | 31,560 | 19,635,026 |
| 2009 | 585,552 | 16,258 | 433,238 | 234,101 | 8,422,147 | 6,135,427 | 75 | 0 | 32,310 | 15,859,108 |
| 2010 | 342,116 | 6,024 | 490,067 | 163,371 | 6,574,894 | 7,312,159 | 3 | 0 | 36,882 | 14,925,516 |
| 2011 | 465,049 | 11,346 | 694,673 | 238,050 | 5,379,417 | 5,054,186 | 44 | * | 44,899 | 11,933,656 |
| 2012 | 363,381 | 2,811 | 901,455 | 273,849 | 6,908,462 | 3,106,616 | 62 | * | 69,378 | 11,626,014 |

* confidential data

**Table 3. Recreational harvest (pounds) of Atlantic croaker by state, 1981-2012**
(Source: personal communication with NMFS Fisheries Statistics Division, Silver Spring, MD.)

| Year | NJ | DE | MD | VA | NC | SC | GA | FL | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1981 | 582 | 2,317 | | 535,297 | 426,240 | 67,284 | 9,665 | 305,547 | 1,346,932 |
| 1982 | | | 70,276 | 455,250 | 264,607 | 67,015 | 45,161 | 754,956 | 1,657,265 |
| 1983 | | | 32,053 | 486,006 | 395,402 | 14,158 | 25,412 | 510,599 | 1,463,630 |
| 1984 | | | 86,462 | 634,870 | 584,660 | 161,661 | 80,684 | 1,856,599 | 3,404,936 |
| 1985 | | | 17,169 | 843,414 | 278,214 | 72,780 | 40,421 | 684,449 | 1,936,447 |
| 1986 | | 2,595 | 116,542 | 2,034,337 | 126,888 | 173,028 | 21,504 | 2,783,651 | 5,258,545 |
| 1987 | | | 191,628 | 1,306,814 | 352,346 | 64,696 | 14,947 | 1,005,053 | 2,935,484 |
| 1988 | | 827 | 926,399 | 2,390,573 | 935,460 | 54,313 | 20,313 | 316,900 | 4,644,785 |
| 1989 | | 284 | 19,189 | 1,329,680 | 658,567 | 80,580 | 21,138 | 268,335 | 2,377,773 |
| 1990 | | 112 | 37,873 | 875,427 | 347,183 | 123,795 | 205,352 | 127,525 | 1,717,267 |
| 1991 | 4,264 | 10,972 | 117,210 | 1,728,021 | 157,660 | 16,173 | 54,116 | 460,453 | 2,548,869 |
| 1992 | | 3,291 | 53,556 | 1,768,962 | 233,533 | 28,512 | 132,596 | 407,672 | 2,628,122 |
| 1993 | 844 | 9,641 | 476,866 | 1,993,915 | 282,910 | 18,005 | 55,604 | 180,517 | 3,018,302 |
| 1994 | 818 | 2,892 | 991,166 | 3,024,118 | 351,230 | 128,306 | 34,048 | 337,474 | 4,870,052 |
| 1995 | 9,515 | 82,864 | 567,149 | 2,675,381 | 326,135 | 25,386 | 20,862 | 301,918 | 4,009,210 |
| 1996 | 39,099 | 205,526 | 702,037 | 2,716,759 | 346,501 | 14,480 | 21,797 | 50,038 | 4,096,237 |
| 1997 | 278,758 | 340,198 | 1,117,999 | 5,522,195 | 309,457 | 53,863 | 26,272 | 113,096 | 7,761,838 |
| 1998 | 135,733 | 293,560 | 1,150,459 | 5,920,436 | 161,117 | 76,821 | 30,966 | 141,756 | 7,910,848 |
| 1999 | 301,957 | 522,201 | 1,024,398 | 4,969,283 | 212,991 | 26,356 | 32,375 | 231,692 | 7,321,253 |
| 2000 | 1,125,730 | 483,963 | 2,672,996 | 4,888,910 | 201,306 | 13,457 | 62,390 | 242,912 | 9,691,664 |
| 2001 | 1,132,214 | 304,127 | 1,278,699 | 7,674,759 | 355,009 | 10,750 | 7,844 | 320,487 | 11,083,889 |
| 2002 | 268,423 | 250,899 | 1,162,278 | 7,075,130 | 242,184 | 29,343 | 10,622 | 117,880 | 9,156,759 |
| 2003 | 682,698 | 262,114 | 2,069,176 | 5,674,111 | 317,606 | 59,399 | 71,881 | 79,396 | 9,216,381 |
| 2004 | 861,987 | 307,898 | 1,078,951 | 5,792,487 | 300,440 | 69,510 | 15,597 | 275,858 | 8,702,728 |
| 2005 | 1,183,631 | 755,232 | 987,748 | 7,240,971 | 163,751 | 34,922 | 14,995 | 145,376 | 10,526,626 |
| 2006 | 638,138 | 729,730 | 864,415 | 6,460,336 | 218,775 | 16,240 | 9,210 | 188,671 | 9,125,515 |
| 2007 | 441,806 | 320,458 | 806,024 | 6,111,612 | 129,675 | 11,109 | 12,756 | 207,030 | 8,040,470 |
| 2008 | 526,458 | 317,997 | 462,531 | 3,612,065 | 133,416 | 16,212 | 12,948 | 320,430 | 5,402,057 |
| 2009 | 127,115 | 239,126 | 1,512,280 | 3,708,788 | 132,895 | 71,517 | 36,771 | 271,949 | 6,100,441 |
| 2010 | 36,087 | 40,166 | 977,562 | 3,185,485 | 233,607 | 12,566 | 10,067 | 109,513 | 4,605,053 |
| 2011 | 21,460 | 52,889 | 443,520 | 1,837,183 | 100,692 | 240,665 | 21,548 | 264,884 | 2,982,841 |
| 2012 | 85,093 | 61,535 | 397,873 | 1,905,100 | 105,541 | 12,291 | 13,503 | 371,635 | 2,952,571 |

**Table 4. Recreational harvest (numbers) of Atlantic croaker by state, 1981-2012**
(Source: personal communication with NMFS Fisheries Statistics Division, Silver Spring, MD.)

| Year | NJ | DE | MD | VA | NC | SC | GA | FL | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1981 | 1,054 | 3,003 | 0 | 964,013 | 1,043,240 | 165,742 | 35,591 | 598,896 | 2,811,539 |
| 1982 | | | 10,452 | 273,039 | 596,493 | 193,554 | 169,749 | 1,682,619 | 2,925,906 |
| 1983 | | | 108,355 | 2,154,133 | 1,620,909 | 60,811 | 75,173 | 1,148,227 | 5,167,608 |
| 1984 | | | 211,035 | 2,047,720 | 2,147,871 | 588,114 | 202,364 | 2,781,742 | 7,978,846 |
| 1985 | | | 21,276 | 2,284,334 | 723,933 | 260,265 | 144,341 | 1,306,955 | 4,741,104 |
| 1986 | | 4,694 | 123,578 | 6,384,966 | 356,742 | 599,442 | 69,887 | 5,118,552 | 12,657,861 |
| 1987 | 0 | 0 | 208,488 | 3,234,224 | 904,030 | 166,978 | 44,783 | 2,580,727 | 7,139,230 |
| 1988 | | 1,186 | 1,005,452 | 4,048,690 | 2,256,128 | 144,057 | 64,093 | 685,778 | 8,205,384 |
| 1989 | | 478 | 22,871 | 2,203,504 | 2,131,763 | 217,023 | 72,598 | 359,417 | 5,007,654 |
| 1990 | | 281 | 100,673 | 2,374,679 | 1,063,452 | 346,631 | 585,380 | 304,064 | 4,775,160 |
| 1991 | 16,235 | 37,500 | 288,471 | 4,298,542 | 434,067 | 100,816 | 184,435 | 1,030,115 | 6,390,181 |
| 1992 | 0 | 9,854 | 117,427 | 4,524,040 | 723,823 | 74,051 | 440,185 | 754,595 | 6,643,975 |
| 1993 | 2,552 | 19,352 | 805,560 | 4,990,098 | 755,998 | 32,700 | 89,734 | 304,067 | 7,000,061 |
| 1994 | 1,567 | 5,718 | 1,633,581 | 6,494,691 | 1,179,735 | 188,520 | 102,974 | 599,032 | 10,205,818 |
| 1995 | 15,184 | 136,865 | 827,183 | 5,029,708 | 850,606 | 75,422 | 100,826 | 438,076 | 7,473,870 |
| 1996 | 35,037 | 235,389 | 775,115 | 4,997,021 | 662,240 | 37,464 | 61,957 | 116,575 | 6,920,798 |
| 1997 | 342,089 | 385,586 | 1,053,232 | 8,066,926 | 661,116 | 118,428 | 64,050 | 235,430 | 10,926,857 |
| 1998 | 143,404 | 391,231 | 1,126,058 | 6,730,181 | 387,427 | 170,528 | 64,953 | 234,360 | 9,248,142 |
| 1999 | 357,261 | 662,724 | 1,209,572 | 5,881,671 | 442,185 | 54,761 | 104,438 | 403,982 | 9,116,594 |
| 2000 | 1,023,442 | 517,886 | 2,674,880 | 5,486,159 | 391,056 | 32,332 | 128,922 | 455,870 | 10,710,547 |
| 2001 | 1,177,813 | 312,005 | 1,319,928 | 9,335,313 | 635,552 | 19,802 | 21,503 | 426,264 | 13,248,180 |
| 2002 | 253,472 | 261,634 | 1,223,385 | 9,129,060 | 408,944 | 66,409 | 36,497 | 177,751 | 11,557,152 |
| 2003 | 692,391 | 341,174 | 1,619,766 | 6,695,192 | 490,399 | 198,339 | 248,853 | 165,459 | 10,451,573 |
| 2004 | 855,927 | 389,218 | 896,855 | 8,259,608 | 511,418 | 171,544 | 38,599 | 415,570 | 11,538,739 |
| 2005 | 1,227,349 | 825,267 | 784,246 | 7,657,147 | 326,777 | 143,387 | 39,561 | 302,784 | 11,306,518 |
| 2006 | 511,220 | 763,216 | 754,969 | 7,221,148 | 556,024 | 58,500 | 34,081 | 172,586 | 10,071,744 |
| 2007 | 406,238 | 359,064 | 872,838 | 6,944,886 | 461,162 | 38,147 | 45,068 | 310,130 | 9,437,533 |
| 2008 | 600,975 | 368,911 | 619,942 | 8,388,497 | 317,940 | 65,853 | 38,246 | 449,054 | 10,849,418 |
| 2009 | 193,464 | 451,849 | 1,335,439 | 5,327,388 | 368,990 | 238,900 | 82,269 | 438,209 | 8,436,508 |
| 2010 | 63,027 | 75,404 | 1,136,589 | 4,743,697 | 478,156 | 46,464 | 35,635 | 132,664 | 6,711,636 |
| 2011 | 40,855 | 92,289 | 554,206 | 3,305,707 | 246,676 | 349,464 | 44,044 | 476,292 | 5,109,533 |
| 2012 | 237,994 | 84,403 | 701,482 | 3,445,232 | 288,812 | 27,541 | 38,402 | 589,643 | 5,413,509 |

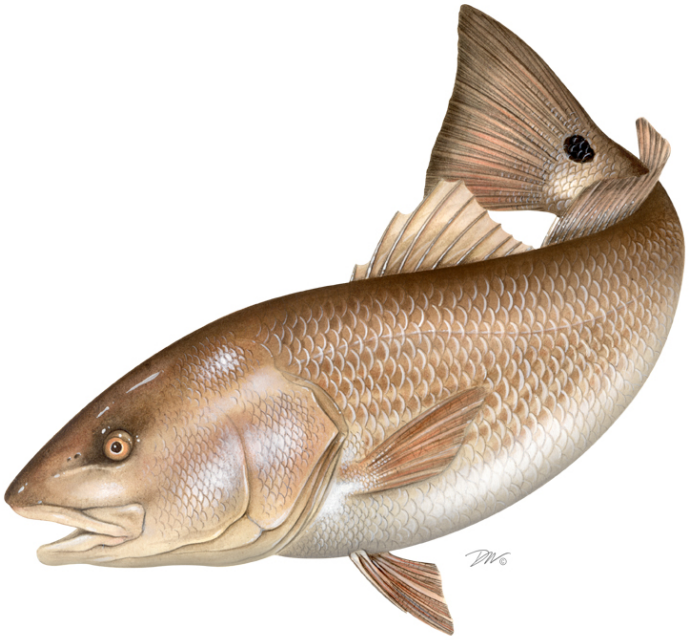
**Table 5. Recreational releases (number) of Atlantic croaker by state, 1981-2012**
(Source: personal communication with NMFS Fisheries Statistics Division, Silver Spring, MD.)

| Year | NJ | DE | MD | VA | NC | SC | GA | FL | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1981 | | | 16,233 | 324,238 | 704,259 | 128,192 | 13,481 | 85,740 | 1,272,143 |
| 1982 | | | | 77,756 | 641,327 | 107,340 | 111,630 | 188,277 | 1,126,330 |
| 1983 | | | 1,507,184 | 1,410,151 | 424,562 | 119,036 | 70,499 | 379,021 | 3,910,453 |
| 1984 | | | 70,192 | 673,080 | 1,701,418 | 746,905 | 37,573 | 236,432 | 3,465,600 |
| 1985 | | | 13,132 | 1,616,052 | 1,596,901 | 238,678 | 66,649 | 1,146,582 | 4,677,994 |
| 1986 | | 1,757 | 43,399 | 2,578,268 | 137,841 | 84,335 | 40,623 | 318,511 | 3,204,734 |
| 1987 | 1,374 | 861 | 32,074 | 2,056,580 | 560,853 | 108,366 | 76,908 | 1,770,697 | 4,607,713 |
| 1988 | | 582 | 273,231 | 832,284 | 984,219 | 112,271 | 20,021 | 200,630 | 2,423,238 |
| 1989 | | 1,307 | 41,822 | 1,342,169 | 891,926 | 58,642 | 17,632 | 72,822 | 2,426,320 |
| 1990 | | 1,268 | 88,688 | 3,922,564 | 1,351,152 | 111,085 | 317,497 | 168,144 | 5,960,398 |
| 1991 | 91,633 | 75,319 | 3,352,190 | 7,418,045 | 669,385 | 25,168 | 140,402 | 647,824 | 12,419,966 |
| 1992 | 4,103 | 43,583 | 856,292 | 4,167,137 | 954,494 | 26,729 | 178,267 | 251,343 | 6,481,948 |
| 1993 | 5,799 | 13,194 | 2,504,362 | 5,795,479 | 1,499,217 | 16,949 | 83,203 | 138,875 | 10,057,078 |
| 1994 | 17,253 | 14,069 | 1,628,824 | 7,676,780 | 3,110,528 | 141,513 | 99,026 | 331,736 | 13,019,729 |
| 1995 | 31,019 | 41,574 | 496,046 | 5,494,289 | 1,172,716 | 108,345 | 89,609 | 141,732 | 7,575,330 |
| 1996 | 17,585 | 76,851 | 403,776 | 5,151,206 | 1,218,799 | 64,494 | 60,282 | 126,300 | 7,119,293 |
| 1997 | 111,468 | 384,233 | 1,497,670 | 7,275,160 | 1,443,568 | 138,107 | 25,630 | 116,276 | 10,992,112 |
| 1998 | 221,324 | 839,932 | 3,021,780 | 4,990,541 | 1,060,928 | 266,068 | 159,928 | 152,744 | 10,713,245 |
| 1999 | 860,325 | 1,017,499 | 2,483,800 | 5,668,925 | 1,368,478 | 116,826 | 57,567 | 967,894 | 12,541,314 |
| 2000 | 688,746 | 694,813 | 4,967,856 | 7,811,048 | 1,569,385 | 96,402 | 169,903 | 428,131 | 16,426,284 |
| 2001 | 853,621 | 285,123 | 1,585,806 | 7,086,706 | 1,256,807 | 115,284 | 192,362 | 282,461 | 11,658,170 |
| 2002 | 369,003 | 361,355 | 2,523,276 | 7,107,656 | 925,806 | 92,498 | 194,474 | 217,054 | 11,791,122 |
| 2003 | 833,508 | 654,697 | 1,393,224 | 6,543,524 | 1,552,315 | 440,446 | 965,496 | 192,356 | 12,575,566 |
| 2004 | 1,237,164 | 599,207 | 854,132 | 6,276,767 | 1,656,049 | 320,788 | 154,259 | 253,951 | 11,352,317 |
| 2005 | 1,692,401 | 674,684 | 1,136,876 | 8,738,109 | 1,401,413 | 321,861 | 280,889 | 293,692 | 14,539,925 |
| 2006 | 503,490 | 937,193 | 1,783,557 | 4,193,675 | 2,578,819 | 595,075 | 283,851 | 187,562 | 11,063,222 |
| 2007 | 590,078 | 672,771 | 1,258,131 | 8,504,212 | 1,608,120 | 224,454 | 228,564 | 321,559 | 13,407,889 |
| 2008 | 2,373,945 | 601,994 | 2,127,219 | 7,806,627 | 1,419,019 | 205,373 | 293,926 | 596,450 | 15,424,553 |
| 2009 | 108,370 | 537,587 | 1,137,578 | 7,621,484 | 1,912,670 | 514,839 | 434,608 | 406,822 | 12,673,958 |
| 2010 | 167,191 | 228,936 | 1,011,236 | 4,824,151 | 1,598,139 | 187,138 | 263,987 | 188,637 | 8,469,415 |
| 2011 | 62,391 | 88,524 | 365,716 | 4,872,928 | 1,798,230 | 240,605 | 262,493 | 452,669 | 8,143,556 |
| 2012 | 1,134,778 | 444,935 | 1,578,524 | 5,091,063 | 1,255,215 | 216,420 | 167,488 | 641,569 | 10,529,992 |

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

# RED DRUM (*Sciaenops ocellatus*)

2012 FISHING YEAR




**The Red Drum Plan Review Team**
Steve Arnott, South Carolina Department of Natural Resources
Mike Murphy, Florida Fish & Wildlife Conservation Commission
Lee Paramore, North Carolina Division of Marine Fisheries
Roger Pugliese, South Atlantic Fishery Management Council
Kirby Rootes-Murdy, Atlantic States Marine Fisheries Commission, Chair

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## I. Status of the Fishery Management Plan

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

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

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

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

Substantial reductions in fishing mortality were necessary to achieve the escapement rate; however, because of a lack of data on the status of adult red drum along the Atlantic coast, a phase-in approach with a 10% SSBR goal was adopted. States were recommended to implement or maintain harvest controls necessary to attain the goal. All states in the management unit north of Florida modified regulations and/or commercial quotas to reach this goal. Florida maintained its strict regulations that were thought to exceed the target escapement rate. The harvest regulations remained unchanged from 1992-1998, except in Florida where regulations were relaxed somewhat by opening the previously closed March-May period.

As hoped, these management measures led to increased escapement rates of juvenile red drum. Escapement estimates for a northern region from New Jersey through North Carolina (18%) and a southern region from South Carolina through the east coast of Florida (17%) were estimated to be above the 10% phase-in goal, yet still below the ultimate goal of 30% (Vaughan and Carmichael 2000). These regions were based on stock identity, mark-recapture experiments, life history, habitat preferences, human dimensions of the fisheries, and management goals. North Carolina, South Carolina, and Georgia implemented substantive changes to their regulations from 1998-2001 that further restricted the harvest of red drum.

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

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

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

The management area extends from New Jersey through the east coast of Florida, and is separated into a northern and southern region with the division occurring at the North Carolina/South Carolina border. The sSPR of 40% is considered a target; an sSPR below 30% (threshold level) results in an overfishing determination for red drum.

All states in the management area were required (rather than recommended as in previous versions of the plan) to implement appropriate recreational bag and size limit combinations needed to attain the target sSPR. Amendment 2 also required all states to maintain their current,

or implement more restrictive, commercial fishery regulations. The states implemented the provisions of Amendment 2 by January 1, 2003. See Table 1 for state commercial and recreational regulations in 2012.

Following the approval of Amendment 2 in 2002, the process was begun to transfer management authority, including an Environmental Assessment and public comment period. The final rule for the transfer of management authority became effective November 5, 2008. It repeals the federal Atlantic Coast Red Drum Fishery Management Plan and transfers the management authority of Atlantic red drum in the exclusive economic zone from the South Atlantic Fishery Management Council, in cooperation with the Mid-Atlantic Fishery Management Council, under the Magnuson-Stevens Conservation and Management Act to the Atlantic States Marine Fisheries Commission under the Atlantic Coastal Fisheries Cooperative Management Act, as requested by the Councils and the Commission.

## II. Status of the Stocks

At present, only overfishing status can be determined for red drum (SAFMC 2009). The threshold (below which the stock is experiencing overfishing) and the target fishing mortality rates are those that achieve 30 % and 40 % sSPR, respectively. The three-year average sSPR is compared to these reference points. The stock is assessed by region. The next benchmark assessment is scheduled for 2015.

*Northern Region*

Recruitment (age 1 abundance) has fluctuated widely and without apparent trend since 1989 (Figure 1). Abundance of age 1 – 3 red drum increased during 1990 – 2000 after which it fluctuated widely (Figure 2). The initial increase in abundance of these age groups can be explained by the reduction in exploitation rates in the early part of the time series with relative stability since then (Figure 3).

The trend in the three-year average sSPR indicates low sSPR at the start of the time series with increases during 1990 – 1997 and fluctuations thereafter (Figure 4). The average sSPR has been above the overfishing threshold ($F_{30\%}$) since 1994, and with the exception of one year (2002) has been at or above the target ($F_{40\%}$) since 1996. Fishing pressure and mortality appear to be stable and holding near the target fishing mortality. There is a high probability that the stock is not subject to overfishing. The average sSPR is also likely above the target benchmark. Fishing mortality could be allowed to increase relative to the overfishing threshold, but the level of risk associated with any increase should be considered and reviewed in conjunction with Addendum II's goal of maintaining a 40% SPR.

*Southern Region*

The relative trend in recruitment (age 1 abundance) has fluctuated without apparent trend since 1989 (Figure 1). The relative trend in abundance of age 1 – 3 red drum increased during 1989 – 1992, declined during 1992 – 1998 and has fluctuated thereafter (Figure 2). As with the northern stock, the initial increase in abundance of these age groups can be explained by the reduction in exploitation rates in the early part of the time series. There appears to have been a slight increase

in exploitation rates since 1990 (Figure 3). This is reflected in the long-term decline in the three-year average sSPR since 1990 (Figure 4).

There is a high level of uncertainty around the sSPR estimates for the southern region. More work is needed to make definitive statements about sSPR, but it is likely that the average sSPR in 2007 was above the overfishing threshold ($F_{30\%}$), although not above the target as likely in the northern region. The stock is therefore likely not subject to overfishing at this time. Due to the uncertainties, it is not possible to determine status in relation to the target of 40% sSPR.

## III. Status of the Fishery

*The following discussion utilizes the results from direct queries of the MRIP data through their website. Adjustments needed to make these consistent through time (convert pre-2004 MRFSS data, adjust for changes in for-hire component of survey, and deletion of 1981-85 headboat data) have not been made here.*

Total red drum landings from New Jersey through the east coast of Florida in 2012 are estimated at 1.8 million pounds (Tables 2 and 3, Figure 5). This represents a 12.5% increase from the total harvest in 2011 and is above (15%) the previous ten-year (2002-2011) average. The commercial and recreational fisheries harvested 4 and 96% of the total, respectively. In 2012, 80% of the total landings came from the South Atlantic region, where the fishery is almost exclusively recreational, and 20% from the Mid-Atlantic region (Figure 6).

Few commercial landings of red drum have been recorded in states north of Maryland in recent years, with the notable exception of New Jersey in 2012 (Table 2). Coastwide commercial landings show no particular temporal trends, ranging from approximately 55,000 to 440,000 pounds annually over the last 50 years (Figure 5). The greatest harvest was taken in 1980, and the lowest in 2004. In 2012, coastwide commercial harvest decreased from 96,323 pounds in 2011 to 77,513 pounds, the majority (86*%*) from North Carolina (Table 2). Historically, the major commercial harvesters were North Carolina and Florida. However, commercial harvest has been prohibited in Florida under state regulation since January 1988. South Carolina also banned the commercial harvest or sale of native caught red drum beginning in 1987.

In North Carolina, a daily commercial trip limit and an annual cap of 250,000 pounds, with payback of any overage, constrain the commercial harvest. The red drum fishing year in North Carolina extends from September 1 to August 31 (all other states operate on a calendar year). In 2008, the Management Board approved using the fishing year to monitor the cap. During the 2009/2010 fishing year, North Carolina had an overage of 25,858 lbs and set its 2010/2011 fishing cap at 224,142 lbs. North Carolina's harvest for 2010/2011 was 126,185 pounds (2011 calendar harvest was 91,951 pounds), which corrected the overage. For fishing year 2011/2012, North Carolina's harvest totaled 94,210 pounds

Recreational harvest of red drum peaked in 1984 at 1.05 million fish (or 2.6 million pounds; Tables 3 and 4). Since 1988, the number has fluctuated without trend between 250,000 and 530,000 fish (800,000 to 1.7 million pounds; Figures 5 and 7). Recreational harvest increased from 494,604 fish (1.5 million pounds) in 2011 to 504,287 fish (1.7 million pounds) in 2012. The

2012 harvest represents a 2% increase in numbers and a 22% increase in pounds from the previous ten year (2002-2011) average. Florida anglers landed the largest share of the coastwide recreational harvest in numbers (47%), followed by South Carolina (24%) and North Carolina (10%). Anglers release far more of the red drum they catch than they keep; the percent of the catch released is generally over 90% during the last decade (Figure 7). Recreational releases show an increasing trend over the time series. The proportion of releases increased in 2012 to 92% (versus 82% in 2010), and the overall number of fish released increased by approximately 3.6 million to 5.7 million fish (Figure 3, Table 5). It is estimated that 8% of released fish die as a result of being caught, resulting in an estimated 460,432 dead discarded fish in 2012 (Table 5). Recreational removals from the fishery are thus estimated to be 964,719 fish in 2012 (Figure 8).

## IV. Status of Assessment Advice

Current stock status information comes from the 2009 benchmark stock assessment (SAFMC 2009) completed by the ASMFC Red Drum Stock Assessment Subcommittee and Technical Committee, peer reviewed by an independent panel of experts at the Southeast Data, Assessment, and Review (SEDAR) 18, and approved by the South Atlantic State-Federal Fisheries Management Board for use in management decisions. Previous interstate management decisions were based on regional assessments conducted by Vaughan and Helser (1990), Vaughan (1992, 1993, 1996), and Vaughan and Carmichael (2000). Several states have also conducted state-specific assessments (e.g., Murphy and Munyandorero 2009; Takade and Paramore 2007).

The 2009 stock assessment uses a statistical catch at age (SCA) model with age-specific data for red drum ages 1 through 7+. The Stock Assessment Subcommittee decided to move away from virtual population analyses used in past assessments primarily because of the assumption inherent in these models that the catch at age is known without error, whereas there is limited data to describe the catch of red drum early in the time series. Data available for the years 1989 through 2007 were included from the following sources: commercial and recreational harvest and discard data, fishery-dependent and -independent biological sampling data, tagging data, and fishery-independent survey abundance data.

The SEDAR 18 Review Panel considered the use of an SCA model appropriate given the types of data available for red drum. With certain revisions made to the data and the model configurations before or at the Review Workshop, the SEDAR 18 Review Panel supported the use of the final model runs. For the northern region, the Review Panel agreed that the model was informative of age 1 – 3 abundance and exploitation rates, but not for older age groups. The model was also found to be informative of annual trends in static spawning potential ratio (sSPR) and the 2005 – 2007 average sSPR. For the southern region, the Review Panel agreed that the model was informative of relative (not absolute) trends in age 1 – 3 abundance and exploitation, but not for older age groups. The model was also considered to be informative of relative trends in annual sSPR and the three-year average sSPR, this result being highly conditional on the estimated fishery selectivity pattern. These results for the southern region allow for only general statements on stock status.

The Review Panel accepted the existing threshold and target overfishing benchmarks of 30% sSPR and 40% sSPR for red drum. However, the Review Panel did not consider annual changes

in sSPR to be informative and recommended adopting a three-year running mean of estimated annual sSPR as the indicator to compare to the management benchmarks. Because of the high uncertainty in the age 4 $-7^{+}$ dynamics, the Review Panel did not see value in attempting to estimate indicators and benchmarks of stock biomass which would be used to measure overfished status.

The next benchmark stock assessment is scheduled for 2015.

## V. Status of Research and Monitoring

There are no monitoring or research programs required annually of the states except for the submission of a compliance report. The following fishery-dependent (other than catch and effort data) and fishery-independent monitoring programs were reported in the 2012 reports.

Fishery Dependent Monitoring

- Maryland DNR – Samples commercial pound nets once every other week in the Chesapeake Bay from late spring through summer (2012: 458 fish; highest value of the 20 year time series). Dealer sampling of red drum initiated in 2009 (2012: 0 fish). Monitors the number of sportfishing citations issued for large red drum releases (2012: 0 entry). Monitors licensed charter boat captain logbooks for red drum captures (2012: 299 caught, 271 harvested).
- Virginia MRC – Samples commercially landed red drum through its biological monitoring program (2012: 38 fish). Coordinates volunteer angler tagging of red drum via the Virginia Game Fish Tagging Program that began in 1995 (2012: 18,371 fish tagged, 1612 reported recaptures). Collects carcasses through the Marine Sportfish Collection Project (2012: 4 fish).
- North Carolina DMF – Samples commercially-landed red drum through its biological monitoring program (2012: 359 fish, primarily gill net).
- South Carolina DNR – Conducts a state finfish survey for catch, effort, and length data (2012: parties with targeted trips = 533, catch n = 1,386). Monitors charterboat trip reports for catch and effort data (2012: release rate = 93.4%). Runs a cooperative public tagging program to study movement patterns, growth rates, and release-mortality rates (2012: 722 fish tagged, 71 recaptured). Collects data from fishing tournaments and a carcass collection program (101 collected in 2012).
- Georgia CRD – Collects age, length, and gender data through the Marine Sportfish Carcass Recovery Project (2012: 293 red drum).
- Florida FWC – Conducts a random survey of licensed anglers on the sizes of kept and released fish (2002-2009: 101 lengths collected from 139 trips; 2012: 404 lengths (81 harvest, 323 released) from 131 anglers responding).
- NMFS – Collects recreational catch, harvest, release, and effort data, and length measurements via the Marine Recreational Information Program.

Fishery Independent Monitoring

- North Carolina DMF - Conducts a seine survey to produce an age-0 abundance index (2012: n=326; CPUE decreased from the 2011 overall state mean of 10.9 and was lower than the long-term mean of 5.9). Conducts a gill net survey in Pamlico Sound to characterize size and age distribution, produce an abundance index, improve bycatch

estimates, and study habitat usage (2012: n= 752; CPUE increased to 3.06, the third highest in the time series); DMF conducts a longline survey to produce an adult index of abundance and tag fish (2012: n=376; CPUE: remained relatively stable at 5.2 fish per set, with a time series average of 5.3).

- South Carolina DNR – Conducts an estuarine trammel net survey for subadults (CPUE: continual decreased from 2010 relative peak). Conducts an electrofishing survey in low salinity estuarine areas for juveniles and sub-adults (CPUE: general decrease from 2010). Conducts an inshore bottom longline survey for biological data and an abundance index of adults (2012 mix of seasonal increases and decreases in CPUE). Tags fish caught in each of these surveys (46,680 fish from trammel nets since 1991 (2012 n = 1,624); 6,416 fish from electrofishing since 2001 (2012 n = 572); 4,281 fish from longline since 1994 (2012 n = 535)).
- Georgia CRD – Conducts an estuarine trammel net survey for subadult biological data and an abundance index (2011: n = 158; CPUE increased in Wassaw estuary to .10 from 0.08 and decreased in the Altamaha river delta from 0.38 to .09). Conducts an estuarine gill net survey for young-of-year biological data and an abundance index (2011: n = 215; CPUE decreased in Wassaw estuary from 1.32 from .54 and in the Altamaha river delta from 1.08 to .27). Conducts a survey to determine the age structure of the adult stock on five year intervals (small sample size collected, <animals; next sampling in autumn 2013). Conducts a bottom longline survey for adult biological data and an abundance index (2011: n = 18; CPUE decreased to a level of 0.08 fish per set).
- Florida FWC-FWRI – Conducts two seine surveys in the northern Indian River Lagoon (IRL) and the lower reaches of the St. Johns River (SJR) for young-of-the-year (< 40 mm SL) abundance indices (CPUE: decreased to constant lower level in 2011 & 2012 IRL; relatively constant since 2007 although sharp decrease in 2011 in SJR). FWC-FWRI conducts a haul seine survey in these areas and the southern IRL for a subadult index (CPUE: increasing trend from 2003-2008 in the northern and southern IRL before dropping to lower levels in 2009 and 2010; fluctuating with an increasing trend since 2004 in SJR). Age and length data are collected during surveys (2012: 912lengths from 183 meter haul seines, 173 otoliths from sampled fish).

*Ageing Workshop*

A Red Drum Ageing Workshop was held in October 2008. The Red Drum Technical Committee indicated the need for such as workshop prior to the 2009 stock assessment to standardize the otolith sectioning and ageing procedures and the current age dataset. Representatives from Virginia, North Carolina, South Carolina, Georgia, Florida, the National Marine Fisheries Service, and the Gulf Council participated in the workshop. In addition to improving the age dataset for the ongoing assessment, the resulting standardized ageing procedure was published in an ASMFC reference document, with some states having already incorporated ageing instructions into their references..

## VI. Status of Management Measures and Issues

*Fishery Management Plan*

Amendment 2 was fully implemented by January 1, 2003 and provided the management requirements for 2010. Requirements include: recreational regulations designed to achieve at

least 40% sSPR; a maximum size limit of 27 inches or less; and current or more stringent commercial regulations. States are also required to have in place law enforcement capabilities adequate for successfully implementing their red drum regulations. In May 2013, the Management Board approved for public comment Draft Addendum I to Amendment 2 of the Red Drum FMP. The draft addendum proposes revisions to the habitat section of Amendment 2 to include the most current state of information on red drum spawning habitat and habitat by life stage (egg, larval, juvenile, sub-adult, and adult). It also identifies the distribution of key habitats and habitats of concern, including potential threats and habitat bottlenecks, as well as ecosystem considerations. The final action is set for Addendum I in August 2013.

*De Minimis Requests*

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

*Changes to State Regulations*

For 2012, Florida changed to using a regional management (**northern zone**—Nassau south through Flagler County; **southern zone**—Volusia south through Miami-Dade County) scheme for Red Drum in coastal waters of Florida. Outside the creation of two zones, state management measures remained unchanged with the exception of an increased bag limit in the northern region from one to two fish per day. There were no other changes to state regulations in 2012.

## VII. Implementation of FMP Compliance Requirements for 2012

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

## VIII. Recommendations of the Plan Review Team

Management and Regulatory Recommendations

< Consider approval of the *de minimis* requests by New Jersey and Delaware
< Support a continued moratorium of red drum fishing in the exclusive economic zone.

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

*Stock Assessment and Population Dynamics*

< Improve catch/effort estimates and biological sampling from recreational and commercial fisheries for red drum, including increased effort to intercept night fisheries for red drum. This should include significant efforts to determine the size and age structure of regulatory discards of live red drum. (H)

- States should maintain annual age-length keys. Expand biological sampling based on a statistical analysis to adequately characterize the age/size composition of removals by all statistical strata (gears, states, etc.) (H)
- Each state should develop an on-going red drum tagging program that can be used to estimate both fishing and natural mortality and movements. This should include concurrent evaluations of tag retention, tagging mortality, and angler tag reporting rates. (M)
- Establish programs to provide on-going estimates of commercial discards and recreational live release mortality using appropriate statistical methods. Discard estimates should examine the impact of slot-size limit management and explore regulatory discard impacts due to high-grading. (M)
- Evaluate the broader survey needs to identify gaps in current activities and provide for potential expansion and/or standardization between/among current surveys (M).

*Biological*

- Explore methods to effectively sample the adult population in estuarine, nearshore, and open ocean waters, such as in the ongoing red drum long line survey. (H)
- Determine if natural environmental perturbations limit recruitment, and if spawning stock size is the cause of recruitment variability (H)
- Continue tagging studies to determine stock identity, inshore/offshore migration patterns of all life stages (i.e. basic life history info gathering). Specific effort should be given to developing a large-scale program for tagging adult red drum (M)
- Fully evaluate the effects and effectiveness of using cultured red drum to facilitate higher catch rates along the Atlantic coast. (M)
- Determine habitat preferences, environmental conditions, growth rates, and food habits of larval and juvenile red drum throughout the species range along the Atlantic coast. Assess the effects of environmental factors on stock density/yearclass strength. (M)
- Refine maturity schedules on a geographic basis. Thoroughly examine the influence of size and age on reproductive function. Investigate the possibility of senescence in female red drum. (M)

*Social*

- Examine the effectiveness of controlling fishing mortality and minimum size in managing red drum fisheries.
- Encourage the NMFS to fund socioeconomic add-on questions to the recreational fisheries survey that are specifically oriented to red drum recreational fishing.

*Economic*

- Encourage the NMFS to continue funding socioeconomic add-on questions to the recreational fisheries survey that include data elements germane to red drum recreational fisheries management.
- Where appropriate, encourage member states to conduct studies to evaluate the economic costs and benefits associated with current and future regulatory regimes impacting recreational anglers including anglers oriented toward catch and release fishing trips.
- Fully evaluate the efficacy of using cultured red drum to restore native stocks along the Atlantic Coast including risk adjusted cost-benefit analyses.

- < Conduct a special survey and related data analysis to determine the economic and operational characteristics of the "for-hire sector" targeting red drum especially fishing guide oriented businesses in the South Atlantic states.
- < Estimate the economic impacts (e.g. sales, jobs, income, etc.) of recreational red drum fisheries at the state and regional level including the "for-hire sector" (e.g. fishing guides).
- < States with significant fisheries (over 5,000 pounds) should collect socioeconomic data on red drum fisheries through add-ons to the recreational fisheries survey or by other means.

*Habitat*

- < Identify spawning areas of red drum in each state from North Carolina to Florida so these areas may be protected from degradation and/or destruction. (H)
- < Identify changes in freshwater inflow on red drum nursery habitats. Quantify the relationship between freshwater inflows and red drum nursery/sub-adult habitats. (H)
- < Determine the impacts of dredging and beach re-nourishment on red drum spawning and early life history stages. (M)
- < Investigate the concept of estuarine reserves to increase the escapement rate of red drum along the Atlantic coast. (M)
- < Identify the effects of water quality degradation (changes in salinity, DO, turbidity, etc.) on the survival of red drum eggs, larvae, post-larvae, and juveniles. (M)
- < Quantify relationships between red drum production and habitat. (L)
- < Determine methods for restoring red drum habitat and/or improving existing environmental conditions that adversely affect red drum production. (L)

## IX. References


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Vaughan, DS and TE Helser. 1990. Status of the red drum stock of the Atlantic coast: Stock assessment report for 1989. NOAA Tech. Mem. NMFS-SEFC-263. 117 p.

## X. Figures

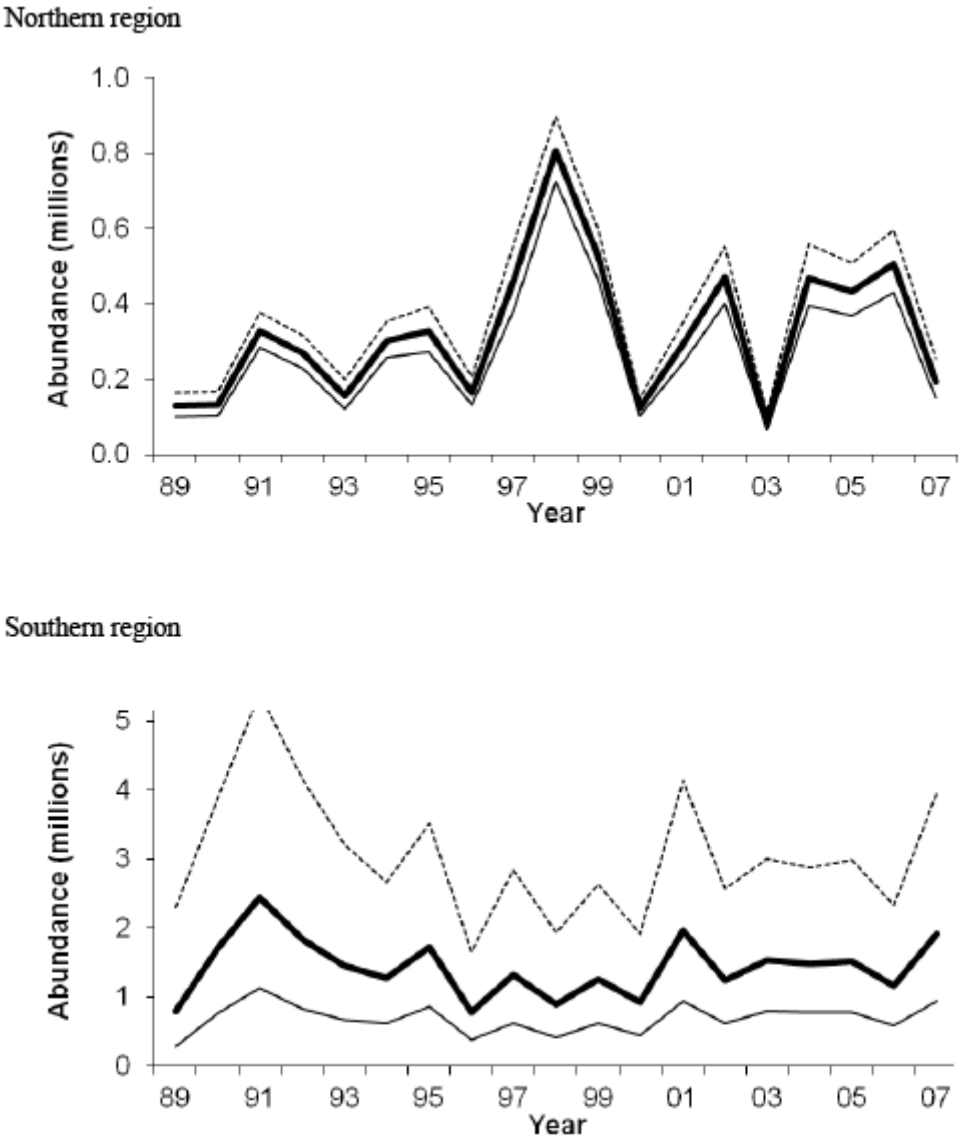



**Figure 1. Estimated recruitment (age-1 abundance, heavy solid line) and ± 1.96 standard errors for the northern and southern regions during 1989-2007** (Source: SAFMC 2009). Note: assessment results for the southern region are indicative of relative trends but not absolute values.

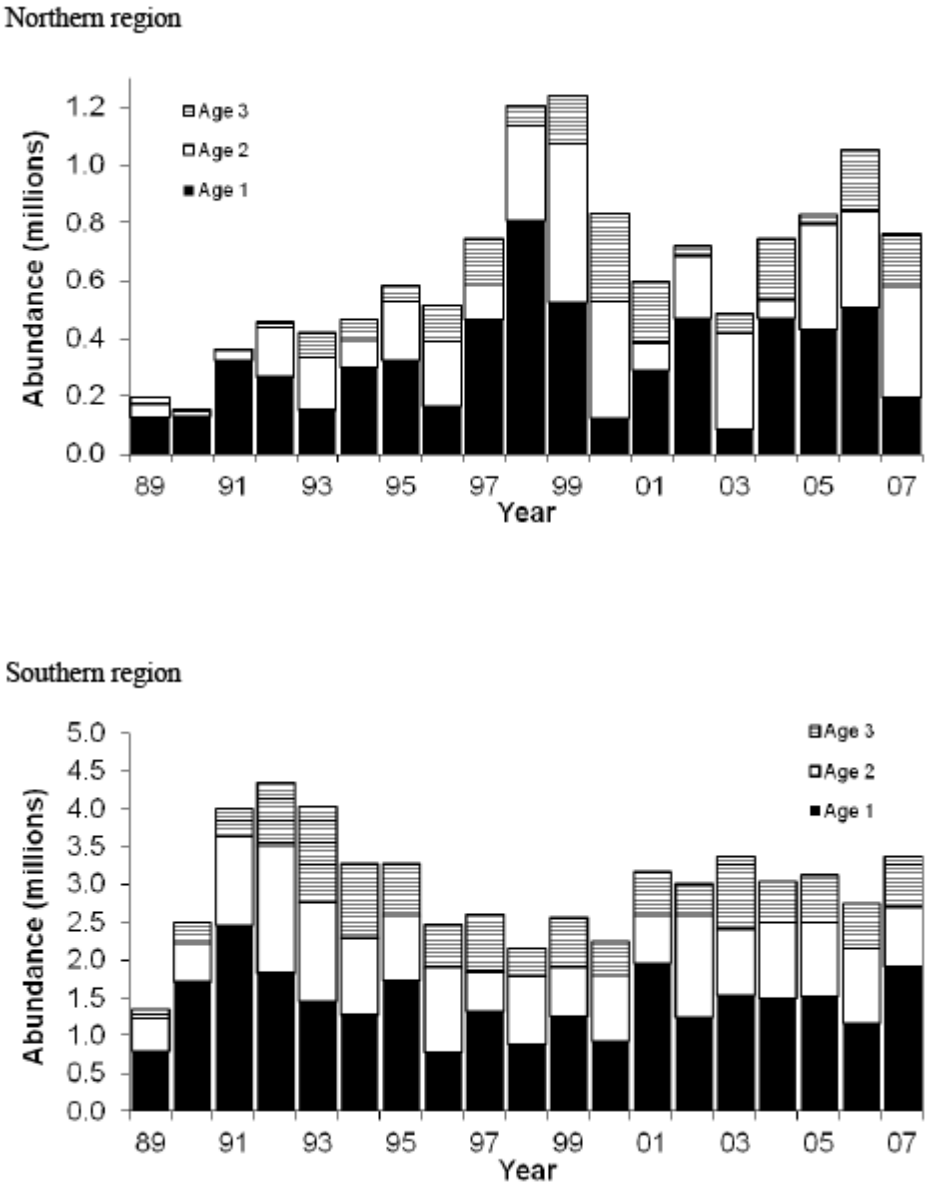



**Figure 2. Estimates of abundance of red drum ages 1-3 in the northern and southern regions during 1989-2007** (Source: SAFMC 2009). Note: assessment results for the southern region are indicative of relative trends but not absolute values.

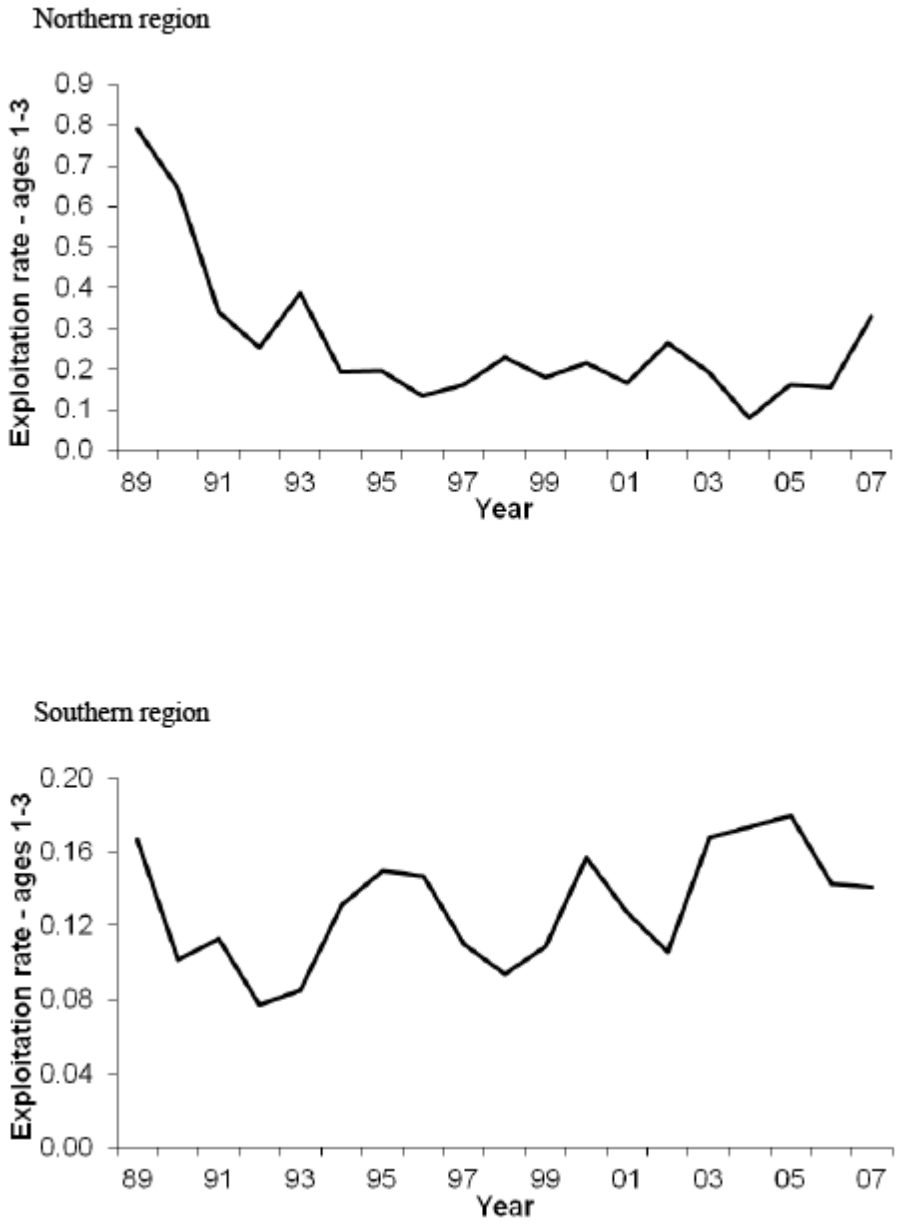
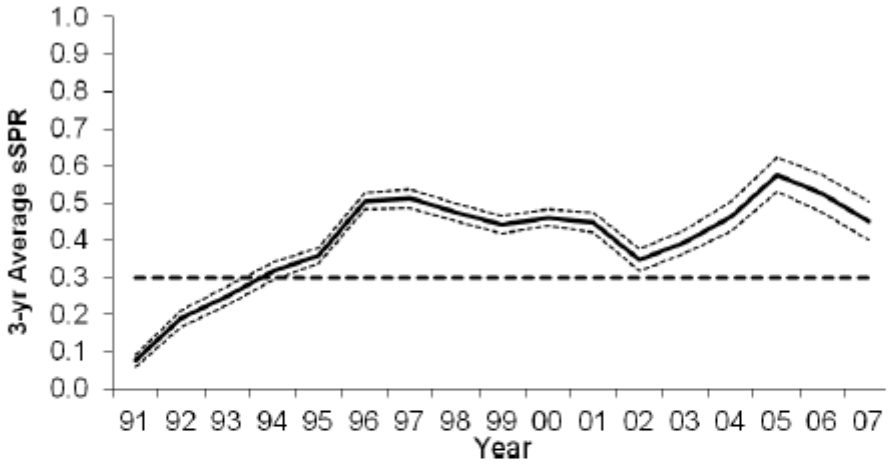



**Figure 3. Estimated annual exploitation rate for red drum ages 1-3 in the northern and southern regions during 1989-2007** (Source: SAFMC 2009). Note: assessment results for the southern region are indicative of relative trends but not absolute values.

Northern region




Southern region

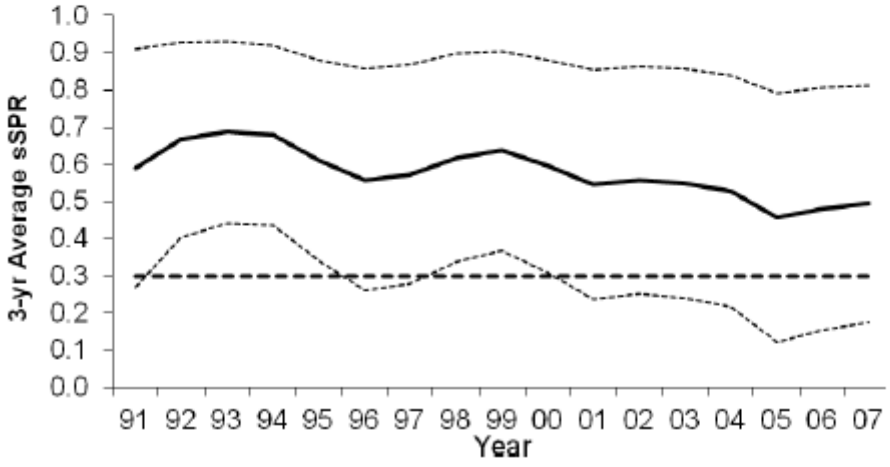



**Figure 4. Northern and southern region estimates of three-year average static spawning potential ratio with ± 1.96 standard errors (dashed lines) during 1991-2007. Three-year averages include current and previous two year's sSPR estimates. The heavy dashed line shows the 30% overfishing threshold** (Source: SAFMC 2009). Note: assessment results for the southern region are indicative of relative trends but not absolute values.

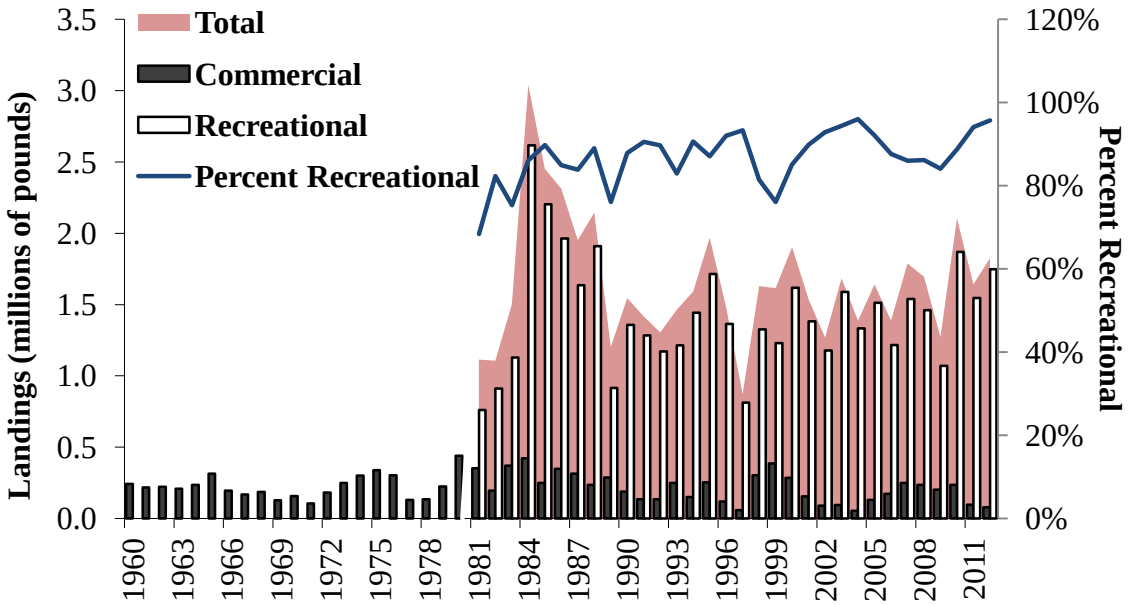



**Figure 5. Commercial and recreational landings (pounds) of red drum.** Recreational data not available prior to 1981. See Tables 2 and 3 for values and data sources.

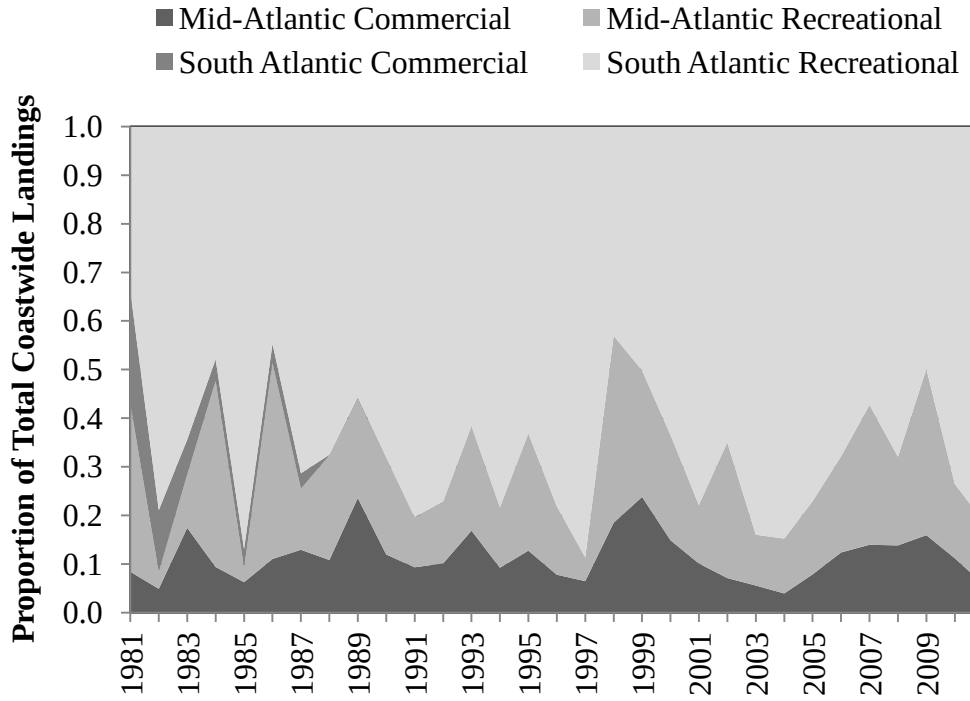



**Figure 6. Proportion of regional, sector-specific landings to total coastwide landings (pounds).** See Tables 2 and 3 for data sources.

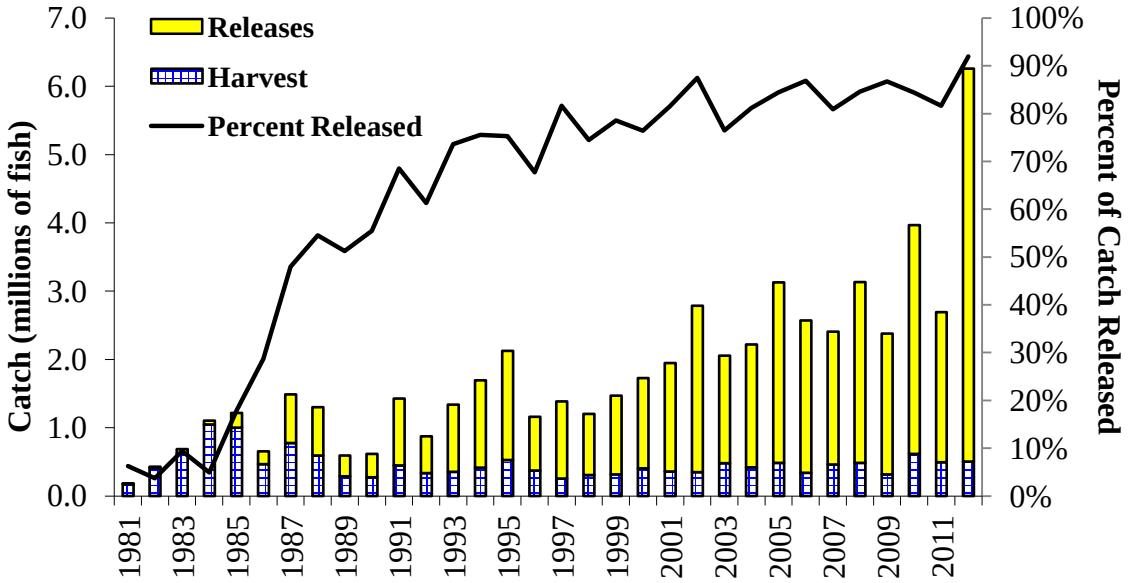



**Figure 7. Recreational catch (harvest and alive releases) of red drum (numbers) and the proportion of catch that is released.** See Tables 4 and 5 for values and data sources.

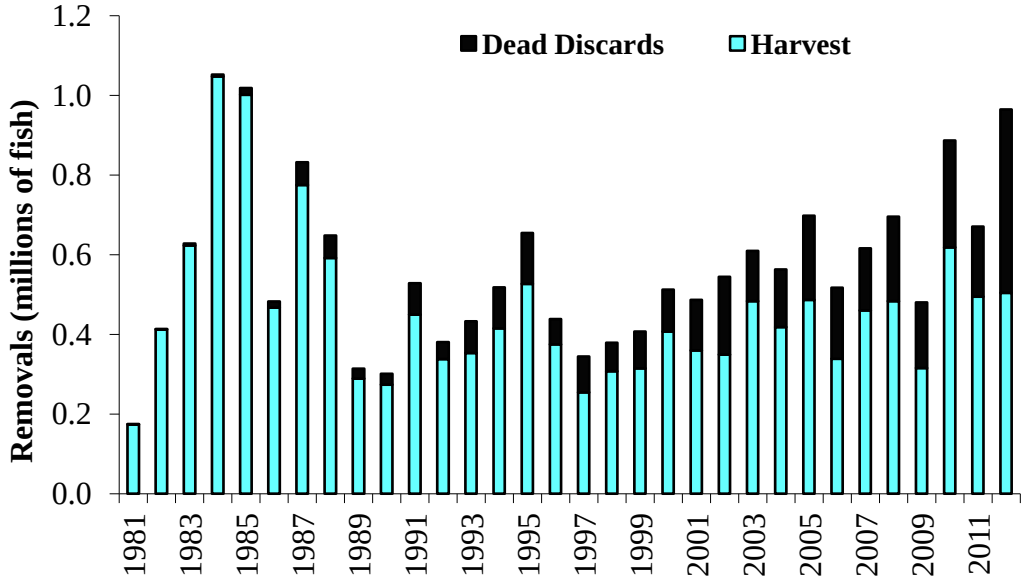



**Figure 8. Recreational removals (harvest and dead discards) of red drum (numbers).** Dead discards are estimated by applying an 8% discard mortality rate to alive releases. See Tables 4 & 5 for values and data sources.

## XI. Tables

**Table 1. Red drum regulations for 2012.** The states of New Jersey through Florida are required to meet the requirements in the FMP; states north of New Jersey are encouraged to follow the regulations. All size limits are total length.

| State | Recreational | Commercial |
|---|---|---|
| ME | None | None |
| NH | 14" - 27", 5 fish | 14" - 27", 5 fish |
| MA | 14" min | 14" min |
| RI | None | None |
| CT | ≤ 27" | ≤ 27" |
| NY | ≤ 27" | ≤ 27" |
| PA | None | None |
| NJ | 18" - 27", 1 fish | 18" - 27", 1 fish |
| DE | 20" - 27", 5 fish | 20" - 27", 5 fish |
| MD | 18" - 27", 1 fish | 18" - 25", 5 fish |
| PRFC | 18" - 25", 5 fish | 18" - 25", 5 fish |
| VA | 18" - 26", 3 fish | 18" - 26", 3 fish |
| NC | 18" - 27", 1 fish | 18" - 27"; 250,000 lb harvest cap with overage payback; 4 and 7 fish daily trip limits during the year (1 fish for hook and line); closed December 1, 2008 – April 31, 2009; red drum must be less than 50% of catch (lbs, excluding menhaden); small mesh (<5" stretched mesh) gill nets attendance requirement May 1 - November 30. Fishing year: September 1 – August 31. Quota reduced to 235,174 pounds for 2010/11 fishing year to account for overage |
| SC | 15" - 23", 3 fish. Gigging allowed November - March. | Gamefish Only |
| GA | 14" - 23", 5 fish | 14" - 23", 5 fish |
| FL | 18" - 27", Northern Region- 2 fish; Southern Region- 1 fish | Sale of native fish prohibited |

**Table 2. Commercial landings (pounds) of red drum by state, 1981-2012.** (Source: personal communication with NMFS Fisheries Statistics Division, Silver Spring, MD and ACCSP, Arlington, VA, except where noted below)

| Year | NJ | DE | MD | PRFC | VA | NC | SC | GA | FL | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **1981** | | | | | 200 | 93,420 | | 261 | 258,374 | 352,255 |
| **1982** | | | | | 1,700 | 52,561 | 2,228 | 251 | 139,170 | 195,910 |
| **1983** | | | 100 | | 41,700 | 219,871 | 2,274 | 1,126 | 105,164 | 370,235 |
| **1984** | | | | | 2,600 | 283,020 | 3,950 | 1,961 | 130,885 | 422,416 |
| **1985** | | | | | 1,100 | 152,676 | 3,512 | 3,541 | 88,929 | 249,758 |
| **1986** | | | 1,000 | | 5,400 | 249,076 | 12,429 | 2,939 | 77,070 | 347,914 |
| **1987** | | | | | 2,600 | 249,657 | 14,689 | 4,565 | 42,993 | 314,504 |
| **1988** | | | 8,100 | 2 | 4,000 | 220,271 | | 3,281 | 284 | 235,938 |
| **1989** | | | 1,000 | 86 | 8,200 | 274,356 | 165 | 3,963 | | 287,770 |
| **1990** | | | 29 | 86 | 1,481 | 183,216 | | 2,763 | | 187,575 |
| **1991** | | | 7,533 | 3,808 | 24,771 | 96,045 | | 1,637 | | 133,794 |
| **1992** | | | 1,087 | 196 | 2,352 | 128,497 | | 1,759 | | 133,891 |
| **1993** | | | 55 | | 8,637 | 238,099 | | 2,533 | | 249,324 |
| **1994** | | | 859 | | 4,080 | 142,119 | | 2,141 | | 149,199 |
| **1995** | | | 6 | | 2,992 | 248,122 | | 2,578 | | 253,698 |
| **1996** | | | 215 | | 2,006 | 113,338 | | 2,271 | | 117,830 |
| **1997** | | | 22 | 4 | 3,820 | 52,502 | | 1,395 | | 57,743 |
| **1998** | 311 | | 336 | | 6,456 | 294,366 | | 672 | | 302,141 |
| **1999** | 241 | 6 | 504 | 186 | 10,856 | 372,942 | | 1,115 | | 385,850 |
| **2000** | | | 843 | 10 | 11,512 | 270,953 | | 707 | | 284,025 |
| **2001** | | | 727 | 191 | 4,905 | 149,616 | | * | | 155,439 |
| **2002** | | | 1,161 | 310 | 7,361 | 81,370 | | * | | 90,202 |
| **2003** | | | 631 | 47 | 2,716 | 90,525 | | * | | 93,919 |
| **2004** | 12 | | 12 | | 638 | 54,086 | | * | | 54,748 |
| **2005** | 517 | | 37 | 51 | 527 | 128,770 | | * | | 129,385 |
| **2006** | 186 | | 8 | 2 | 2,607 | 169,206 | | * | | 171,823 |
| **2007** | | | 90 | 58 | 6,505 | 243,227 | | * | | 249,747 |
| **2008** | | | 40 | 69 | 4,910 | 229,809 | | * | | 234,503 |
| **2009** | 129 | | 12 | 157 | 8,315 | 194,296 | | * | | 201,908 |
| **2010** | | | 19 | 22 | 3,634 | 231,760 | | * | | 235,435 |
| **2011** | | | | 3 | 4,369 | 91,951 | | | | 96,323 |
| **2012** | 7,971 | | 334 | 81 | 2,609 | 66,518 | | | | 77,513 |

* Notes: NJ landings from SAFIS, 2004-present; MD landings from state reporting program, 1991-present; PRFC landings from agency reporting program, 1988-present; VA landings from state reporting program, 1996-present; NC landings from state reporting program, 1994-present; GA landings from state reporting program, 2000-present, * indicates confidential landings because less than three dealers reported.

**Table 3. Recreational landings (pounds) of red drum by state, 1981-2012.** (Source: personal communication with NMFS Fisheries Statistics Division, Silver Spring, MD)

| Year | NJ | DE | MD | VA | NC | SC | GA | FL | Total |
|---|---|---|---|---|---|---|---|---|---|
| **1981** | | | 4,370 | 347,939 | 31,519 | 50,230 | 9,442 | 317,963 | 761,463 |
| **1982** | | | | | 37,511 | 340,686 | 52,150 | 480,676 | 911,023 |
| **1983** | | | 3,018 | 51,299 | 109,540 | 222,691 | 67,298 | 675,924 | 1,129,770 |
| **1984** | | | | 1,285 | 1,160,539 | 183,282 | 294,583 | 976,971 | 2,616,660 |
| **1985** | | | | | 70,677 | 1,532,316 | 185,887 | 414,176 | 2,203,056 |
| **1986** | | | 754,161 | 145,517 | 31,594 | 498,586 | 173,837 | 360,725 | 1,964,420 |
| **1987** | | | | 44,332 | 200,729 | 913,639 | 250,795 | 227,222 | 1,636,717 |
| **1988** | | | | 9,030 | 451,974 | 1,050,049 | 385,860 | 12,507 | 1,909,420 |
| **1989** | | | 2,348 | 27,236 | 214,849 | 396,771 | 127,245 | 146,064 | 914,513 |
| **1990** | | | 2,679 | | 302,994 | 631,819 | 161,712 | 258,569 | 1,357,773 |
| **1991** | | | 5,635 | 30,582 | 108,268 | 284,290 | 337,207 | 516,999 | 1,282,981 |
| **1992** | | | | 55,324 | 109,134 | 411,484 | 198,751 | 396,555 | 1,171,248 |
| **1993** | | | | 45,505 | 266,459 | 282,614 | 328,245 | 290,930 | 1,213,753 |
| **1994** | | | | 3,684 | 192,060 | 314,632 | 353,616 | 578,412 | 1,442,404 |
| **1995** | | | | 66,270 | 405,620 | 417,595 | 300,337 | 525,231 | 1,715,053 |
| **1996** | | | | 1,512 | 204,556 | 396,394 | 164,756 | 596,483 | 1,363,701 |
| **1997** | | | | 1,810 | 39,077 | 296,155 | 129,836 | 345,390 | 812,268 |
| **1998** | | | | 34,861 | 591,428 | 129,619 | 84,348 | 487,091 | 1,327,347 |
| **1999** | | | | 92,794 | 326,303 | 103,777 | 166,630 | 540,310 | 1,229,814 |
| **2000** | | | | 95,596 | 316,029 | 93,043 | 228,965 | 885,447 | 1,619,080 |
| **2001** | | | | 51,890 | 132,578 | 188,198 | 155,854 | 853,714 | 1,382,234 |
| **2002** | | 860 | 15,154 | 155,212 | 182,225 | 103,831 | 170,572 | 551,128 | 1,178,982 |
| **2003** | | | | 57,213 | 118,808 | 449,399 | 234,865 | 729,446 | 1,589,731 |
| **2004** | | | | 32415 | 124,264 | 312,569 | 296,777 | 566,508 | 1,332,533 |
| **2005** | | | | 7,624 | 239,694 | 298,600 | 177,169 | 788,993 | 1,512,080 |
| **2006** | | 2,064 | | 21,039 | 251,735 | 160,760 | 143,699 | 636742 | 1,216,039 |
| **2007** | | | | 209,248 | 305,664 | 152,190 | 197,510 | 674,463 | 1,539,075 |
| **2008** | | | | 72,510 | 236,744 | 254,305 | 244,594 | 652,613 | 1,460,766 |
| **2009** | | | | 148,573 | 286,702 | 165,874 | 125,499 | 343,359 | 1,070,007 |
| **2010** | | | | 40,323 | 281,587 | 451,144 | 319,427 | 776,346 | 1,868,827 |
| **2011** | | | | | 212,245 | 441,833 | 229,214 | 66,2811 | 1,546,103 |
| **2012** | | 396 | 26,788 | 27,422 | 238,310 | 368,445 | 107,368 | 978,727 | 1,747,456 |

**Table 4. Recreational landings (numbers) of red drum by state, 1981-2012.** (Source: personal communication with NMFS Fisheries Statistics Division, Silver Spring, MD)

| Year | NJ | DE | MD | VA | NC | SC | GA | FL | Total |
|---|---|---|---|---|---|---|---|---|---|
| **1981** | | | 601 | 49,630 | 15,054 | 27,319 | 6,323 | 75,244 | 174,171 |
| **1982** | | | | | 16,445 | 160,760 | 30,757 | 204,401 | 412,363 |
| **1983** | | | 2,413 | 32,940 | 81,528 | 104,806 | 56,854 | 344,513 | 623,054 |
| **1984** | | | | 1,457 | 108,787 | 129,547 | 258,188 | 549,381 | 1,047,360 |
| **1985** | | | | 0 | 22,077 | 530,110 | 183,837 | 265,185 | 1,001,209 |
| **1986** | | | 12,804 | 28,139 | 17,501 | 193,188 | 102,279 | 113,440 | 467,351 |
| **1987** | | | | 2,186 | 61,100 | 522,420 | 138,062 | 51,225 | 774,993 |
| **1988** | | | | 4,311 | 142,626 | 287,916 | 147,042 | 9,542 | 591,437 |
| **1989** | | | 1,014 | 12,007 | 62,359 | 127,492 | 51,557 | 34,748 | 289,177 |
| **1990** | | | 1,279 | 0 | 33,149 | 118,666 | 76,304 | 44,280 | 273,678 |
| **1991** | | | 2,745 | 17,119 | 38,658 | 125,833 | 162,802 | 102,727 | 449,884 |
| **1992** | | | | 13,275 | 23,593 | 112,534 | 83,861 | 104,265 | 337,528 |
| **1993** | | | | 14,005 | 49,493 | 119,189 | 105,710 | 65,140 | 353,537 |
| **1994** | | | | 1,378 | 28,953 | 129,515 | 134,214 | 120,938 | 414,998 |
| **1995** | | | | 3,665 | 88,593 | 202,430 | 134,915 | 96,927 | 526,530 |
| **1996** | | | | 572 | 36,746 | 130,649 | 60,251 | 146,823 | 375,041 |
| **1997** | | | | 1,920 | 8,749 | 129,022 | 39,041 | 75,235 | 253,967 |
| **1998** | | | | 13,070 | 114,638 | 46,509 | 24,929 | 107,982 | 307,128 |
| **1999** | | | | 12,425 | 64,739 | 44,069 | 67,283 | 126,180 | 314,696 |
| **2000** | | | | 22,603 | 61,618 | 37,217 | 94,144 | 191,070 | 406,652 |
| **2001** | | | | 6,967 | 23,142 | 61,420 | 90,376 | 177,633 | 359,538 |
| **2002** | | 275 | 5,521 | 49,795 | 42,541 | 41,190 | 90,993 | 119,010 | 349,325 |
| **2003** | | | | 13,607 | 25,481 | 162,484 | 122,259 | 159,331 | 483,162 |
| **2004** | | | | 5,005 | 30,017 | 107,803 | 138,893 | 136,728 | 418,446 |
| **2005** | | | | 2,766 | 51,807 | 130,655 | 105,655 | 195,550 | 486,433 |
| **2006** | | 468 | 6,362 | 12,665 | 55,714 | 48,703 | 68,813 | 145,860 | 338,585 |
| **2007** | | | | 46,405 | 66,789 | 72,261 | 113,237 | 161,427 | 460,119 |
| **2008** | | | | 20,847 | 50,809 | 119,471 | 133,107 | 159,246 | 483,480 |
| **2009** | | | | 38,670 | 57,543 | 70,326 | 68,857 | 79,635 | 315,031 |
| **2010** | | | | 11,076 | 64,024 | 172,708 | 194,826 | 175,828 | 618,462 |
| **2011** | 995 | | | | 45,143 | 161,503 | 106,962 | 180,001 | 494,604 |
| **2012** | | 296 | 17,869 | 28,149 | 52,948 | 121,068 | 45,766 | 238,191 | 504,287 |

**Table 5. Recreational alive releases and dead discards (numbers) of red drum by state, 1981-2012.** Dead discards are estimated based on an 8% release mortality rate. (Source: personal communication with NMFS Fisheries Statistics Division, Silver Spring, MD.)

| Year | NJ | DE | MD | VA | NC | SC | GA | FL | Total | Dead Discards |
|---|---|---|---|---|---|---|---|---|---|---|
| **1981** | | | | | 2,230 | 417 | | 9,042 | 11,689 | 935 |
| **1982** | | | | | | 2,496 | 3,377 | 10,172 | 16,045 | 1,284 |
| **1983** | | | | | 1,866 | 6,751 | 1,417 | 54,723 | 64,757 | 5,181 |
| **1984** | | | | | 2,931 | 0 | 4,232 | 47,196 | 54,359 | 4,349 |
| **1985** | | | | 1,115 | | 16,688 | 6,315 | 193,399 | 217,517 | 17,401 |
| **1986** | | | | 7,595 | | 24,018 | 56,045 | 100,095 | 187,753 | 15,020 |
| **1987** | | | | | 18,499 | 82,595 | 234,676 | 377,959 | 713,729 | 57,098 |
| **1988** | | | | 3,958 | 24,874 | 269,176 | 177,319 | 233,988 | 709,315 | 56,745 |
| **1989** | | | 2,918 | 7,038 | 7,566 | 42,824 | 71,162 | 172,303 | 303,811 | 24,305 |
| **1990** | | | 0 | 934 | 12,452 | 102,611 | 156,263 | 68,667 | 340,927 | 27,274 |
| **1991** | | | 4,432 | 14,461 | 121,178 | 99,968 | 92,803 | 645,773 | 978,615 | 78,289 |
| **1992** | 301 | | | 15,383 | 60,230 | 46,269 | 128,066 | 284,893 | 535,142 | 42,811 |
| **1993** | | | | 50,434 | 182,301 | 146,324 | 140,386 | 465,656 | 985,101 | 78,808 |
| **1994** | | | | 10,684 | 107,662 | 324,706 | 146,039 | 691,261 | 1,280,352 | 102,428 |
| **1995** | | | | 33,560 | 164,520 | 362,844 | 356,618 | 683,706 | 1,601,248 | 128,100 |
| **1996** | | | | 2,424 | 35,752 | 176,517 | 71,983 | 500,374 | 787,050 | 62,964 |
| **1997** | | 2,571 | | 109,754 | 259,570 | 175,772 | 22,736 | 560,559 | 1,130,962 | 90,477 |
| **1998** | | | 2,768 | 93,660 | 199,701 | 84,274 | 33,882 | 481,009 | 895,294 | 71,624 |
| **1999** | | | 2,148 | 232,893 | 247,146 | 87,776 | 18,586 | 565,981 | 1,154,530 | 92,362 |
| **2000** | | | 1,458 | 196,541 | 203,967 | 94,050 | 129,190 | 693,152 | 1,318,358 | 105,469 |
| **2001** | | | | 30,365 | 238,552 | 221,045 | 249,892 | 850,044 | 1,589,898 | 127,192 |
| **2002** | | 1,388 | 18,412 | 801,239 | 640,857 | 142,931 | 168,902 | 663,879 | 2,437,608 | 195,009 |
| **2003** | | 731 | 2,935 | 43,379 | 75,561 | 430,052 | 272,897 | 748,765 | 1,574,320 | 125,946 |
| **2004** | | | | 33,777 | 181,252 | 438,173 | 141,972 | 1,006,814 | 1,801,988 | 144,159 |
| **2005** | | | | 28,351 | 378,541 | 493,595 | 334,521 | 1,405,967 | 2,640,975 | 211,278 |
| **2006** | | 875 | 12,357 | 185,859 | 510,264 | 539,936 | 136,306 | 847,269 | 2,232,866 | 178,629 |
| **2007** | | | | 110,566 | 416,352 | 436,797 | 225,985 | 758,684 | 1,948,384 | 155,871 |
| **2008** | | 75 | 217 | 236,787 | 658,887 | 552,217 | 313,743 | 889,550 | 2,651,476 | 212,118 |
| **2009** | | | 14,754 | 178,396 | 429,776 | 751,123 | 167,704 | 521,659 | 2,063,412 | 165,073 |
| **2010** | | | 2,182 | 28,580 | 635,876 | 786,452 | 483,650 | 1,414,115 | 3,350,855 | 268,068 |
| **2011** | | | | 61,330 | 207,697 | 664,291 | 213,781 | 1,051,143 | 2,198,242 | 175,859 |
| **2012** | | 5,873 | 280,000 | 2,503,237 | 1,533,006 | 543,618 | 90,237 | 799,428 | 5,755,399 | 460,432 |

# Atlantic States Marine Fisheries Commission

1050 N. Highland Street • Suite 200A-N • Arlington, VA 22201
703.842.0740 • 703.842.0741 (fax) • www.asmfc.org


# MEMORANDUM

**July 30, 2013**

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

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

**RE:** **Traffic Light Method Analysis Report for the Atlantic Croaker Fishery**

This memorandum serves as a report on the use of the traffic light approach the South Atlantic State/Federal Management Board requested the Atlantic Croaker Technical Committee (TC) develop during the 2012 August Board meeting. As noted by the TC in the Annual Assessment Update of the Atlantic Croaker Triggers (2013), this methodology is useful in providing a more comprehensive view of trends in the Croaker fishery. The TC requests to use this methodology in conjunction with the current triggers mandated in Amendment 1 to the Interstate Fishery Management Plan for Atlantic Croaker.

**A Comparison of Fuzzy Traffic Light Models for assessment use in the Atlantic Croaker Fishery.**

Under the current 70% trigger scheme outlined in Amendment 1 of the Interstate Fishery Management Plan for Atlantic Croaker, the high degree of variability in year to year index values results in rapid changes that make it difficult to respond to 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 other sciaenidae such as 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. 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.

This section of the analysis directly compares the current hard trigger indices from Amendment 1 section 3.2 (Commercial and Recreational Harvest) as well as 4 fishery independent indices using a 70% threshold of the previous 2-year index average with a Traffic Light analysis (TLA) of these same indices. The Traffic Light analysis will be broken into two separate models:

1. Strict Traffic Light Analysis (STLA)
2. Fuzzy Traffic Light Analysis (FTLA)

The fishery independent indexes used for the comparison 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 changes 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. Both traffic light models used the 1996-2008 time period to set reference boundaries for color transition zones. 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.

cc: Spot Plan Review Team

**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. Only Harvest indices are hard triggers. The four independent indices are included for comparison.

| Year | Percent Change by Index from the Previous 2-Yr Average | | | | | |
|---|---|---|---|---|---|---|
| | MRIP | Comm | VIMS | NCDMF | SEAMAP | NMFS |
| | Harvest | Harvest | Spring | 120.00 | Fall | Fall |
| 1972 | | | | | | |
| 1973 | | | | | | |
| 1974 | | | | | | 331.91 |
| 1975 | | | | | | 381.37 |
| 1976 | | | | | | 287.93 |
| 1977 | | | | | | 78.08 |
| 1978 | | | | | | 52.41 |
| 1979 | | | | | | 9.77 |
| 1980 | | | | | | 22.27 |
| 1981 | | | | | | 818.30 |
| 1982 | | | | | | 48.58 |
| 1983 | | | | | | 85.41 |
| 1984 | 218.20 | 110.15 | | | | 789.97 |
| 1985 | 79.55 | 125.02 | | | | 82.59 |
| 1986 | 196.90 | 114.81 | | | | 69.65 |
| 1987 | 81.60 | 92.01 | | | | 128.38 |
| 1988 | 113.37 | 91.25 | | 71.74 | | 9.05 |
| 1989 | 62.74 | 76.51 | | 138.51 | | 226.94 |
| 1990 | 48.91 | 65.52 | 84.87 | 352.57 | | 104.16 |
| 1991 | 124.49 | 52.16 | 276.50 | 110.54 | | 2.49 |
| 1992 | 123.21 | 87.55 | 16.10 | 21.20 | 26.82 | 58.48 |
| 1993 | 116.60 | 223.92 | 46.28 | 263.68 | 129.52 | 34.32 |
| 1994 | 172.50 | 163.91 | 10.46 | 65.38 | 127.26 | 5457.99 |
| 1995 | 101.65 | 141.07 | 53.27 | 52.26 | 30.46 | 30.70 |
| 1996 | 92.27 | 168.62 | 2.09 | 40.61 | 52.16 | 52.78 |
| 1997 | 191.52 | 155.16 | 6272.00 | 347.32 | 44.98 | 49.73 |
| 1998 | 133.43 | 105.75 | 38.69 | 309.63 | 125.14 | 120.02 |
| 1999 | 93.43 | 102.20 | 12.73 | 137.05 | 502.84 | 580.21 |
| 2000 | 127.25 | 102.57 | 13.27 | 23.45 | 37.82 | 97.57 |
| 2001 | 130.30 | 107.09 | 50.30 | 24.57 | 24.57 | 9.62 |
| 2002 | 88.15 | 94.06 | 562.75 | 54.94 | 269.93 | 74.99 |
| 2003 | 91.07 | 104.39 | 19.67 | 180.40 | 237.29 | 302.18 |
| 2004 | 105.06 | 93.27 | 101.88 | 358.93 | 131.68 | 220.24 |
| 2005 | 109.24 | 90.74 | 103.44 | 73.05 | 161.50 | 84.13 |
| 2006 | 97.43 | 83.26 | 267.51 | 38.51 | 61.60 | 102.66 |
| 2007 | 73.97 | 87.82 | 104.42 | 63.00 | 51.25 | 356.64 |
| 2008 | 74.33 | 92.81 | 354.65 | 249.17 | 112.94 | 16.02 |
| 2009 | 90.36 | 81.14 | 59.30 | 38.61 | 81.94 | 114.89 |
| 2010 | 75.36 | 92.73 | 151.93 | 624.37 | 196.87 | 62.78 |
| 2011 | 51.52 | 73.15 | 22.54 | 14.21 | 42.62 | 110.34 |
| 2012 | 75.93 | 81.29 | 317.14 | 180.35 | 276.35 | 159.98 |
| | | | | | | |
| | **Pink highlighted cells indicate when 70% trigger level (of previous 2Yr average) was met. | | | | | |

**Commercial Harvest**

The commercial harvest index was only examined as far back as 1984 since the recreational index only went back to 1982 and the first year where a comparison could be made to the previous 2-year average would have been 1984. However, commercial landings are available back to 1951.

The 70% trigger was tripped in 1990-1991 (Table 1). In comparison, the STLA model would have triggered a red flag from 1983 through 1995 based on the 1996-2008 reference time frame for the yellow/green and yellow/red boundaries (Fig. 1). The FTLA model showed steady decline with the increasing proportion of red from 1982-1992 indicating that the same decline as the STLA model. The years where the index shows some improvement (1997-2003), there is 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 yellow/red zone in 2006. All of the trends shown in stock changes, while reflected in both STLA and FTLA, appear to be more detailed and better reflected in the fuzzy model. The FTLA was more sensitive to changes than the 70% trigger because it takes the longer time frame into consideration for the long term mean. It must also be noted that the commercial landings were primarily driven by harvest in only a few states (VA, NC, MD) compared to the recreational harvest.

**Recreational Harvest**

The 70% trigger was tripped in 1989-1990 and 2011. In comparison, the STLA model indicated red in 1982-1985, 1987-1996, and 2010-2012 (Fig. 2). Green years in the STLA model coincided with peak years in the recreational harvest index. The FTLA model showed declining red with the first indication of green proportions showing up in 1997. In recent years, the STLA model stayed green in 2000-2006 while the fuzzy model began to show the declining trend via the decreasing proportion of green as harvest decreased in 2006, even though it remained above the long term mean. 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 1996-2012 mean and boundary values.

**Figure 1.** Strict and Fuzzy traffic light models for commercial Atlantic croaker harvest using 1996-2008 long term mean for reference points.

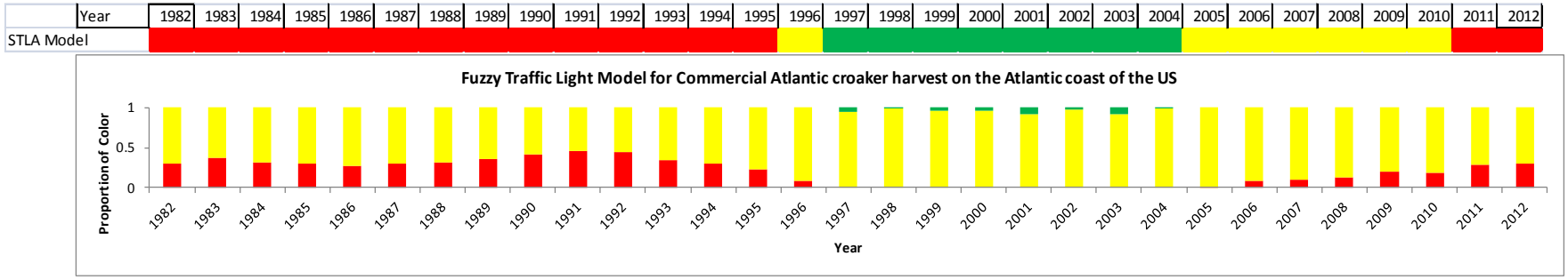
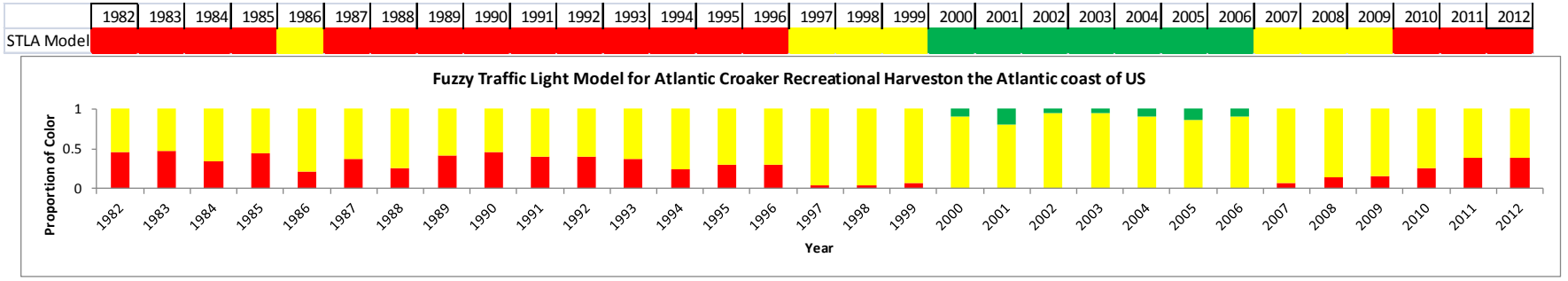



**Figure 2**. Strict and Fuzzy traffic light models for recreational Atlantic croaker harvest using 1996-2008 long term mean for reference points.



**VIMS Spring Surveys**

The VIMS survey was conducted in Chesapeake Bay and the rivers in Virginia (Fig. 3). This was a juvenile survey and shows a high degree of year to year variability which likely reflects variable recruitment and year-class strength. Both the STLA and FTLA models reflect extended periods of low abundance (1988, 1994-1996, 1999-2005, and 2011) and some periods of highly elevated catches (1997, 2008, 2010, and 2012). Under the 70% threshold scheme, the index triggered in the same years, except in 2010 where only the 70% threshold triggered (Table 1), but the FTLA did not. The FTLA and the STLA models showed the changes in index values earlier as well as covering the overlapping time periods of the 70% threshold scheme. This was true even in years where the STLA model was green while the greater proportion of the FTLA model was yellow rather than green (1998). The FTLA model generally showed greater sensitivity to changes than either the 70% threshold model or the 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.

**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) (Fig. 4). 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).

**Figure 3.** VIMS juvenile fish and blue crab survey.

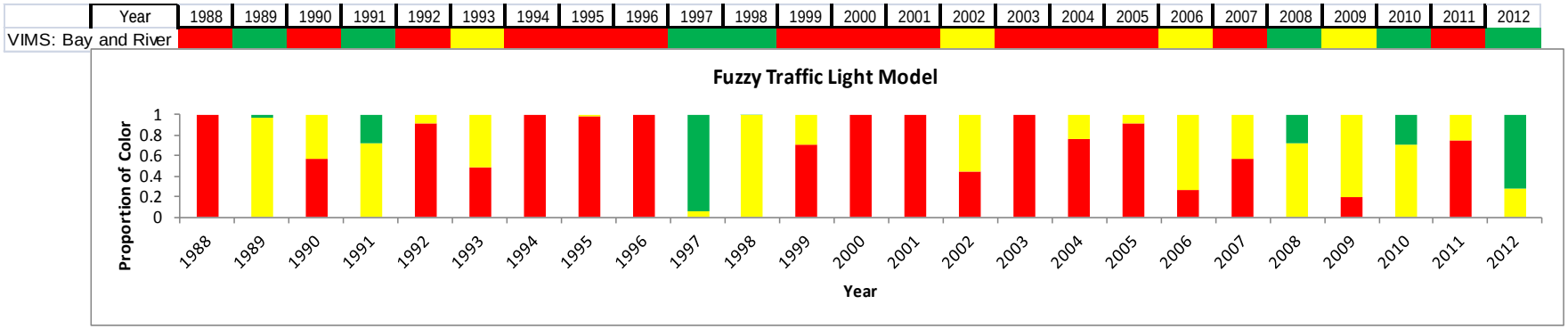
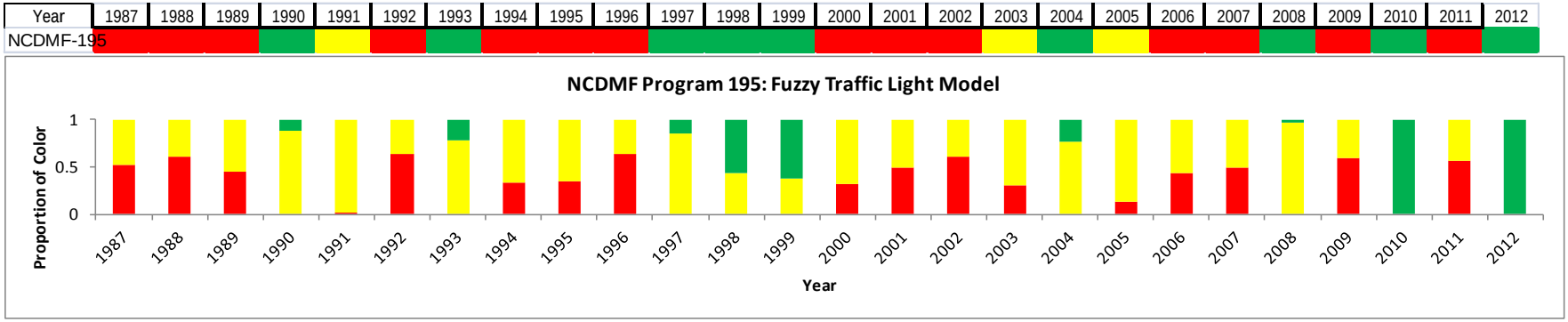



**Figure 4.** NCDMF Program 195 survey



**SEAMAP Fall Trawl Survey**

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 STLA model agreed with 7 of the 9 years where the 70% threshold had tripped by coming out red (1992, 1995-1997, 2000-2001, 2011) (Fig. 5). The FTLA model generally showed the trends better with a general decline beginning from 1994-2001, with the exception of one year (1999) in that time period. Even in the years ranked green by the STLA model, the FTLA model generally 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.

**NEFSC (NMFS) Fall Ground-Fish Survey**

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. 6). During the early time period (1972-1993) the CPUE was well below the lower threshold for both the 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.

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. 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 STLA model (Fig. 7) had all years prior to 1998 in the red (with the exception of 1994 and 1996), and the FTLA model had relatively high proportions of red for all of these years. 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 they did in the STLA model.

**Figure 5.** Strict and Fuzzy Traffic Light models for SEAMAP trawl survey for Atlantic croaker.

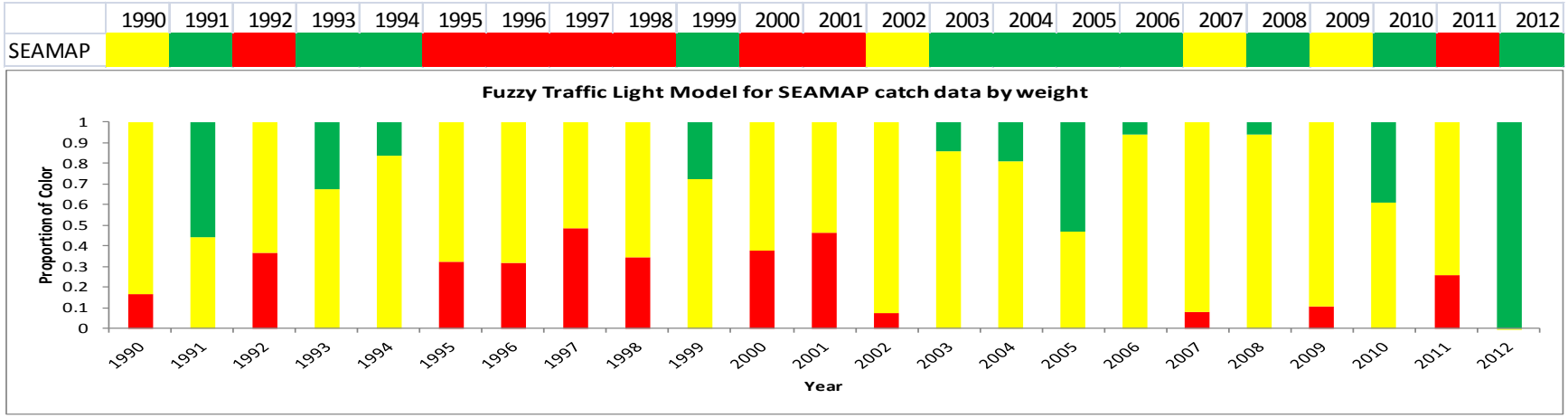



**Figure 6**. Mean annual stratified CPUE for NEFSC Fall Ground-fish survey with strict traffic light designations using 1996-2008 for boundary reference points (dotted lines).

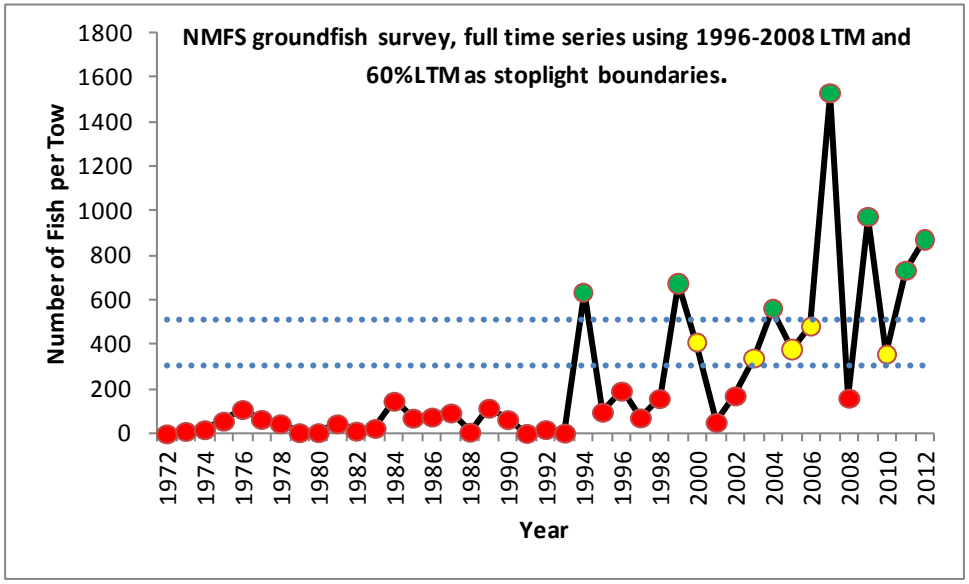
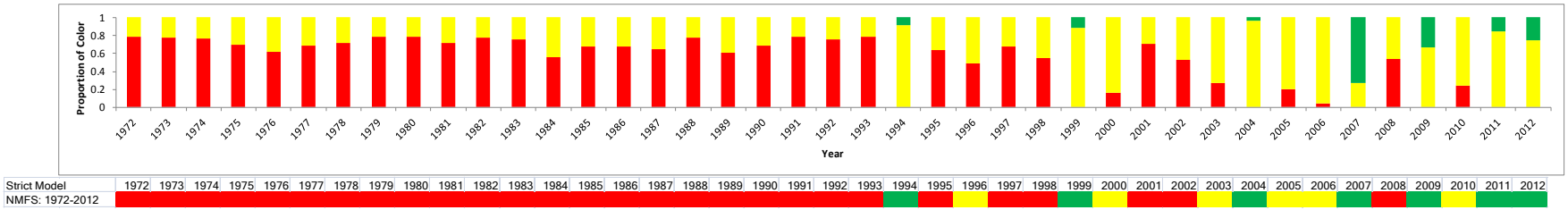
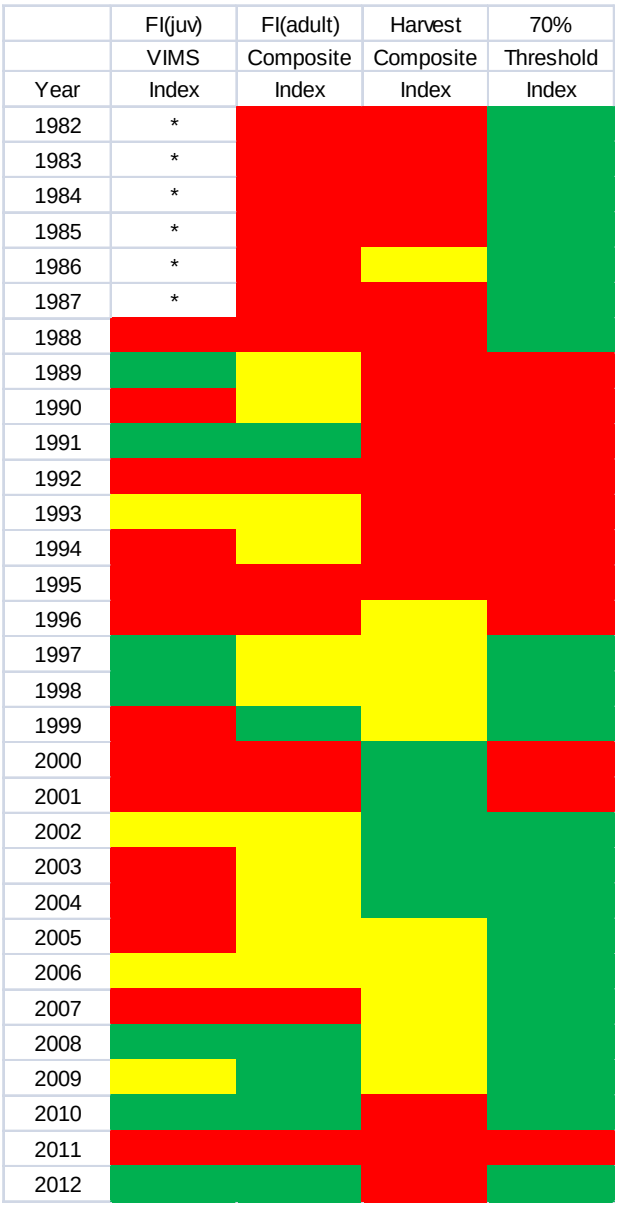


**Figure 7.** Strict and Fuzzy Traffic Light models for NEFSC Fall Ground-Fish trawl survey using 1996-2008 as the color reference boundaries for setting reference points.



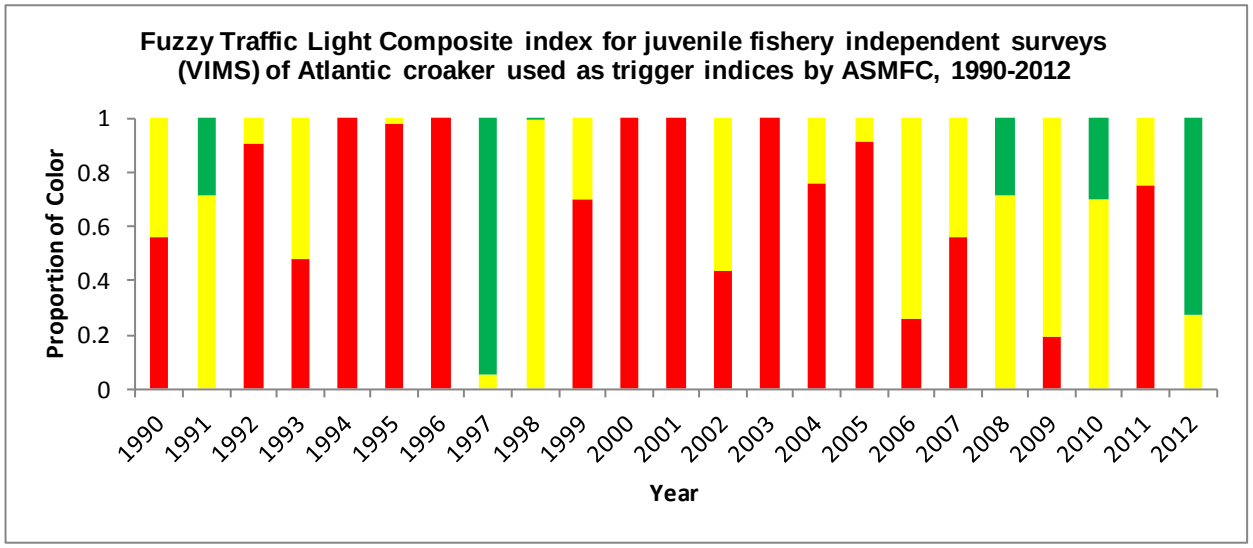

Given the changes in catch levels that occurred after 1994, the use of the entire time series means to set boundary reference points would not be prudent because of the level of low catches which occurred in the first 20 years of the data series, relative to catch levels in the second 20 years of the 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 NEFSC 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.

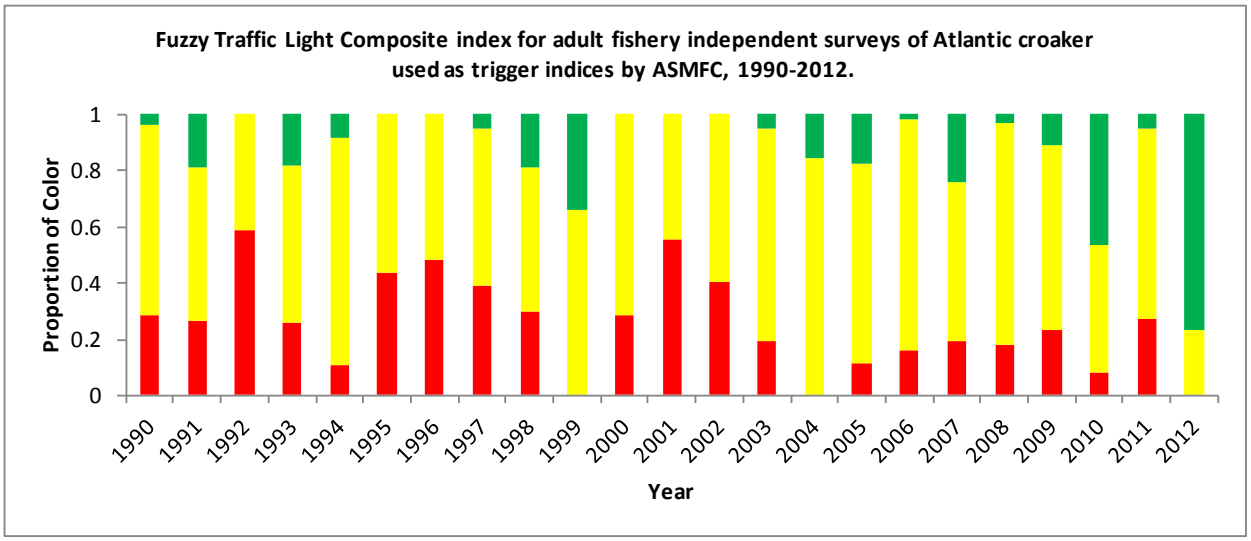
**Figure 8.** Composite Strict Traffic Light Models for fishery independent abundance trigger surveys (divided between juvenile surveys (VIMS, NCDMF) and adult surveys (NEFSC, SEAMAP,)), fishery dependent "hard" harvest triggers, and the 70% threshold index. Red in the 70% threshold index indicates year where it would have tripped either the fishery dependent harvest triggers or more than two fishery independent indices.

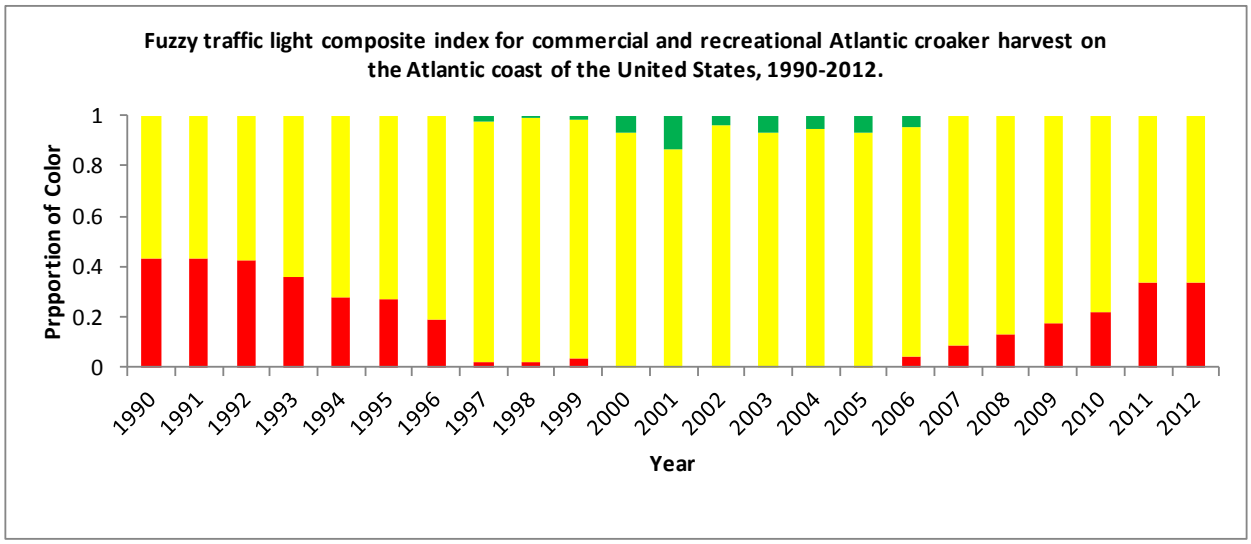



There were only three years (1992, 1995, and 2011) where the 70% trigger and the composite indices were tripped. The STLA composite models tripped red in 6 years (1982-1985, 1987-1988). The STLA model showed greater sensitivity to changes than the 70% trigger index.

**Figure 9.** Fuzzy Traffic Light composite models for fishery independent abundance indexes for adult (NEFSC, , SEAMAP) and juvenile (VIMS and NCDMF) Atlantic croaker and Fishery Dependent harvest indexes (commercial and recreational harvest) using a 1996-2008 reference time period.



**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 1990-2012 time period which was when all of the indicator component indices were available.

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. 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, 2008, 2010, and 2012. 1997 appears to be a particularly strong year-class. 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 (1993, 1996, 2001, 2005) through the mid 2000's. After 2005, the years with higher proportions of green occurred in shorter intervals of approximately every 2 years (2005, 2007, 2010, 2012). Declining trends 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.

The composite FTLA model for harvest (commercial and recreational harvest combined) showed peak harvests occurring from 1997-2006. While harvest was in the red from 1990-1996, the increase in general harvest levels that occurred from 1997-2006 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. While this is apparent in the FTLA it was not apparent in the STLA or the 70% threshold index. 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 (2000-2003) coincided with decreasing abundance in the FTLA 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.