Fishery Management Report No. 44

of the

Atlantic States Marine Fisheries Commission

Working towards healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.

Amendment 1 to the Interstate Fishery Management Plan for Atlantic Croaker

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Prepared by

Atlantic States Marine Fisheries Commission
Atlantic Croaker Plan Development Team

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This Management Plan was prepared under the guidance of the Atlantic States Marine Fisheries Commission's South Atlantic State/Federal Fisheries Management Board, Chaired by Spud Woodward of Georgia. Technical and advisory assistance was provided by the Atlantic Croaker Technical Committee, the Atlantic Croaker Stock Assessment Subcommittee, and the Atlantic Croaker Advisory Panel.

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EXECUTIVE SUMMARY

1.0 Introduction

The purpose of managing Atlantic croaker stocks is to ensure that the Atlantic croaker resource can be utilized throughout its range by current and future generations of the fishing and non-fishing public. Effective management will require controls on mortality due to fishing and habitat degradation, as well as cooperation among the groups responsible for managing different areas utilized by Atlantic croaker.

The Atlantic croaker program functions under the Atlantic States Marine Fisheries Commission's Interstate Fisheries Management Program (ISFMP), with immediate oversight by the South Atlantic State/Federal Fisheries Management Board.

The Atlantic Coastal Fisheries Cooperative Management Act, established in 1993 (16 U.S.C. 5101-5108; Title VIII of Pub. L. 103-206, as amended) mandates the Commission, upon adoption of an FMP, to identify each State that is required to implement and enforce that plan. The South Atlantic State/Federal Fisheries Management Board of the ASMFC reviewed the status of several plans to define those compliance issues to be enforced under the Atlantic Coast Fisheries Cooperative Management Act (ACFCMA). The Board found the Atlantic Croaker FMP was vague and no longer valid; they recommended an amendment to define a management program necessary to achieve the goals of the FMP.

In 2002, the South Atlantic Board directed the Atlantic Croaker Technical Committee to conduct the first coastwide stock assessment of Atlantic croaker. This assessment was conducted in 2003. It was reviewed by the SEDAR panel in October 2003. At that time the SEDAR panel requested additional work be done on the assessment before it could be used for management purposes. The Technical Committee incorporated the suggestions of the review panel and conducted a revised assessment. This assessment was approved by the same SEDAR review panel in June of 2004. It was presented to the South Atlantic Board in August 2004, after which, they initiated the development of Amendment 1.

2.0 Goals, Objectives, Management Unit, Overfishing Definition

Amendment 1 to the Interstate Fishery Management Plan for Atlantic croaker completely replaces all previous Commission management plans for Atlantic croaker.

The Goal of Amendment 1 to the Interstate Management Plan for Atlantic croaker 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.

In support of this goal, the following objectives are recommended for Amendment 1:

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.

Specification of Management Unit *(2.4)*
The management area of this amendment shall be the entire coastwide distribution of the resource from the estuaries eastward to the inshore boundary of the EEZ.

Management Areas *(2.4.1)*
The management area shall be the entire Atlantic coast distribution of the resource from Florida through New Jersey. The stock assessment divides the Atlantic croaker stock into a southern region, which includes the waters of the Atlantic coast of Florida north to the North Carolina/South Carolina border. The northern region extends from the North Carolina/South Carolina border north through New Jersey. The Atlantic croaker fishery will be managed on a regional basis consistent with the stock assessment. There will be south-Atlantic region, which includes Florida, Georgia, and South Carolina. The mid-Atlantic region will include North Carolina, Virginia, PRFC, Maryland, Delaware, and New Jersey.

Fishing Mortality & Threshold *(2.5)*
The Atlantic croaker fishing mortality threshold under Amendment 1 is the fishing mortality rate that allows for maximum sustainable yield (Fmsy), currently estimated to be 0.39. Amendment 1 also establishes a fishing mortality target of 0.75 Fmsy (0.29). The fishing mortality threshold and target are for the mid-Atlantic region only, the status of the stock for the south-Atlantic remains unknown due to a lack of data. The latest F estimates (2002) for Atlantic croaker in the mid-Atlantic region are 0.11. Therefore, overfishing is not occurring.

Spawning Stock Biomass Target &Threshold *(2.5)*
Amendment 1 establishes a biomass target and threshold based on the sexually mature females in the Atlantic croaker population. The biomass target is the spawning stock biomass that allows for maximum sustainable yield (SSBmsy), currently estimated at 28,932 MT. The threshold is 70% of SSBmsy (20,252MT). The SSB target and threshold are for the mid-Atlantic region only. The latest SSB estimates (2002) for Atlantic croaker are approximately 80,000 MT. Therefore, Atlantic croaker in the mid- Atlantic region are not considered overfished.

Stock Rebuilding Program *(2.6)*
Should the stock be defined as overfished or depleted, the Management Board will take action to recover the stock to the desired target level (in terms of spawning stock biomass). Should it be determined that overfishing is occurring, the Management Board will take action to reduce the fishing mortality on the stock to at least the desired target level. If fishing mortality exceeds the

threshold level and SSB is less than the proposed threshold level, the Management Board must act immediately to reduce fishing mortality to the desired target level or lower.

Stock Rebuilding Targets and Schedules *(2.6.1)*
If the stock becomes overfished or overfishing is occurring, the South Atlantic State/Federal Fisheries Management Board will determine a stock rebuilding target and schedule.

3.0 Monitoring

The Atlantic Croaker Technical Committee will meet at least once each year (resources permitting) to review the stock assessment and all other relevant data pertaining to stock status. The Technical Committee will report on all required monitoring elements outlined in *Section 3* and forward any recommendations to the South Atlantic State/Federal Fisheries Management Board. The Technical Committee shall also report to the Management Board the results of any other monitoring efforts or assessment activities not included in *Section 3* that may be relative to the stock status of Atlantic croaker or indicative of ecosystem health and interactions.

The Atlantic Croaker Advisory Panel will meet as necessary to review the stock assessment and all other relevant data pertaining to stock status. The Advisory Panel will forward its report and any recommendations to the Management Board.

The Atlantic Croaker Plan Review Team (PRT) will annually review implementation of the management plan and any subsequent adjustments (addenda), and report to the Management Board on any compliance issues that may arise. The PRT will also prepare the annual Atlantic Croaker FMP Review and coordinate the annual update and prioritization of research needs (see *Section 6.0*).

4.0 Management Programs/Elements/Implementation

Recreational Fisheries Management Measures *(4.1)*
There are no ASMFC management measures restricting the recreational harvest of Atlantic croaker in Amendment 1. Some states in the management unit have adopted more conservative measures and are encouraged to keep these regulations in place.

Commercial Fisheries Management Measures *(4.2)*
There are no ASMFC management measures to restrict commercial harvest of Atlantic croaker in Amendment 1. Some states in the management unit have adopted more conservative measures and are encouraged to keep these regulations in place.

Habitat Measures *(4.3)*
No mandatory measures related to habitat or habitat protection are implemented through this amendment.

***De minimis* Fishery Guidelines** *(4.4.3)*

The ASMFC Interstate Fisheries Management Program Charter defines *de minimis* as "a situation in which, under the existing condition of the stock and scope of the fishery, conservation, and enforcement actions taken by an individual state would be expected to contribute insignificantly to a coastwide conservation program required by a Fishery Management Plan or amendment" (ASMFC 2000).

States may apply for *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 two year period. A state that qualifies for *de minimis* based on their commercial landings will qualify for exemptions in their commercial fishery only, and a state that qualifies for *de minimis* based on their recreational landings will qualify for exemptions in their recreational fishery only.

Adaptive Management *(4.5)*

The South Atlantic State/Federal Fisheries Management Board may vary the requirements specified in this amendment as a part of adaptive management in order to conserve the Atlantic croaker resource. Specifically, the Management Board may change target fishing mortality rates and harvest specifications, or other measures designed to prevent overfishing of the stock complex or any spawning component. Such changes will be instituted to be effective on the first fishing day of the following year, but may be put in place at an alternative time when deemed necessary by the Management Board. These changes should be discussed with the appropriate federal representatives and Councils prior to implementation in order to be complementary to the regulations for the EEZ.

Measures Subject to Change (4.5.2)

The following measures are subject to change under adaptive management upon approval by the South Atlantic State/Federal Fisheries Management Board:

(1) Fishing year and/or seasons;
(2) Area closures;
(3) Overfishing definition, MSY and OY;
(4) Rebuilding targets and schedules;
(5) Catch controls, including bag and size limits;
(6) Effort controls;
(7) Reporting requirements;
(8) Gear limitations;
(9) Measures to reduce or monitor bycatch;
(10) Observer requirements;
(11) Management areas and/or stock units;
(12) Recommendations to the Secretaries for complementary actions in federal jurisdictions;
(13) Research or monitoring requirements;
(14) Maintenance of Stock Structure
(15) Stock enhancement protocols;
(16) Measures to address delayed implementation of compliance criteria by states; and

(17) Any other management measures currently included in Amendment 1.

Recommendations to the Secretaries *(4.9)*
There are no recommendations at the time. In the future, if the South Atlantic State/Federal Fisheries Management Board finds it necessary to make a recommendation they can do so under Adaptive Management.

5.0 Compliance

Mandatory Compliance Elements for States *(5.1)*
A state will be determined to be out of compliance with the provisions of this fishery management plan, according to the terms of Section Seven of the ISFMP Charter if:

- it fails to meet any schedule required by *Section 5.1.2*, or any addendum prepared under adaptive management (*Section 4.6*); or
- it has failed to implement a change to its program when determined necessary by the South Atlantic State/Federal Fisheries Management Board; or
- it makes a change to its regulations required under *Section 4* or any addendum prepared under adaptive management (*Section 4.6*), without prior approval of the South Atlantic State/Federal Fisheries Management Board.

Mandatory Elements of State Programs *(5.1.1)*
To be considered in compliance with this fishery management plan, all state programs must include management controls on Atlantic croaker consistent with the requirements of *Sections 4.1, 4.2* and *4.3*; except that a state may propose an alternative management program under *Section 4.5*, which, if approved by the Management Board, may be implemented as an alternative regulatory requirement for compliance.

Regulatory Requirements *(5.1.1.1)*
The following lists the specific compliance criteria that a state/jurisdiction must implement in order to be in compliance with Amendment 1:

1. All states must submit an annual compliance report containing commercial and recreational landings as well as any monitoring programs that intercept Atlantic croaker.

Once approved by the South Atlantic State/Federal Fisheries Management Board, states are required to obtain prior approval from the Board of any changes to their management program for which a compliance requirement is in effect. Other measures must be reported to the Board but may be implemented without prior Board approval. A state can request permission to implement an alternative to any mandatory compliance measure only if that state can show to the Board's satisfaction that its alternative proposal will have the same conservation value as the measure contained in this amendment or any addenda prepared under Adaptive Management (*Section 4.6*). States submitting alternative proposals must demonstrate that the proposed action will not contribute to overfishing of the resource. All changes in state plans must be submitted in writing to

the Board and to the Commission either as part of the annual FMP Review process or the Annual Compliance Reports.

Compliance Schedule *(5.1.2)*
States must implement Amendment 1 according to the following schedule:

January 1, 2006:	States with must implement Amendment 1. States may begin implementing management programs prior to this deadline if approved by the Management Board.

Reports on compliance must be submitted to the Commission by each jurisdiction annually, no later than July 1st each year, beginning in 2007.

6.0 Management and Research Needs

Amendment 1 contains a list of management and research needs that should be addressed in the future in order to improve the current state of knowledge of the Atlantic croaker biology, stock assessment, population dynamics, and habitat issues. By no means are these lists of research needs all-inclusive, and they will be reviewed and updated annually through the Commission's FMP review process.

7.0 Protected Species

Amendment 1 provides an overview of protected species known to occur throughout the range of Atlantic croaker. There are numerous species that inhabit the range of the Atlantic croaker management unit covered under this Amendment that are protected under the MMPA and ESA. Sixteen species are classified as endangered or threatened under the ESA, while the remainder are protected by the provisions of the MMPA.

ACKNOWLEDGMENTS

Amendment 1 to the Interstate Fishery Management Plan for Atlantic croaker was developed under the supervision of the Atlantic States Marine Fisheries Commission's South Atlantic State/Federal Fisheries Management Board chaired by Spud Woodward of Georgia. Members of the Plan Development Team (PDT) include Doug Lipton (University of Maryland), Tina Moore (NC DMF), Harry Rickabaugh (MD DNR), and Nancy Wallace (ASMFC, PDT Chair).

Considerable support was provided by the Atlantic Croaker Technical Committee, chaired by Robert O'Reilly of Virginia and the Atlantic Croaker Stock Assessment Committee, chaired by Janaka DeSilva of Florida and John Foster of Georgia.

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1.1.1 Statement of the Problem

The purpose of managing Atlantic croaker stocks is to ensure that the Atlantic croaker resource can be utilized throughout its range by current and future generations of the fishing and non-fishing public. Effective management will require controls on mortality due to fishing and habitat degradation, as well as cooperation among the groups responsible for managing different areas utilized by Atlantic croaker.

The Atlantic croaker program functions under the Atlantic States Marine Fisheries Commission's Interstate Fisheries Management Program (ISFMP), with immediate oversight by the South Atlantic State/Federal Fisheries Management Board.

The original Interstate Fisheries Management Plan for Atlantic croaker was adopted in October 1987 and includes the states from Maryland through Florida. The FMP identified the following management measures for implementation:

1. Promote the development and use of bycatch reduction devices through demonstration and application in trawl fisheries.

2. Promote increases in yield per recruit through delaying entry to croaker fisheries to age one and older (ASMFC 1987).

The Atlantic Coastal Fisheries Cooperative Management Act, established in 1993 (16 U.S.C. 5101-5108; Title VIII of Pub. L. 103-206, as amended) mandates the Commission, upon adoption of an FMP, to identify each State that is required to implement and enforce that plan. The South Atlantic State/Federal Fisheries Management Board of the ASMFC reviewed the status of several plans to define those compliance issues to be enforced under the Atlantic Coast Fisheries Cooperative Management Act (ACFCMA). The Board found the Atlantic Croaker FMP was vague and no longer valid; they recommended an amendment to define a management program necessary to achieve the goals of the FMP. In the final schedule for compliance under the ACFCMA, the Interstate Fisheries Management Program (ISFMP) Policy Board adopted the finding that the 1987 Atlantic Croaker FMP does not contain any management measures that states are required to implement (ASMFC 2002).

In 2002, the South Atlantic Board directed the Atlantic Croaker Technical Committee to conduct the first coastwide stock assessment of Atlantic croaker. This assessment was conducted in 2003. It was reviewed by the Southeast Data Assessment Review (SEDAR) panel in October 2003. At that time the SEDAR panel requested additional work be done on the assessment before it could be used for management purposes. The Technical Committee incorporated the suggestions of the review panel and conducted a revised assessment. This assessment was approved by the same SEDAR review panel in June of

2004. It was presented to the South Atlantic Board in August 2004, after which, they initiated the development of Amendment 1. Even though the Atlantic croaker stock appears to be healthy, the Management Board initiated the development of Amendment 1 to come into compliance with the ACFCMA.

1.1.2 Benefits of Implementation

1.1.2.1 Social and Economic Benefits

Widely varying abundance is a natural part of the fishery for Atlantic croaker. The fishery management program will have a beneficial economic and social impact on the recreational and commercial fisheries if it results in fewer prolonged periods of extremely low abundance due to overfishing.

Setting up a management regime to insure long-term sustainability of the Atlantic croaker stock will provide long-term economic opportunity in both the harvesting and processing sectors. Sustaining a viable Atlantic croaker fishery benefits fishing communities by helping maintain diversity in the industry and providing opportunities to harvest, process, and further develop support industries.

1.2 DESCRIPTION OF THE RESOURCE

This brief resource description is summarized from several reports referenced in this document and is intended to provide the reader with the basic information necessary to understand Atlantic croaker. The reader is referenced to reports for literature that documents life history details.

1.2.1 Atlantic Croaker Life History

Atlantic croaker (*Micropogonias undulatus* Linnaeus) occur in coastal waters from the Gulf of Maine to Argentina (Lee et al. 2001). Although not common north of New Jersey, this species is one of the most abundant inshore demersal fish of the Atlantic Coast of the United States (ASMFC 1987). The Atlantic croaker is an opportunistic bottom-feeder on benthic epifauna and infauna and consumes a variety of invertebrates, including polychaetes, mollusks, ostracods, copepods, amphipods, mysids, and decapods, and occasionally fish (ASMFC 1987). Differences in spatial and temporal distribution, as well as differences in feeding behavior, reduce competition between juvenile sciaenids, such as Atlantic croaker and spot, and allow them to coexist in the same area (both spot and Atlantic croaker frequently co-occur in the same habitats – including juveniles). Predators of Atlantic croaker are larger piscivourous species such as striped bass, southern flounder, bluefish, weakfish, and spotted seatrout (ASMFC1987).

Larvae have been collected from near the edge of the continental shelf to within estuaries of the Mid- and South Atlantic coast (ASMFC 1987). Atlantic croaker larvae move from offshore spawning grounds to estuarine areas by mechanisms that are not well understood, but are likely influenced by both behavior of the larvae and physical processes (Barbieri et al. 1994a).

Recruitment of young-of-the-year (YOY) Atlantic croaker to estuarine areas occurs over an extended period of time. Movement into the nursery areas generally peaks in the fall

north of Cape Hatteras, North Carolina and in the winter and early spring to the south. Young –of-the-year were collected in August - October in the Delaware River (Miller 2002), October to February in a Virginia Atlantic coast estuary, and July to November in Chesapeake Bay. Recruitment of early life stages to estuaries south of Chesapeake Bay took place from August to April with maximum ingress in December through February for North Carolina, South Carolina, Georgia and Florida (ASMFC 1987).

Early life history stages of Atlantic croaker exhibit ontogenetic shifts in prey items and habitat preferences. Larval and post larval Atlantic croaker are primarily zooplantivourous, while detritus appears to be a major component of the juvenile diet. The detritus may be a result of the foraging on benthic infauna and epifauna rather than a source of energy. Post-larval and very young Atlantic croaker occupy estuarine nursery areas, where they are often associated with the shallow marsh habitat over a broad range of estuarine salinities (ASMFC 1987).

Temperature induced winter mortality may be an important factor limiting recruitment in the mid-Atlantic Bight. Lankford and Targett (2001) determined winter water temperatures at or below 3^{o} C drastically reduced survival of YOY Atlantic croaker. Laboratory experiments indicated 0% survival at 1^{o}C and 1.3% survival at 3^{o}C. There was a size-dependent factor where smaller individuals survived at higher rates than larger individuals (Lankford and Targett, 2001).

Initial studies of the age of Atlantic croaker in the Gulf of Mexico were based on the analysis of marks on scales (White and Chittenden 1977). These researchers found few age groups and concluded that this species has a short life span, early age at maturity and could withstand considerable exploitation. Barger (1985) found that transverse sections of sagittal otoliths gave the most repeatable age estimates of Atlantic croaker from the Gulf of Mexico. Marginal increment analysis indicated that a single mark was deposited annually on the sagittae. Also, eight age groups were found suggesting that scales underestimate the true age of the fish in that area.

Ross (1988) aged Atlantic croakers from North Carolina waters also by scale analysis. Subsequently, Barbieri et al. (1994b) used sections of sagittae to age fish from the Chesapeake Bay during 1988-1991. A single annulus formed each year during April and May for all age classes (8); precision of the estimates was very good (99%). Their maximum age was 8 years from Chesapeake Bay collections (Barbieri et al. 1994b). Since this study, the population has expanded and maximum observed age has increased to 12 from fishes landed in Virginia and North Carolina in 2001 (Bobko et al. 2003 and NCDMF 2002). Sections of Atlantic croaker otoliths removed from archeological excavations near St. Augustine, Florida indicated that coastal Indians from the First Spanish period captured fish with a maximum age of 15 years (Hales and Reitz 1992).

Since Atlantic croaker have an extended spawning season and recruit to the estuarine nursery areas over an extended period, there are some problems associated with the assignment of ages to fish taken along the Atlantic coast of the U.S. As previously stated, the fish may move into the estuaries north of North Carolina as early as July. This

would result in these croakers being approximately seven to ten months of age during their first spring. Along the southeast coast (North Carolina and south), most Atlantic croaker recruit to the estuaries from January through March. These fish would be from two to five months of age during their initial spring. The YOY north of Cape Hatteras form a rather indistinct mark near the core of the otolith that has been designated as the first annulus by some researchers, e.g., Barbieri et al. (1994b). The problem lies in the fact that this mark is not seen in the transverse sections of the sagittae of all fish. In those fish with the ring proximate to the core, the indistinct mark is designated as the first annulus. If the mark is absent and the distance to the first well-defined increment is relatively large, one is added to the number of annuli.

South of Chesapeake Bay, some fish do have the hazy area near the core, but many fish lack it. Ages of the fish from North Carolina and south have been determined by designating the first well-defined, distinct ring as the first annulus. The ages may be made comparable by either subtracting one from the northern estimates by Virginia researchers or adding one to the counts from North Carolina and South Carolina biologists.

The size-at-age for Atlantic croaker is highly variable (Chittenden et al. 1994). Atlantic croaker grow rapidly during the first year; but the rate decreases during the second year and remains comparatively low thereafter. Barbieri et al. (1993) found on average, 64% of the cumulative total observed growth in length occurred in the first year and 84% was completed after two years. There was no difference found in the total length-total weight relationship between sexes (Chittenden et al. 1994).

The increased number of older fish in recent samples from Virginia and North Carolina result in larger von Bertalanffy estimates of theoretical maximum size (ASMFC 2003a) than those of Barbieri et al. (1994a). Estimates of the growth parameter, K, appear to be lower for data in the recent time series than those of Barbieri et al. (1994a). There also appears to be a similarity in the recent von Bertalanffy estimates to those estimated by Hales and Reitz (1992) for Atlantic croaker from archeological sites (ASMFC 2003a).

Atlantic croaker are multiple spawners with asynchronous oocyte development and indeterminate fecundity. At a population level, spawning extends over a six-month period (July- December, could extend into January). Some authors suggest that individual fish spawn for only 2-3 months (Chittenden et al. 1994). Atlantic croaker spawn in the lower Chesapeake Bay as well as in coastal oceanic waters (Chittenden et al. 1994). Apparently, spawning starts in Chesapeake Bay and continues offshore and south as Atlantic croaker migrate out of the estuary. However, the occurrence during the fall of some regressing and resting females in Chesapeake Bay indicates that at least some individuals may complete their spawning in estuarine waters. A re-examination of the historical ichthyoplankton studies of the Chesapeake Bay would provide an indication of the magnitude of estuarine spawning for this species.

Atlantic croaker in the Chesapeake Bay region showed temporal changes in sex ratio (Chittenden et al. 1994). In 1990-1991, Chittenden et al. 1994 found the contribution of

the males in the Chesapeake Bay decreased at the beginning of the spawning season (June-July) and reached a minimum in September-October. Males became more abundant again during November-December. Between 1989 and 2002 the annual proportion of females for the Virginia commercial fishery range between 0.54 and 0.8 with an average of 0.67.

Based on samples of the commercial catches in the Chesapeake Bay and the Virginia and North Carolina coastal waters (n = 3,091) during 1990 to 1991, Barbieri et al. (1994a) determined that Atlantic croaker mature at a small size and early age. Males and females started to mature at 170 and 150 mm total length, respectively. At larger sizes, the percentages of mature fish in the samples increased rapidly. Estimated mean length at first maturity was 182 mm TL for males and 173 mm TL for females. All individuals greater than or equal to 250-260mm TL were mature, regardless of sex. They also indicated that the same general pattern held for the maturity schedule by age. More than 85% of both males and females were sexually mature by the end of their first year.

Genetic population structure in Atlantic croaker was examined by using the polymerase chain reaction (PCR) and restriction fragment length polymorphism (RFLP) analysis of mitochondrial DNA (mtDNA) (Lankford et al. 1999).

Juvenile croaker from three U.S. Atlantic localities (Delaware, North Carolina, and Florida) and one Gulf of Mexico locality (Louisiana) were screened to document the magnitude and spatial distribution of mtDNA variation in this species. The objectives were to evaluate the integrity of Cape Hatteras, North Carolina, as a genetic stock boundary; and to estimate levels of gene flow among Atlantic localities to provide an improved basis for future decisions regarding coast wide management of this fishery resource (Lankford et al. 1999). There was significant heterogeneity between Atlantic and Gulf of Mexico samples, suggesting restricted gene flow between these two regions. Analysis of molecular variance also indicated regional (Atlantic versus Gulf) population structure, but provided no evidence that Cape Hatteras represents a genetic stock boundary. These findings are consistent with: 1) a single genetic stock of *M. undulatus* on the Atlantic coast, and 2) separate, weakly differentiated stocks in the Atlantic and Gulf of Mexico (Lankford et al. 1999)

1.2.2 Stock Assessment Summary

The latest stock assessment was completed in 2004 and reviewed by the SEDAR peer review panel (ASMFC 2004a). The stock assessment committee used an Age Structured Production Model. This assessment only accounts for the mid-Atlantic region (North Carolina and north). There is currently not enough data to assess the South Atlantic region (Florida through South Carolina). In this assessment, fishing mortality rates (F) are based on the average population weighted F for ages 1-10+. Fishing mortality rates for Atlantic croaker exhibit a cyclical trend over the time series. From 1977 to 1979, F rose rapidly reaching a maximum of 0.5 in 1979. From 1980 onwards, F rapidly declined reaching its lowest levels in 1992 (Figure 1) Since 1993, F has gradually increased and between 1997 and 2002 remained relatively stable around 0.11.

For the base mid-Atlantic run, the trend in population abundance indicates a step-wise increase reaching a peak of 974 million fish in 1999. Population estimates from 1999 to 2002 have ranged from 663 to 974 million fish. Spawning Stock Biomass (SSB) estimates exhibit a cyclical trend over the time series. From the early 1970's to 1983 SSB declined to its lowest level (11,746 MT). Since 1984, SSB has increased in three distinct phases, with estimates reaching a maximum in 1996 (Figure 2). Between 1999 and 2002 SSB estimates have ranged between 80-91,000 metric tons.

The mid-Atlantic model, which is the core of the population, indicates fishing mortality rates were high in the mid 1970's, abruptly declined, and has been low and stable since the mid 1990's. Between 1973 and 2002 the relationship between the different sources of removals has changed. In particular, estimates of scrap/discards reached their peak in 1979 (3,200 MT) and since then declined to their lowest levels in 2002 (425 MT). Between 1973 and 1995, scrap/discard removals averaged 1,687 MT per year, whereas between 1996-2002 scrap/discards averaged 595 MT per year. It appears that the significant reduction in removals of predominantly age 1 and younger fish may have contributed to relatively stable fishing mortality and spawning stock biomass estimates since the mid 1990's. In relation to the proposed reference points, the Atlantic croaker population is not overfished or undergoing overfishing. The commercial and recreational catch-at-age data from recent years also shows an increasing age distribution, with a few fish of 12 years being observed in the commercial landings. Anecdotal evidence from the mid-Atlantic indicates an expansion of the population at the northern part of the range. For example, in Delaware, fishery independent indices indicate a recent increase in abundance of Atlantic croaker in the region (D. Kahn, personal communication). In addition, both commercial and recreational landings from New Jersey and Delaware have increased recently. The population has benefited from good recruitment in recent years, which may also be tied to the regulatory changes that have affected some of the fisheries that indirectly target Atlantic croaker.

While this analysis does not capture all of the sources of uncertainty, examination of the effects of alternate weightings of the likelihood components and alternate steepness and natural mortality estimates indicate that reference points derived from the base run are relatively robust. The reference points suggest that there was less than a 10% chance that the population is overfished or undergoing overfishing. Sensitivity analysis evaluating the inclusion/non-inclusion of shrimp bycatch estimates, indicate that SSB_{msy} estimates are sensitive to the inclusion of Atlantic croaker caught as shrimp bycatch. However, increased SSB_{msy} estimates are also accompanied by higher SSB estimates. The ratio of SSB_{2002}:SSB_{msy} when shrimp bycatch is included indicates that the stock is unlikely to be below the threshold estimates. Of concern, would be management goals that define biomass reference points in absolute terms. There appears to be some justification for revising the reference points for the biomass target and threshold to relative terms until a more comprehensive evaluation of Atlantic croaker from shrimp bycatch can be carried out.

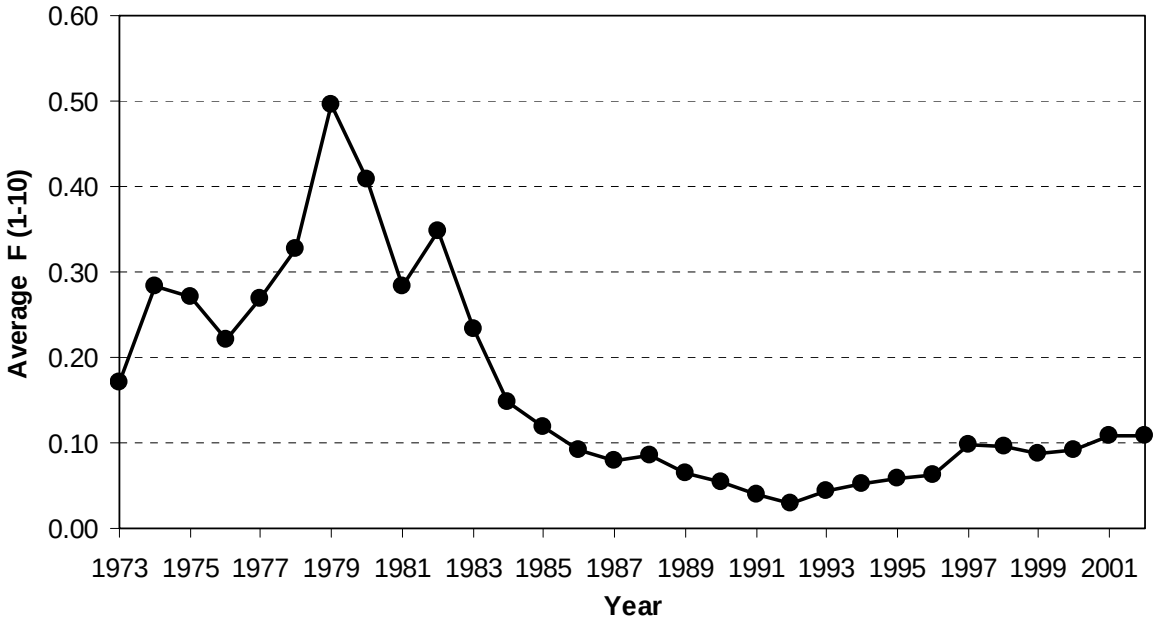


Figure 1. Average fishing mortality rates (ages 1-10) for Atlantic croaker in the Mid-Atlantic

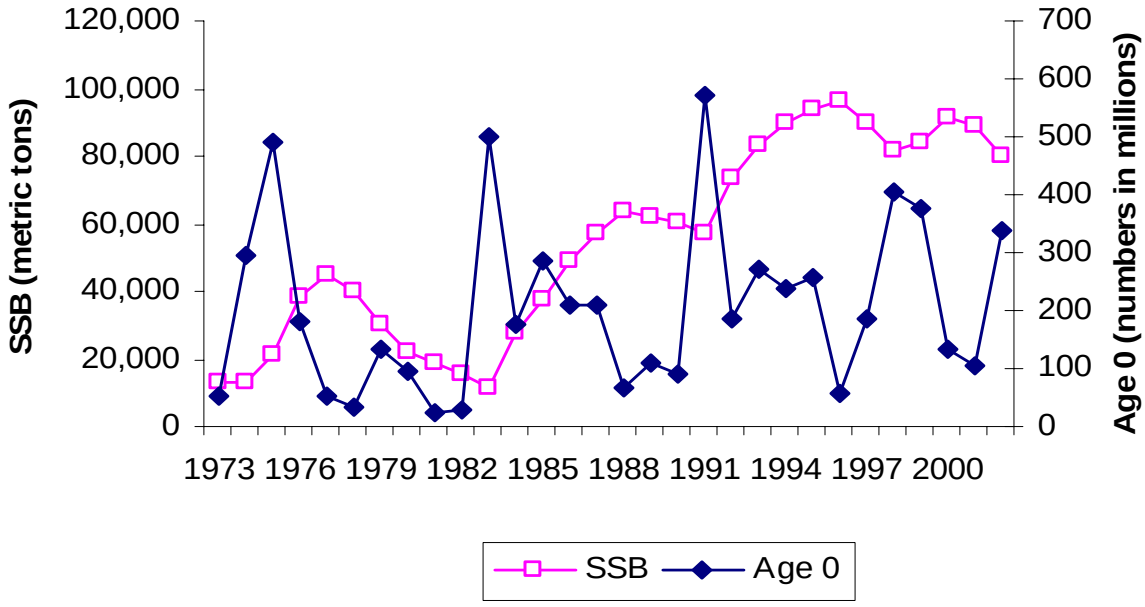


Figure 2. Spawning stock biomass (metric tons) and age 0 recruits (millions of fish) estimates from the base Mid-Atlantic model.

1.2.3 Abundance and Present Condition

The most recent stock assessment estimate of total Atlantic croaker abundance was 786.87 million fish in 2002. The 2002 estimate of age 0 croaker was 338.55 million fish, with a SSB of 80,328 metric tons. Total abundance and SSB estimates have been relatively stable at a high level for the past 11 years. Samples of Atlantic croaker aged from 1988-1991 (Barbieri et al. 1994b) had a maximum age of 8 years. Recent samples

have produced ages up to 12 years (Bobko et al. 2003 and NCDMF 2002). This expansion of age structure coinciding with an extended period of high abundance is an indication the mid-Atlantic population is in good condition.

1.3 DESCRIPTION OF THE FISHERY

Atlantic croaker are caught recreationally and commercially in estuaries and the open ocean. Atlantic croaker has been part of a mixed-stock commercial fishery on the Atlantic Coast since the 1800's. Atlantic croaker are caught commercially with a wide variety of gear. The dominant gears used include gill nets, pound nets, haul seines, and trawls. Atlantic croaker are landed commercially throughout the year with slightly lower landings in the fall and slightly increased landings in late winter. Recreational anglers target Atlantic croaker by bottom fishing and chumming with shrimp, clams, worms, cut fish, and soft or peeler crabs. Recreational harvests typically peak in the warmer months (May through October) when effort tends to be greatest. The majority of recreational fishing occurs in state waters.

1.3.1 Commercial Fishery

Atlantic croaker was landed commercially at least in some years in all coastal states from New Hampshire to Florida between 1950 and 2003 (Table 1.). The species currently has significant commercial landings of over 10 million pounds in Virginia, North Carolina, and over 1 million pounds in New Jersey and Maryland. Landings from these 4 states have been broken down by port to show the communities with the greatest social and economic stake in the Atlantic croaker fishery (Tables 2-5). Commercial landings of Atlantic croaker is only a small and sporadic or recent component of most other states landings. Georgia has had only four years with reported landings since 1983, and less than 600 pounds were landed in any of the four years. South Carolina has reported no landings since 1990. Delaware reported no landings for 21 years during the 1950 – 2003 time period, with most of the zero harvest years in the middle of the time series. New Jersey reported no landings from 1963 – 1969, but reported over one million pounds per year between 1997 and 2003. New York, Rhode Island, Massachusetts and New Hampshire reported no landings for most years, and total landings for the time series did not exceed 20,000 pounds for any of these states. Because Atlantic croaker are usually caught in a mixed fishery and landings are small in some states in some years, some of the sporadic nature of the reported landings may be due to reporting landings in the miscellaneous finfish category.

Commercial landings of Atlantic croaker varied from one million pounds in 1970 to nearly 30 million pounds in 1976 and 1977 along the Atlantic coast. From 1996 to 2003, commercial landings have exceeded 20 million pounds annually. Annual landings consistently increased from a low of 3.7 million pounds in 1991 to 27 million pounds in 1997 (Table1, Figure 3). North Carolina landings have continued to grow since 1993, to a maximum in 2003, and North Carolina accounted for 54% of the cumulative coast wide landings for the 1950 – 2003 time period. However, the largest increase in landings was in Virginia, where only 164,000 pounds were reported in 1991, and more than 10 million pounds have been landed annually in Virginia since 1997. Coast wide landings of Atlantic croaker have remained steady at 25 to 28 million pounds from 1997 to 2003.

Gill nets, haul seines, trawls and pound nets accounted for most of those landings. (ASMFC 2002).

Nominally, the dockside value of the commercial Atlantic coast croaker harvest has ranged from a low of $70,123 in 1970 to a high of $9,808,457 in 2000 (Table 6). Annual coast wide value has been above $6.5 million since 1996. However, after adjusting dockside landings for inflation and adjusting to 2003 U.S. dollars, we find that 1970 is still the low point at $341,398, but 1950 was the peak value at $13.1 million.

Nominal, coast wide price per pound for Atlantic croaker remained relatively stable from 1950 to 1978 averaging 10.5 cents. Price per pound then rose rapidly in the 1980's to a high of 51 cents in 1990, but dropped sharply by 1992 to 35 cents, and has varied between 24 and 36 cents through 2003. Florida and New York have received the highest price per pound in recent years. Again, after adjusting for inflation and adjusting to 2003 U.S. dollars, the real price trends tell a somewhat different story. Real prices declined from an all-time high of $1.15 a pound in 1950 to $0.29 in 1969. Real price trended upward from 1969-1989, peaking at $0.79 a pound. Since 1989, there has been a relatively steady decline in price, and in 2003, real prices were at an all-time low of $0.24 a pound.

Given the huge variability in Atlantic croaker landings, it is important to understand the linkage between real ex-vessel prices and harvests. To estimate this, a simple inverse ex-vessel demand model of Atlantic croaker price as a function of total landings was completed. This simple model only explains 11% of the variability in price ($R^2 = 0.11$), but the coefficient on total landings is significant at the 95% confidence level. The price flexibility, calculated at the mean of the landings and real price data is -0.17, indicating that a 1% increase in Atlantic croaker landings is associated with a 0.17% decrease in Atlantic croaker ex-vessel price. A more sophisticated demand model could capture the other factors that influence Atlantic croaker price, but clearly, other factors besides an increase in Atlantic croaker landings are accounting for the decline in price in recent years.

The inflexibility of Atlantic croaker price in regard to its own landings is helpful to commercial fishermen in times of abundance since real revenues can increase significantly. However, when Atlantic croaker are scarce, the inflexibility results in significantly lower revenues. Thus, the revenue variance is high and it makes it risky to rely on Atlantic croaker income as part of the fishermen's portfolio.

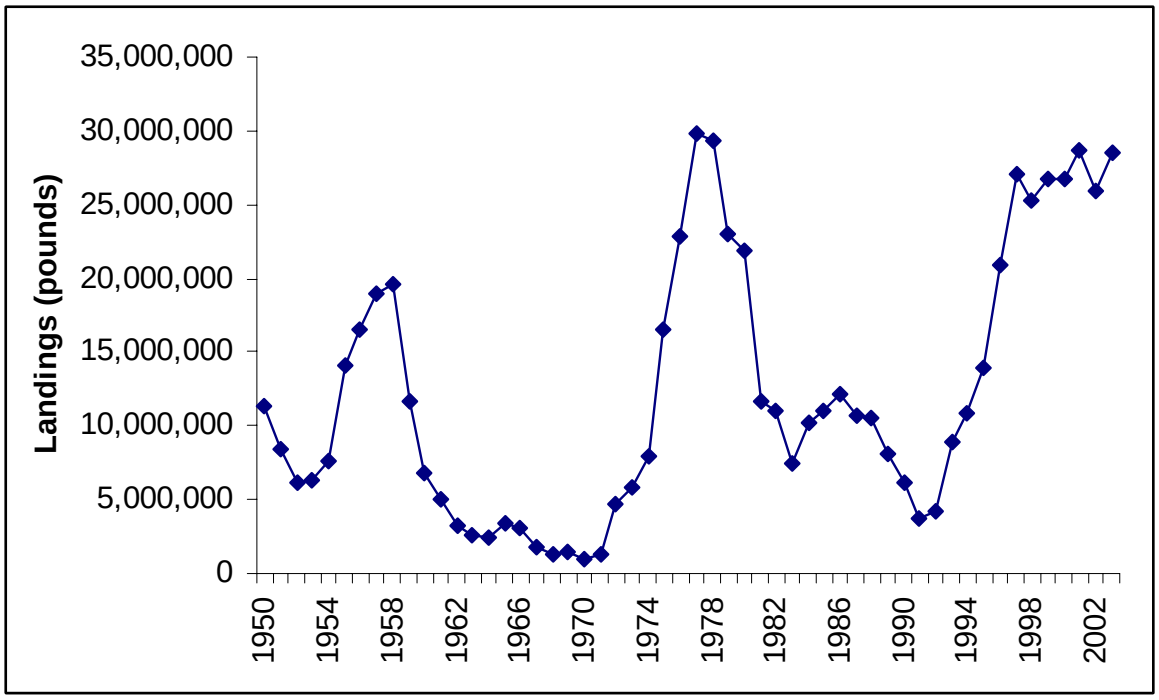


Figure 3. Commercial Landings (pounds) of Atlantic croaker

1.3.2 Recreational Fishery

Between 1981 and 1990 annual average recreational landings (in numbers) amounted to 6.0 million fish, while more recently, between 1997 and 2003, recreational landings have ranged from a minimum of 9.1 million fish to a maximum of 13.2 million fish with average annual landings of 10.8 million fish. The increased landings in recent years have been at the northern range of the fishery (Massachusetts to North Carolina) particularly in New Jersey, Delaware, Maryland, and Virginia (Figures 4 and 5, Tables 7 and 8). During the past 10 years, recreational landings in Virginia, accounted for an average of 68 and 67% of the total landings in numbers and weight, respectively. Landings from states north of New Jersey accounted for sporadic and negligible landings of Atlantic croaker. Recreational landings at the southern range of the fishery (South Carolina through the Atlantic coast of Florida) have not exceeded 1 million fish since 1992. This same region had total landings ranging from 649,038 to 5,785,881 fish with an average of 1,946,479 fish per year from 1981 to 1992. The southern region accounted for 27.9% of the total Atlantic cost recreational catch in numbers from 1984 – 1993 and only 5.7% of the catch from 1994 – 2003. The majority of landings in the southern region of the fishery were made on the Atlantic coast of Florida (Tables 7 and 8).

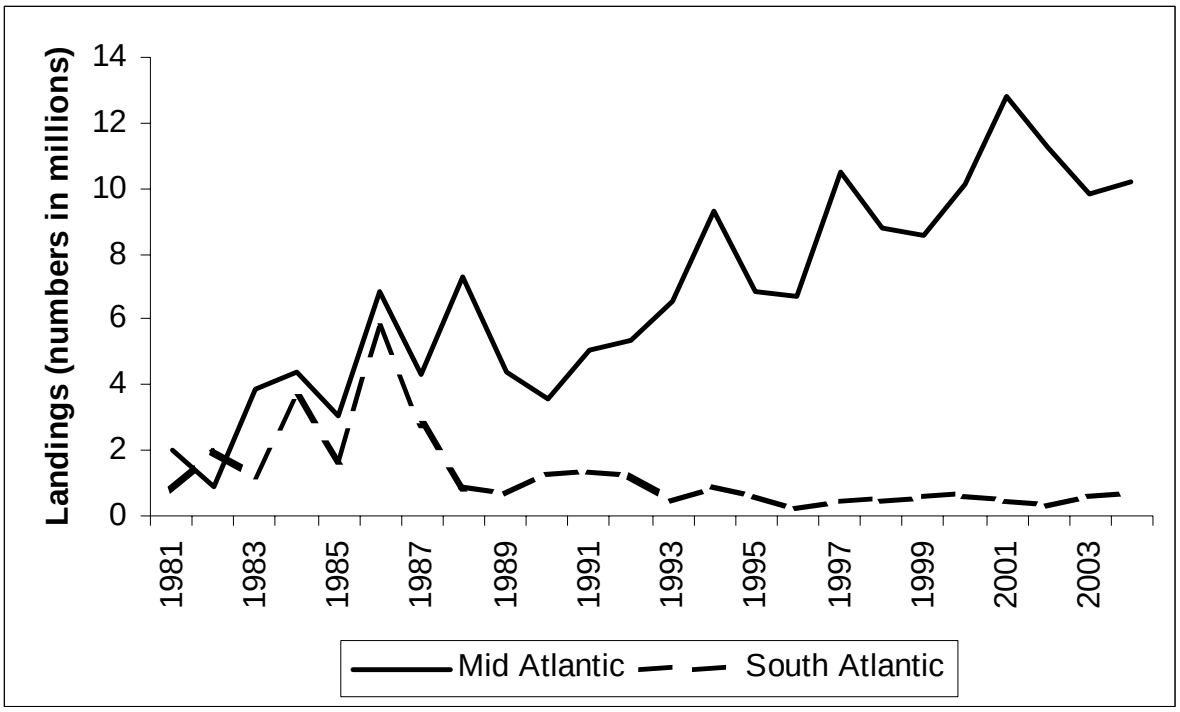


Figure 4. Recreational landings of Atlantic croaker (numbers) by region.

Note: Mid-Atlantic includes North Carolina and all states north. South Atlantic includes South Carolina and all states south.

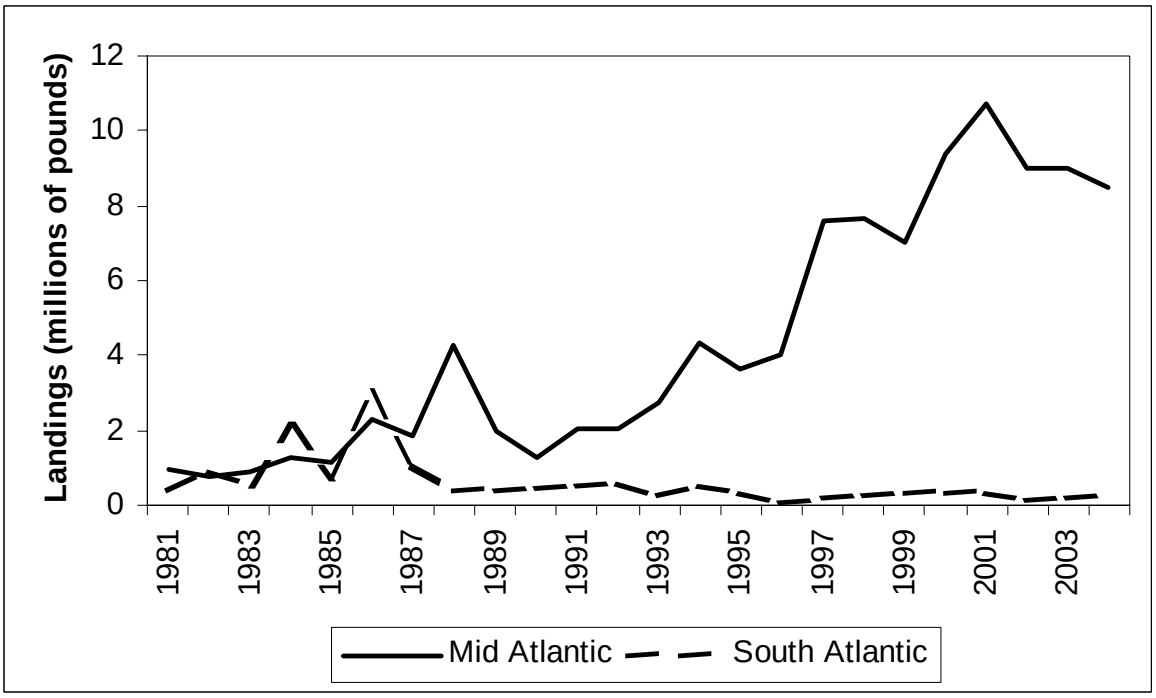


Figure 5. Recreational landings of Atlantic croaker (pounds) by region.

An initial estimate of the economic value of mid and south Atlantic sportfishing using 1988 data was developed by Strand, McConnell and Bockstael (1991) and revised using 1994 data for the mid Atlantic states by Hicks et al. (1999). Both studies aggregate species into broad groups with the earlier study including Atlantic croaker in the

bottomfish category. The latter study apparently did not include Atlantic croaker, but still estimated values for bottomfish. Both studies estimate the marginal effect of increasing (or decreasing) the historic catch rate on a fishing trip. The Strand, McConnell and Bockstael study estimates that an increase of historical catch rate of 0.5 fish per trip adding between $3.55-$4.34 to the value of the trip, depending on the season. This estimate is for all species. Hicks et al. (1999) provide an estimate for just an increase in bottomfish historic catch rate of 1.0 fish per trip. In that case, the increase in the value of the fishing trip is $1.97 across all states. They also provide individual state estimates for the Northeast region. For example, and increase in Maryland is worth $2.44 and $2.06 in Delaware, but only $1.79 in Virginia or a $1.73 in New Jersey.

1.3.3 Subsistence Fishing

Subsistence fishing is often described as catching fish in order to provide necessary food. Often fishing can provide a less expensive alternative to purchasing food. The data describing the exact magnitude of subsistence fishing for Atlantic croaker were not available at the time this Amendment was developed. However, anecdotal information indicates that fishermen, usually fishing from shore, do rely to some degree on fish they catch for food. It is unclear if any of these fishermen target Atlantic croaker, but it is likely that if any Atlantic croaker were caught it would be kept for food.

1.3.4 Non-Consumptive Factors

The MRFSS estimates of Atlantic croaker released alive from the Atlantic coast have generally increased (Figure 6). A ratio of the number of Atlantic croaker harvested versus released reveals a shift to more fish being released in recent years (Figure 7). From 1981 to 1988 values were all greater than one, and were as high as four. From 1990 to the present values have been less variable and ranged from 0.5 to 1. The increase in recreational releases would have a corresponding increase in discard mortality. This shift could indicate recreational anglers are being more selective, some anglers are catch and release fishing for Atlantic croaker, the increase in the stock has led to more incidental catch or, a combination of these factors. For fishermen targeting Atlantic croaker, the increase in abundance could lead to higher number of releases as fishermen continue fishing after having filled their need to keep fish for consumption.

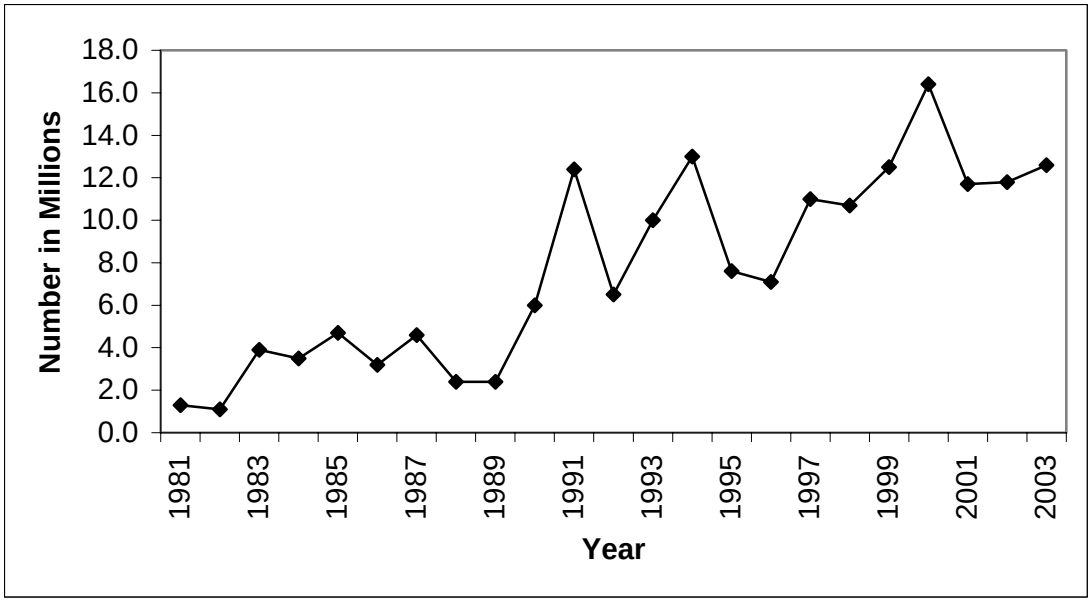


Figure 6. **Number in millions of recreational releases of croaker for the Atlantic Coast, 1981-2003.**

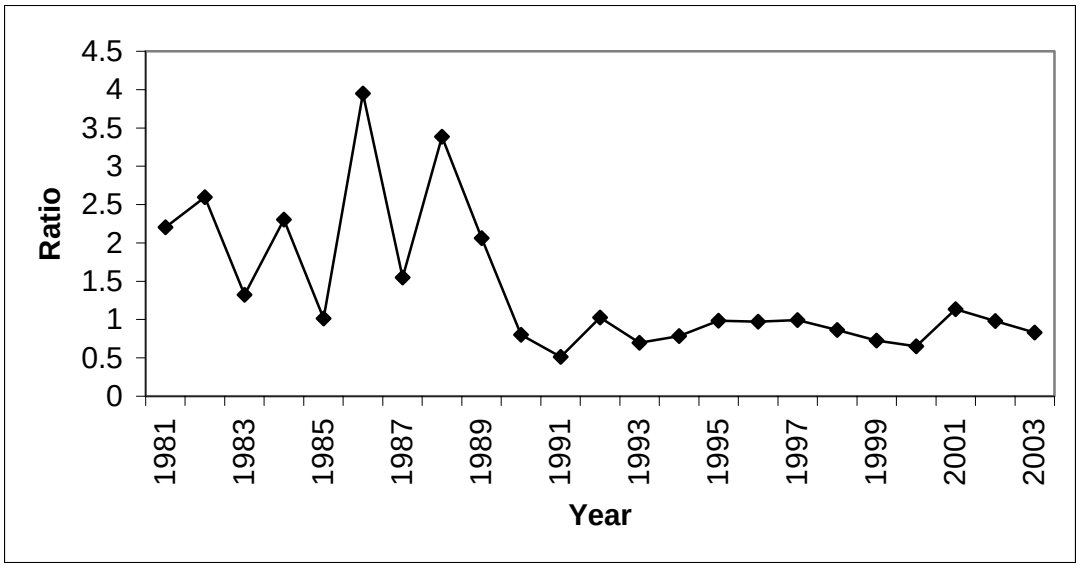


Figure 7. **Ratio of Atlantic croaker recreationally harvested to released from the Atlantic coast, 1981-2003.**

1.3.5 Interactions with Other Fisheries, Species, or Users

Atlantic croaker are prey for larger predators such as bluefish, striped bass, weakfish and summer flounder (ASMFC 1987). Hartman and Brandt (1995) reported Atlantic croaker as being a very small component of striped bass, weakfish and bluefish diets in Chesapeake Bay, with the exception of age one and older bluefish in July and August when Atlantic croaker became an important dietary item.

Atlantic croaker is part of a mixed stock fishery and fluctuations in its abundance may affect landings of other species. Conversely high abundance of more desirable species, such as weakfish, may reduce fishing pressure for Atlantic croaker. Commercial fishermen are likely to change locations, gear type, or mesh size to target the more plentiful or profitable species, while still landing other species that are encountered.

1.4 HABITAT CONSIDERATIONS

1.4.1 Description of the Habitat

1.4.1.1 Spawning Habitat

Atlantic croaker spawn in tidal inlets, estuaries, and on the continental shelf, at depths ranging from 7 to 81 m (26 to 266 ft) and in polyhaline and eurohaline zones (Diaz and Onuf 1985). Exact spawning locations may be related to warm bottom waters (Miller et al. 2002). Spawning is reported to occur at water temperatures of 16-25^{o} C in North Carolina (Street et al. 2005). Atlantic croaker have a long spawning season that generally starts in late summer and continues to early spring, with peak reproductive activity occurring in late fall and winter (Diaz and Onuf 1985). In the Chesapeake Bay and North Carolina, spawning begins as early as August and usually peaks in October, whereas peak spawning occurs in November, in the Gulf of Mexico (USFWS 1996).

1.4.1.2 Egg and Larval Habitat

Pelagic eggs are found in polyhaline and euryhaline waters. After hatching, larvae drift into estuaries by passive and active transport via floodtides, upstream bottom currents, and other large-scale oceanographic processes. Older and larger larvae actively swim into these areas (Miglarese et al. 1982, Petrik et al. 1999). Arrival time into estuaries varies regionally. Larvae are present in the Chesapeake Bay and on the North Carolina and Virginia coasts as late as September, and as early as June on the Louisiana coast (USFWS 1996). Localized processes like currents and tidal regimes influence the dispersal of larvae to nursery areas (Petrik et al. 1999). Upon initial arrival in the estuary, larval croaker are restricted to the surface water. However during ebbing tides, larval croakers move to the brackish, bottom waters where they complete their development into juveniles (Miller 2002). Larvae can tolerate colder water temperatures than adults, but extremely cold temperatures may be a major source of larval mortality.

1.4.1.3 Juvenile Habitat

Juveniles use estuaries and tidal riverine habitats along the U.S. Atlantic coast from Massachusetts to northern Florida, and in the Gulf of Mexico, but are most common in coastal waters from New Jersey southward (Able and Fahey 1998; Robbins and Ray 1986; Diaz and Onuf 1985). Recruitment of juveniles into estuaries may be influenced by tidal fluxes in estuaries. For example, in the Pamlico Sound, North Carolina, a shallow estuary where tidal fluxes are largely controlled by wind, recruitment of juveniles is slower than the Cape Fear estuary, where tidal fluxes dictated by lunar cycles average 1.5 meters (Ross 2003). The Cape Fear estuary is representative of most drowned river valley Atlantic Coast estuaries. Juveniles remain in these habitats until early to mid-summer (USFWS 1996). Juveniles migrate downstream as they develop and by late fall, most juveniles emigrate out of the estuaries for open ocean habitats (Miglarese et al. 1982).

Juveniles are associated with areas of stable salinity and tidal regimes and often avoid areas with large fluctuations in salinity. The upper, less saline parts of the estuaries provide the best environment for high growth and survival rates (Ross 2003, Peterson et al. 2004). Juveniles concentrate in oligohaline and mesohaline waters (0.5 to 18 ppt), although they may tolerate more extreme salinities (Diaz and Onuf 1985, Ross 2003). Ross (2003) showed that, juveniles experience reduced mortality in less saline areas. Lower mortality in the less saline areas may be because of lower physiological stress in those environments (Ross 2003). Growth rates in juveniles may be affected by fluctuating salinities and temperatures (Peterson et al. 2004; Chao and Musick 1977). Large changes in salinity can alter the activity of croakers in a way that reduces local abundance; however, smaller changes do not appear to affect juveniles. Sharp fluctuations in salinity can cause intermediate growth rates and increase the bioenergetic costs for juveniles (Peterson et al. 2004). Able and Fahey (1997) suggested that survival in cold December waters in Delaware Bay are not conducive to survival of young croaker. Juvenile croaker prefer deeper tidal creeks because the salinity changes are usually less than in shallow flats and marsh creeks (Diaz and Onuf 1985). Salinity may affect the size distribution of juveniles within an estuary, which may be a result of changing physiological requirements as the juveniles develop (Miglarese et al. 1982). In Delaware Bay, Nemerson and Able (2004) found that the largest concentrations of newly recruited Atlantic croaker were collected over soft bottom habitat having high abundance of benthic invertebrates. Annelids were an important prey component of their diet.

Substrate plays a large role in determining juvenile croaker distribution. Juveniles are positively correlated with mud bottoms with large amounts of detritus that provides sufficient prey (Cowan and Birdsong 1988). Sand and hard substrates are not suitable. Juvenile are often found in more turbid areas of estuaries with higher organic loads that provide a food source for the croakers, but low turbidity is not a limiting factor in juvenile distribution (Diaz and Onuf 1985). The latter stages of young croaker are found more commonly in grass bed in Chesapeake Bay (Olney and Boehlert 1988).

Juvenile Atlantic croaker live at a variety of depths, depending on the estuary. North Carolina estuaries and the coast of the Gulf of Mexico have small tidal fluctuations. In these areas, juvenile croakers amass in shallow, peripheral areas. In estuaries with greater tidal fluctuations such as the Delaware Bay, Chesapeake Bay, or the Cape Fear River Estuary, juvenile croaker assemble in deep channels (Diaz and Onuf 1985).

Field and laboratory data indicate that juveniles are more tolerant of lower temperatures than adults. Juveniles have been found in waters from 0.4° C to 35.5° C (USFWS 1996) but extreme temperature changes can incapacitate juvenile croakers (Diaz and Onuf 1985). Juveniles may favor conditions that can result in low dissolved oxygen, although juveniles will move out of an area if dissolved oxygen levels decrease beyond preferred tolerances (Diaz and Onuf 1985).

Atlantic croaker was described by Petrik et al. (1999) as a habitat generalist. Field surveys of post-settlement croaker in estuarine nursery areas, found no significant

differences in abundances among submerged aquatic vegetation, marsh edge, and sandy bottom (Petrik et al. 1999). In a wetland system, Atlantic croaker along the gulf coast preferred non-vegetated bottom adjacent to wetlands, rather than the marsh itself (Rozas and Zimmerman 2000). In North Carolina, Atlantic croaker have been documented to utilize SAV, wetlands, unvegetated soft bottom, and to a lesser extent, shell bottom (Street et al. 2005). Juvenile croaker utilize these habitats for refuge and foraging and as a corridor through the estuary. In North Carolina, Atlantic croaker is one of the dominant juvenile fish species in North Carolina estuaries (DMF, unpub. data). Because croaker utilizes multiple habitats, the effect of habitat change and condition on fish population is difficult to assess.

Juvenile croaker may be affected by hydrological modifications, water quality degradation, or habitat alterations. Hydrological modifications such as ditching and channelization increase the slope of the shoreline and water velocities in the altered stream. Higher water velocity and reduced natural wetland filtration can result in increased shoreline erosion, increasing sediment and non-point pollutant loading in channelized waterbodies (White 1996; EPA 2001). Several studies have found that the size, number, and species diversity of fish in channelized streams are reduced and the fisheries associated with them are less productive than those associated with unchannelized reaches of streams (Tarplee et al. 1971; Hawkins 1980; Schoof 1980). Pate and Jones (1981) compared nursery areas in North Carolina that were altered and unaltered by channelization and found that Atlantic croaker and other estuarine-dependent species were more abundant in nursery habitats with no man-made drainage. They attributed this to the unstable salinity conditions that occurred in areas adjacent to channelized systems following moderate to heavy rainfall (>1 inch/24 hr).

Pollutants negatively affect growth and physical condition of juvenile Atlantic croaker, with significantly reduced growth rates and condition occurring with increasing pollutant conditions (Burke et al. 1993). Low concentrations of heavy metals can accumulate in fine-grained sediments, particularly organic-rich muddy substrates, to toxic levels, and can be resuspended into the water column (Riggs et al. 1991). Primary nursery areas in North Carolina often consist of such fine-grained sediments and are therefore susceptible to toxic contamination of bottom sediments (Street et al. 2005).

Severe hypoxia of bottom water and sediments, often associated with eutrophication, can adversely affect croaker populations through suffocation, reduced growth rates, loss of preferred benthic prey, changes in distribution, or disease (Street et al. 2005). Mass mortality of benthic infauna associated with anoxia has been documented in the deeper portions of the Neuse River estuary in North Carolina, in association with stratification of the water column in the summer (Lenihan and Peterson 1998; Luettich et al. 1999). During these events, oxygen depletion caused mass mortality of up to 90% of the dominant infauna within the affected area (Buzelli et al. 2002). Utilizing a statistical model and field data, it was estimated that the extensive benthic invertebrate mortality, resulting from intensified hypoxia events, reduced total biomass of demersal predatory fish and crabs during summer months by 17-51% in 1997-1998 (Baird et al. 2004). The decrease in available energy from reduced benthos greatly reduced the ecosystem's

ability to transfer energy to higher trophic levels at the time of year most needed by juvenile fish (Baird et al. 2004).

Alteration of natural shorelines has been shown to have a negative impact on juvenile Atlantic croaker populations. In a study along the Gulf coast comparing fish abundance between unaltered and altered shorelines (bulkheads or rubble), croaker was most abundant at the unaltered unvegetated shoreline (Peterson et al. 2000). Other anthropogenic activities that can potentially degrade shallow shoreline habitat conditions include dredging and proliferation of docks and marinas (Street et al. 2005).

1.4.1.5 Adult Habitat

Atlantic croaker is one of the most common bottom dwelling, estuarine species on the Atlantic Coast. Atlantic croaker range from the coastal waters of Cape Cod, Massachusetts to Florida, but croaker are uncommon north of New Jersey. Croakers are also found along the Gulf of Mexico coast with high abundances in Louisiana and Mississippi (Lassuy 1983). Temperature and depth are strong predictors of adult croaker distribution and the interaction between the two variables may also influence distribution (Eby and Crowder 2002). Adult croaker generally spend the spring and summer in estuaries, moving offshore and to southern latitudes along the Atlantic coast in the fall. Their migration cooling water temperatures because croakers cannot survive in cold winter temperatures. Adults are found in waters from 5° C to 35.5° C, but most catch occurs in temperatures over 24° C (Miglarese et al. 1982). Generally fish over 1 year old are absent in waters below 10° C (Lassuy 1983). Optimal temperatures for growth and survival are not known (Eby and Crowder 2002).

Adult Atlantic croaker prefer muddy and sandy substrates in waters shallow enough to support submerged aquatic plant growth. Adults have also been collected over oyster, coral, and sponge reefs, as well as man-made structures such as bridges and piers. Adult Atlantic croaker also use *Thalassia* sp. beds for refuge although abundance in the seagrass beds is temperature-dependent and changes seasonally (TSNL 1982).

Adults are found in salinity ranges from 0.2-70 ppt, but are most common in waters with salinities ranging from 6-20 ppt (Lassuy 1983, Eby and Crowder 2002). Catch of adult croakers is negatively correlated with increasing salinities (TSNL 1982), but catch also varies with season. In spring, most catch of adult Atlantic croaker is in salinity ranges from 3-9ppt, but in summer, catch peaks in two ranges: the low salinities ranging from 6-12ppt, and high salinities ranging from 24-27ppt (Miglarese et al. 1982). Generally, adults avoid the mid-salinity ranges (Miglarese et al. 1982, Peterson et al. 2004). Mean total length positively correlates with bottom salinities (Miglarese et al. 1982). Turbidity, nitrate-nitrogen concentrations, and total phosphate-phosphorous concentrations also correlate positively with croaker abundance and catch (TSNL 1982).

The distribution and extent of hypoxic zones in estuaries may also influence habitat use and distribution (Eby and Crowder 2002). Croaker generally shift from deep, hypoxic water to shallow, oxygenated waters during hypoxic events. Their distribution is further limited when hypoxic conditions occur in shallower waters. The lower threshold of

dissolved oxygen for Atlantic croaker is about 2.0 mg/L. Below this limit, Atlantic croaker may not survive or may experience sublethal effects. Studies have shown that Atlantic croaker are virtually absent from waters with dissolved oxygen levels below 2.0 mg/L, suggesting they are very sensitive to the amount of dissolved oxygen present (Eby and Crowder 2002).

The size of a hypoxic zone influences habitat use as well. When hypoxic conditions spread in an estuary, Atlantic croaker are forced to use less suitable habitat. Atlantic croaker could incur increased physiological and ecological costs in these areas. For example, Atlantic croaker may face increased intra- and interspecific competition for available space or food in what are essentially compressed habitat zones. To avoid the increased ecological cost, the croaker may return to waters with lower dissolved oxygen (Eby and Crowder 2002).

In spring and fall in moderate water temperatures, moderate hypoxia may not be a limiting Atlantic croaker distribution. However, in summer when water temperatures are higher Atlantic croaker may avoid moderately hypoxic zones in order to avoid the additional physiological costs of staying in waters with less dissolved oxygen (Eby and Crowder 2002). As hypoxia increases in severity and scope within estuarine waters, croaker typically move to shallower parts of an estuary. Large hypoxic zones may limit adult croaker depth and temperature distribution, suggesting a shift in habitat use driven by the severity of a hypoxic event (Eby and Crowder 2002). Atlantic croaker may actually be limited to areas with higher temperatures than their preferred temperatures during hypoxic events (Eby and Crowder 2002).

1.4.2 Identification and Distribution of Habitat and Habitat Areas of Particular Concern

Estuaries, which are especially vulnerable to anthropogenic changes, are designated as Habitat Areas of Particular Concern (HAPCs) Atlantic croaker, as well as for other species. Larvae are particularly vulnerable to changes in estuarine conditions. Environmental conditions in spawning areas may affect growth and mortality of egg and larval croakers (Eby and Crowder 2002).

1.4.3 Present Condition of Habitats and Habitat Areas of Particular Concern

Estuarine areas may be functionally reduced in size or degraded by numerous activities, including but not limited to, development, dredging and filling, toxic chemical and nutrient enrichment discharges from point and non-point sources, habitat alteration (e.g., wetlands converted to agricultural use), failing septic systems, and alterations in seasonal runoff patterns (S.J. Vanderkooy, Gulf States Marine Fisheries Commission, personal communication). These events may reduce the quantity and quality of Atlantic croaker habitat. Scientists believe that Atlantic croaker are affected by these changes, but few specific studies have quantified the effects of habitat degradation on the fishery resource(S.J. Vanderkooy, Gulf States Marine Fisheries Commission, personal communication).

Many coastal and estuarine areas have inadequate water quality because of various land use activities. The Chesapeake Bay is one example of an area that experiences eutrophication from agricultural runoff. Excess nutrients entering coastal waters may cause algal blooms that reduce dissolved oxygen, resulting in hypoxic or anoxic conditions, especially during the summer months (R. Lukacovic, Maryland Department of Natural Resources, personal communication). Large hypoxic areas have also been documented in Louisiana's coastal waters during the summer, because of nutrient loading into he Mississippi River from the Midwestern farm belt. These event can directly impact fisheries in the area (S.J. Vanderkooy, Gulf States Marine Fisheries Commission, personal communication).

1.5 IMPACTS OF THE FISHERY MANAGEMENT PROGRAM

1.5.1 Biological and Environmental Impacts

This Amendment presents biological reference points to prevent overfishing. These reference points a fishing mortality threshold and target as well as a spawning stock biomass target threshold and target. If these targets should be exceeded, this Amendment presents a suite of adaptive management options that can be incorporated quickly through an addendum.

1.5.2 Economic and Social Impacts

1.5.2.1 Recreational Fishery

Widely varying abundance is a natural part of the recreational fishery for Atlantic croaker. When Atlantic croaker are abundant enough to significantly increase the probability of anglers catching at least some fish on a trip, their marginal contribution to the benefit of a fishing trip is high. Extremely high abundances may have much lower marginal values as evidenced by the higher discard rate. In some states, such as Virginia, croaker is part of the directed fishery for recreational anglers. The fishery management program will have a significant economic impact on the recreational fishery if results in a fishery that experiences fewer prolonged periods of extremely low abundance where anglers are unlikely to catch any or few croaker on a trip. Having less fluctuation in the fishery will provide more stable sources of income to coastal communities that rely on the Atlantic croaker fishery.

1.5.2.2 Commercial Fishery

The economic impacts of the fishery management program on the commercial fishery are similar to the recreational fishery in that widely fluctuating landings from year to year are an expected part of the commercial enterprise. Nevertheless, the fishery management program is intended to reduce the variation in catches by lowering the probability of prolonged periods of extremely low harvests that could be attributed to overfishing. The program would thus, increase the average revenue to commercial fishing as well as provide economic benefits from risk reduction. Increased average revenue and reduced risk will benefit the coastal communities that rely on the Atlantic croaker fishery (Tables 2-5).

1.5.2.3 Subsistence Fishery

Subsistence fishermen who are unable to catch fish in sufficient quantities will have to use whatever income they have to purchase food to feed themselves and their families. Like for other fishermen, the fishery management program will reduce the probability of extreme and long-term shortages of Atlantic croaker.

1.5.2.4 Non-Consumptive Factors

Economic and social benefits from Atlantic croaker may be derived from its role in the ecosystem interacting with other species and contributing to the healthy functioning of the marine ecosystem. These benefits from Atlantic croaker have not been studied enough to allow any economic quantification of its importance.

1.5.4 Other Resource Management Efforts

Currently, there are no ASMFC management measures to restrict commercial or recreational harvest of Atlantic croaker. However some states have implemented Atlantic croaker regulations. Georgia has implemented an 8-inch size limit and a 25 fish bag limit in their commercial and recreational fisheries. Maryland has implemented a 9-inch size limit in their commercial fishery and a 9-inch size limit and 25 fish bag limit in their recreational fishery. Delaware has implemented an 8-inch size limit in their recreational fishery.

1.6 LOCATION OF TECHNICAL DOCUMENTATION FOR FMP

1.6.1 Stock Assessment Document

The 2003 and 2004 Stock Assessment Reports for Atlantic croaker (ASMFC 2003a and 2004a) were used to indicate the current condition of this stock. This document can be requested from the Atlantic States Marine Fisheries Commission and viewed on the Commission website at www.asmfc.org

1.6.2 Law Enforcement Assessment Document

ASMFC's Law Enforcement Committee has prepared a document titled "Guidelines for Resource Managers on the Enforceability of Fishery Management Measures' (October 2000), which can be used to evaluate the effectiveness of future measures.

2.0 GOALS AND OBJECTIVES

2.1 HISTORY AND PURPOSE OF THE PLAN

2.1.1 History of Prior Management Actions

The Fishery Management Plan (FMP) for Atlantic croaker, adopted in 1987, included the states from Maryland through Florida. The 1987 Atlantic Croaker FMP identified the following management measures for implementation (ASMFC, 1987):

1. Promote the development and use of bycatch reduction devices through demonstration and application in trawl fisheries.

2. Promote increases in yield per recruit through delaying entry to croaker fisheries to age one and older.

The South Atlantic State/Federal Fisheries Management Board of the ASMFC reviewed the status of several plans to define those compliance issues to be enforced under the Atlantic Coast Fisheries Cooperative Management Act (ACFCMA). The Board found the Atlantic Croaker FMP was vague and no longer valid; they recommended an amendment to define management measures necessary to achieve the goals of the FMP. In the final schedule for compliance under the ACFCMA, the Interstate Fisheries Management Program (ISFMP) Policy Board adopted the finding that the current Atlantic Croaker FMP does not contain any management measures that states are required to implement (ASMFC 2002).

In 2002, the South Atlantic Board directed the Atlantic Croaker Technical Committee to conduct the first coastwide stock assessment of Atlantic Croaker. This assessment was conducted in 2003 (ASMFC 2003a). It was reviewed by the SEDAR panel in October 2003 (ASMFC 2003b). At that time the SEDAR panel requested additional work be done on the assessment before it could be used for management purposes. The Technical Committee incorporated the suggestions of the review panel and conducted a revised assessment (ASMFC 2004a). This assessment was approved by the same SEDAR review panel in June of 2004 (ASMFC 2004b). This assessment was presented to the South Atlantic Board in August 2004, after which, they initiated the development of Amendment 1.

2.1.2 Purpose and Need for Action

The stock assessment shows that Atlantic croaker abundance is high and fishing mortality is low in the mid Atlantic region. Even though the stock appears to be healthy, the Management Board initiated the development of Amendment 1 to the Atlantic Croaker FMP to come into compliance with the ACFCMA. The development of this Amendment did not necessarily mean that additional management measures would be put in place to regulate the harvest of Atlantic croaker, however the Management Board considered a suite of measures that could be implemented through adaptive management should it become necessary.

2.2 GOALS

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.

2.3 OBJECTIVES

1. Manage the fishing mortality rates for Atlantic croaker to provide adequate spawning potential to sustain long-term abundance of the Atlantic croaker populations.
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.

2.4 SPECIFICATION OF MANAGEMENT UNIT

The management area of this amendment shall be the entire coastwide distribution of the resource from the estuaries eastward to the inshore boundary of the EEZ.

2.4.1 Management Areas

The management area shall be the entire Atlantic coast distribution of the resource from Florida through New Jersey. The stock assessment divides the Atlantic croaker stock into a southern region, which includes the waters of the Atlantic coast of Florida north to the North Carolina/South Carolina border. The northern region extends from the North Carolina/South Carolina border north through New Jersey. The Atlantic croaker fishery will be managed on a regional basis consistent with the stock assessment. There will be south-Atlantic region, which includes Florida, Georgia, and South Carolina. The mid-Atlantic region will include North Carolina, Virginia, PRFC, Maryland, Delaware, and New Jersey.

The Technical Committee recommended the regional management of Atlantic croaker with the split at the North Carolina/South Carolina border because of data limitations. In future stock assessments they would like to explore a possible split at Cape Hatteras, as well as looking at the inside and outside waters of North Carolina. The Technical Committee has recommended conducting tagging studies of Atlantic croaker with otolith microchemistry in North Carolina to determine where the split should be, based on biological reasons.

2.5 DEFINITION OF OVERFISHED AND OVERFISHING

In fisheries management, a control rule is used to evaluate the need for management action. The control rule is an indicator of stock status and is based on 1) the level of exploitation or the fishing mortality rate (F), and 2) the level of spawning stock biomass. Overfishing is defined as the relative rate of removals from the population and is determined by the fishing mortality on the stock. The level of spawning stock biomass, as the result of the fishing mortality rate, is the basis for determining if a stock has become overfished. A biomass target or threshold determines the desired condition of the stock whereas the target mortality rate determines how fast the population is moving toward achieving the appropriate level of biomass.

Fishing mortality-based reference points are designed to prevent F from reaching a level that could result in a subsequent decline in the population because individuals are being removed at a rate that is to fast for the stock to replace. Spawning stock biomass (SSB)-based reference points are designed to prevent SSB from getting too low and compromising the ability of the stock to replenish itself. Both fishing mortality rate and

spawning stock biomass levels are used simultaneously to characterize the status of the stock (Figure 8).

The intent of this amendment is to establish a control rule to accurately categorize the status of the stock by considering both fishing mortality and spawning stock biomass, simultaneously. This control rule establishes a target and threshold for spawning stock biomass and a target fishing mortality rate. The management program developed through this amendment is designed to achieve the target F and spawning stock biomass levels.

The Atlantic croaker population will be considered overfished when the spawning stock biomass level falls below the threshold spawning stock biomass level established in this Amendment. Overfishing of the Atlantic croaker population will occur at any time when the fishing mortality threshold is exceeded.

In the 2004 Atlantic Croaker Stock Assessment Report, the Technical Committee has recommended the following reference points for the mid Atlantic region. Currently the stock status of the South Atlantic region is unknown. (Figures 9 and 10). This Amendment sets the following reference points to define overfishing for the mid-Atlantic region.

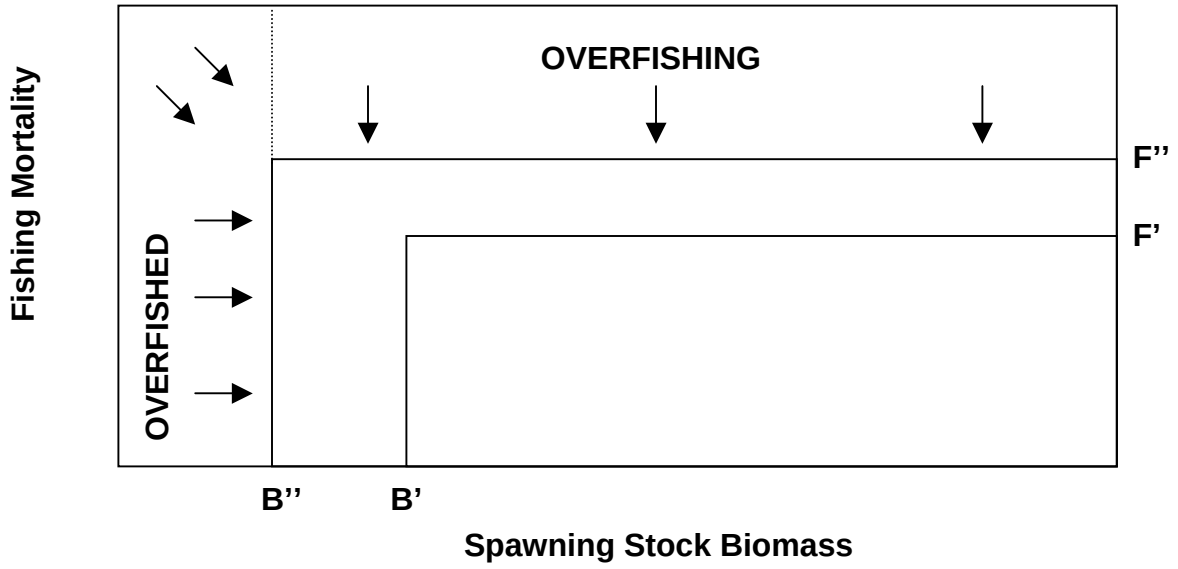
F threshold – Fmsy (0.39)
F target – 0.75 X Fmsy (0.29)
Biomass target – SSBmsy (28,932 MT)
Biomass threshold - 0.7 X SSBmsy (20,252 MT)

The stock assessment includes data through 2002. In 2002, F was 0.11 well below the target and threshold and SSB was approximately 80,000 MT, well above the threshold and target.

F_{msy} is the amount of fishing mortality that can take place for the maximum sustainable yield to be achieved for Atlantic croaker. SSB_{msy} is the spawning stock biomass abundance at which maximum sustainable yield can be achieved. Estimates of F_{msy} from the base mid Atlantic model was 0.39 and SSB_{msy} was equal to 28,932 MT. Estimates of average fishing mortality rates from the base mid Atlantic model of 0.11 indicate that 2002 estimates were below the target and threshold levels. Recent estimates of SSB (~80,000 MT) are above both the proposed target and threshold levels. For 2002, $F:F_{msy}$ ratio was 0.263 and $SSB:SSB_{msy}$ ratio 2.78 (ASMFCa 2004). The spawning potential ratio (SPR) for the recommended F and SSB target is 44% and threshold is 36%. The SPR for Atlantic croaker in 2002 was approximately 69% (Figures 11 and 12).

The Atlantic croaker population in the mid Atlantic region as determined from the biological reference points in the stock assessment is currently not overfished and overfishing is not occurring on the spawning stock biomass. A stock assessment for the south Atlantic region could not be completed and therefore targets and/or thresholds could not be established at this time.

Figure 8. Generalized Representation of the Overfishing Definition utilizing both spawning stock biomass (B', B") and fishing mortality (F', F") targets and thresholds (modified from Mace et al., 1996).



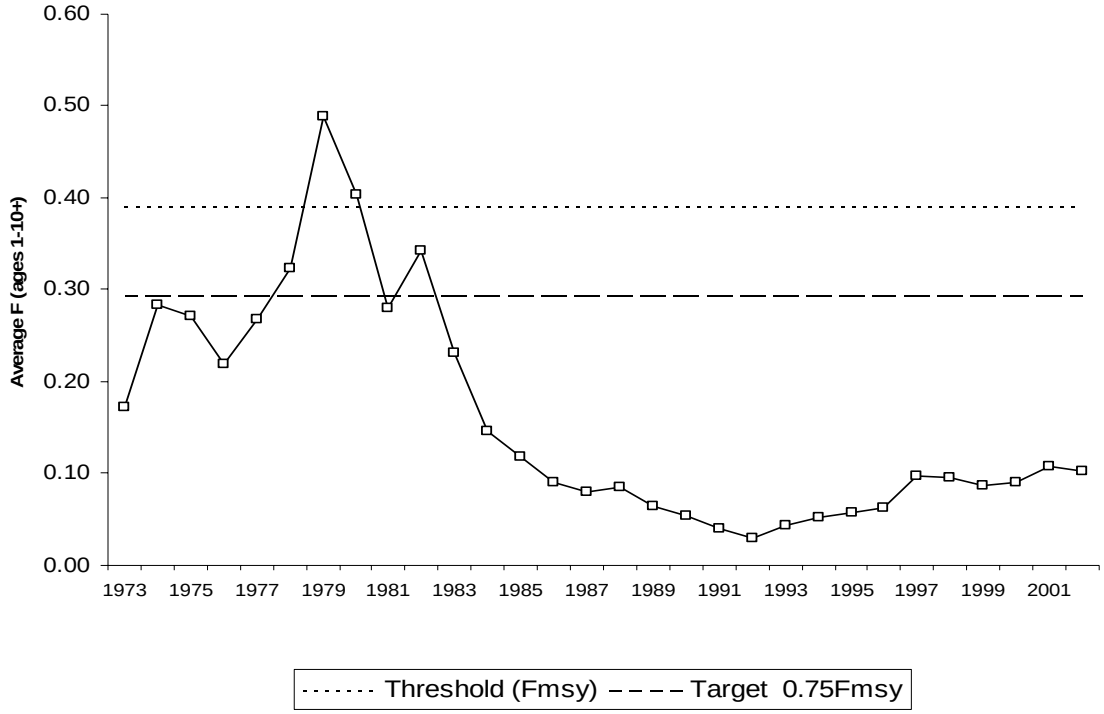


Figure 9 Fishing mortality reference points relative to average fishing mortality rates across the time series for mid-Atlantic base model (steepness=0.76, natural mortality=0.3). F_{msy}=0.39.

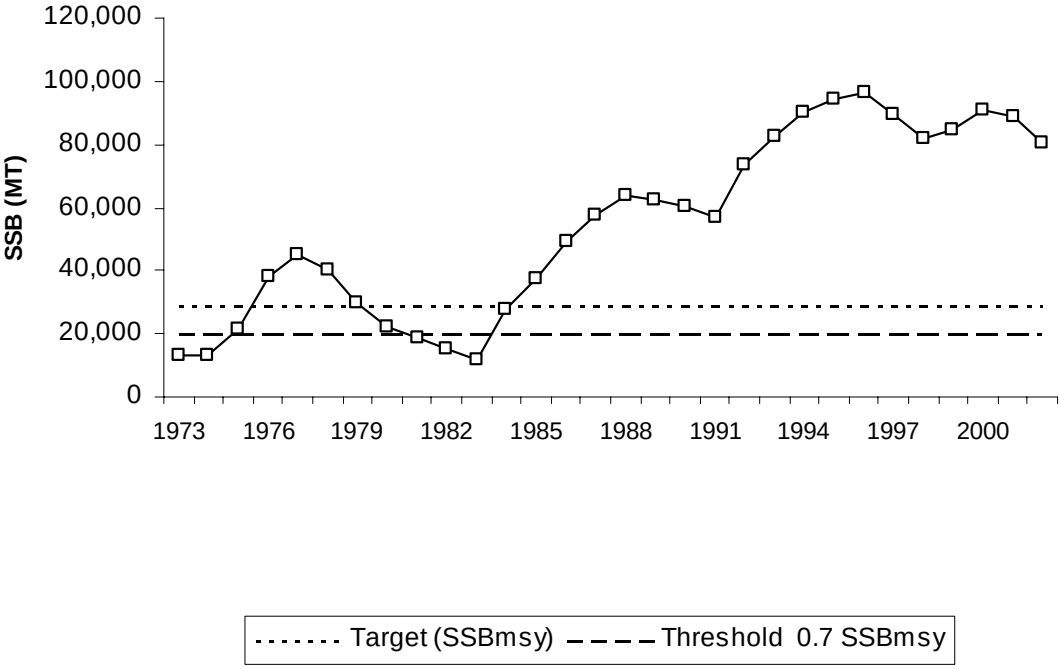


Figure 10 Biomass reference points relative to SSB estimates for the mid-Atlantic base model (steepness=0.76, natural mortality=0.3). SSB_{msy}= 28,932 MT

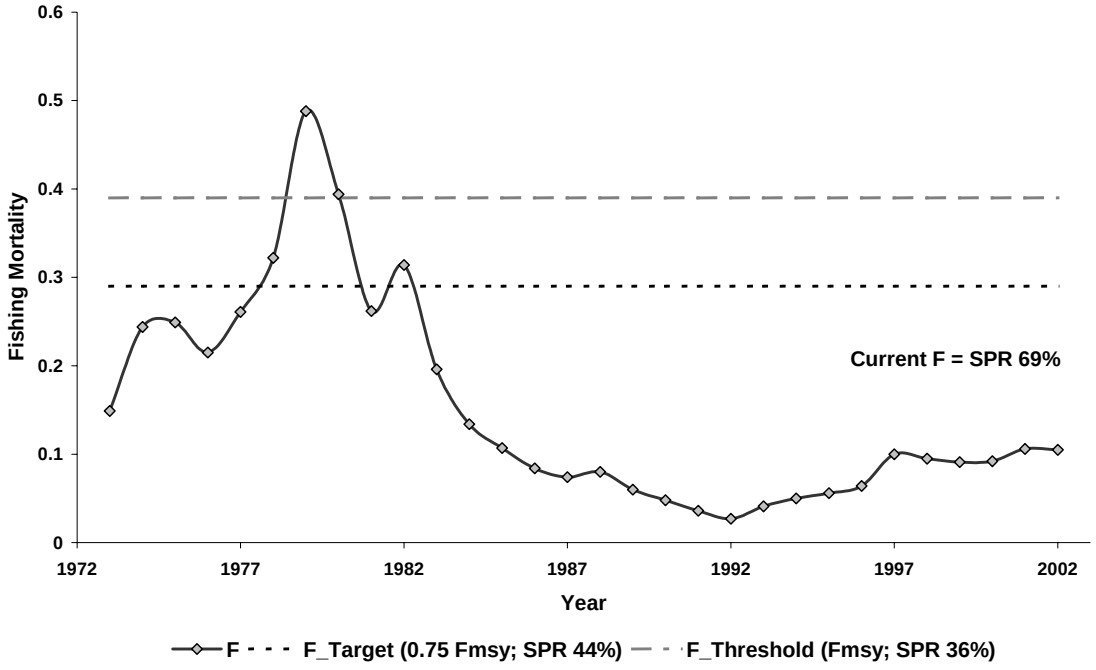


Figure 11. Atlantic croaker F targets and thresholds with SPR values

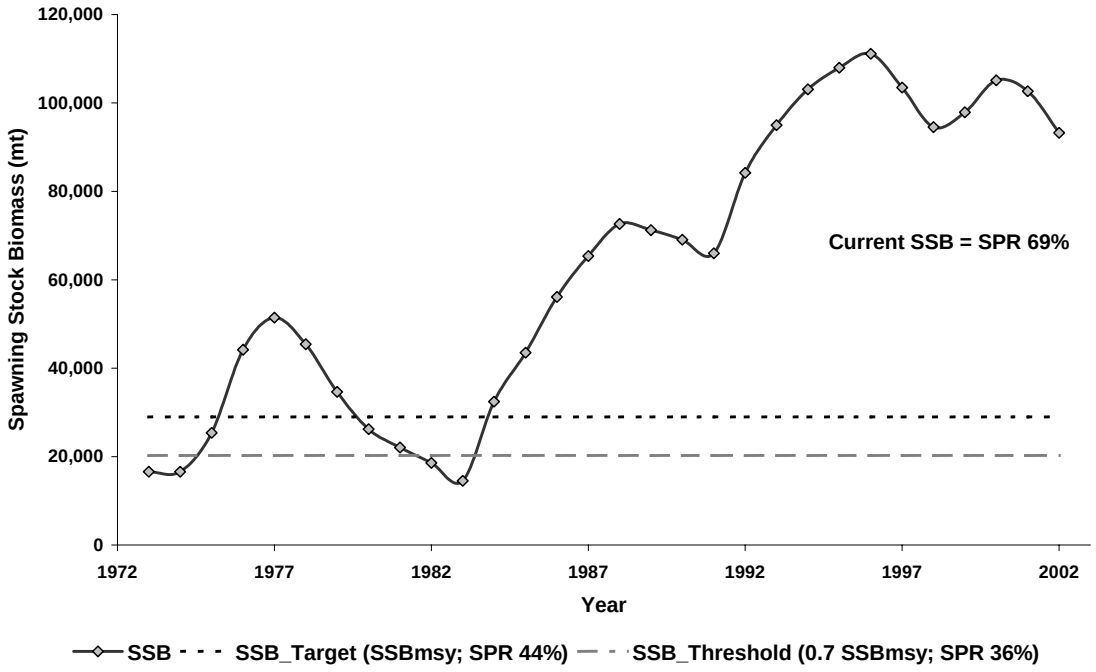


Figure 12. Atlantic croaker SSB targets and thresholds with SPR values

2.6 STOCK REBUILDING PROGRAM

Should the stock be defined as overfished or depleted, the Management Board will take action to recover the stock to the desired target level (in terms of spawning stock biomass). Should it be determined that overfishing is occurring, the Management Board will take action to reduce the fishing mortality on the stock to at least the desired target level. If fishing mortality exceeds the threshold level and SSB is less than the proposed threshold level, the Management Board must act immediately to reduce fishing mortality to the desired target level or lower.

2.6.1 Stock Rebuilding Targets and Schedules

If the stock becomes overfished or overfishing is occurring, the South Atlantic State/Federal Fisheries Management Board will determine a stock rebuilding target and schedule.

2.6.2 Maintenance of Stock Structure

This amendment does not define stock structure. The maintenance of the stock can be determined if it becomes necessary with input from the Technical Committee and Plan Review Team through adaptive management.

2.7 RESOURCE COMMUNITY ASPECTS

Atlantic croaker serve not only as an important recreational and commercial species for fishermen, but also as prey for other aquatic and avian predators (various predators at each life stage), and are predators themselves on other species which form the basis of significant fisheries.

2.8 IMPLEMENTATION SCHEDULE

Amendment 1 was approved and adopted by the Commission during November, 2005, at the Commission's Annual Meeting. All states in the management unit subject to the provisions of Amendment 1 shall fully implement the provisions of Amendment 1 by January 1, 2006.

3.0 MONITORING PROGRAM SPECIFICATIONS/ELEMENTS

The Atlantic Croaker Technical Committee will meet at least once each year to review the stock assessment and all other relevant data pertaining to stock status. The Technical Committee will report on all required monitoring elements outlined in *Section 3* and forward any recommendations to the South Atlantic State/Federal Fisheries Management Board. The Technical Committee shall also report to the Management Board the results of any other monitoring efforts or assessment activities not included in *Section 3* that may be relative to the stock status of Atlantic croaker or indicative of ecosystem health and interactions.

The Atlantic Croaker Advisory Panel will meet as necessary to review the stock assessment and all other relevant data pertaining to stock status. The Advisory Panel will forward its report and any recommendations to the Management Board.

The Atlantic Croaker Plan Review Team (PRT) will annually review implementation of the management plan and any subsequent adjustments (addenda), and report to the Management Board on any compliance issues that may arise. The PRT will also prepare the annual Atlantic Croaker FMP Review and coordinate the annual update and prioritization of research needs (see *Section 6.0*).

The amendment encourages all state fishery management agencies to pursue full implementation of the standards of the Atlantic Coastal Cooperative Statistics Program (ACCSP), which will meet the monitoring and reporting requirements of this FMP. The Board recommends a transition or phased-in approach be adopted to allow for full implementation of the ACCSP. Until such time as the ACCSP is implemented, the Board encourages state fishery management agencies to initiate implementation of specific ACCSP modules, and/or pursue pilot and evaluation studies to assist in development of reporting programs to meet the ACCSP standards. The ACCSP partners are the 15 Atlantic coastal states (Maine - Florida), the District of Columbia, the Potomac River Fisheries Commission, the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, the three fishery management Councils, and the Atlantic States Marine Fisheries Commission. Participation by program partners in the ACCSP does not relieve states from their responsibilities in collating and submitting harvest/monitoring reports to the Commission as required under this Amendment.

3.1 ASSESSMENT OF ANNUAL RECRUITMENT

Annual juvenile recruitment (appearance of juveniles in the ecosystem) of Atlantic croaker is measured in order to provide an indication of future stock abundance. When low numbers of juvenile fish (age 0) are produced in a given year, recreational and commercial catches from that year class may be lower when surviving fish become available to the fisheries. To determine the assessment of annual recruitment, two fishery independent surveys were used in the Atlantic croaker stock assessment. These include the SEAMAP indices and the VIMS trawl survey.

3.2 ASSESSMENT OF SPAWNING STOCK BIOMASS AND FISHING MORTALITY TARGET AND MEASUREMENT

The Atlantic Croaker Stock Assessment Subcommittee will conduct benchmark stock assessments that are consistent with the ASMFC's Technical Guidance Document (every 5 years). Updates of the current stock assessment can occur at the discretion of the Management Board based on input from the Technical Committee.

On each non-assessment year the TC will meet to review Atlantic croaker data. The TC has specified "triggers" that will initiate an assessment in any non-assessment year. It should be noted that these are not management triggers, but are designed only to initiate an assessment to determine the stock status of croaker.

These triggers are a minimum requirement to update the assessment, however, if the TC reviews the data and notes a marked change, they can request that an update of the assessment be done in the absence of hitting these triggers. The first trigger is the only hard trigger. The others are to be monitored annually, and if the TC notices a substantial change, they can request a stock assessment be conducted. For example, an abrupt truncation in the size or age composition should trigger a stock assessment.

Generally, these triggers or monitoring elements are directly applicable to the mid-Atlantic (North Carolina and north) fisheries and surveys. However, the technical committee will also assess similar data from the South Atlantic (South Carolina and south) fisheries and surveys, for consideration by the South Atlantic Fisheries Management Board.

The triggers considered by the technical committee were:

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 year's average landings.

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

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 last two years' mean lengths.
    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 last two years mean size (length and weight) data.
    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.

3) Effort vs. Landings (commercial)
    A) CPUE considerations for the near future: as effort data increases in quality, the trigger should change from a commercial landings basis to commercial CPUE by gear type. At this time, the technical committee will monitor effort (e.g. trips or days fished) vs. landings, on a gear type basis, to track parallel trends.

4) The technical committee will continue to derive a MRFSS CPUE, on a directed trip basis, to examine state-by-state catch rates on an annual basis.

5) Surveys

The technical committee will continue to monitor the NMFS annual survey results and compare these estimates to the long-term average, until further analysis (e.g. other surveys) can be conducted.

3.3 SUMMARY OF MONITORING PROGRAMS

No state monitoring requirements are recommended at this time, however the Atlantic croaker Technical Committee has strongly recommended that the following state and federal Young-of- Year and adult surveys should continue to collect data on Atlantic croaker.

1) New Jersey

A) New Jersey Ocean Stock Assessment Trawl Survey
The Ocean trawl is a random stratified sampling program consisting of New Jersey coastal waters from Ambrose Channel south to Cape Henlopen Channel, and from about the 3 fathom isobath inshore to approximately the 15 fathom isobath offshore. The net is a two seam trawl with forward netting of 12 cm (4.7 inches) stretch mesh and rear netting of 8 cm (3.1 inches) stretch mesh. The cod end is 7.6 cm stretch mesh (3.0 inches) and is lined with a 6.4 mm (0.25 inch) bar mesh liner. Samples are collected four to five times per year by towing the net for 20 minutes.

B) New Jersey Delaware Bay Finfish Trawl Survey
The Delaware Bay trawl is a nearshore fixed station survey conducted from the mouth of the Cohansey River south to the Villas. The net is a standard 16-foot otter trawl towed once a month from April through November at eleven stations.

2) DE trawl surveys

A) Adult finfish trawl survey – samples 9 stations monthly from March through December with a 30’ trawl. Coverage: Delaware Bay
B) Juvenile finfish trawl survey – samples 39 stations monthly from April through October with a 16’ trawl. Coverage: Wilmington to lower Delaware Bay.

3) Maryland

A) Maryland Summer Commercial pound net survey from June through September since 1993. Sampling conducted on the water with nets set and fished by commercial fishermen. Lengths and number of catch are taken when time permits. Otoliths are taken from a sub sample of croaker and aged by South Carolina. The weight and sex is recorded for each fish taken for age.

4) Virginia

A) Virginia Institute of Marine Science Survey (VIMS) Juvenile Finfish and Blue Crab Trawl Survey began in 1955 and monitors the condition of fishery stocks in the lower Chesapeake Bay. Present spatial coverage includes major Virginia tributaries (James, York and Rappahannock Rivers) and the lower portion of Chesapeake Bay. A lined 30' (9.14m) semi-balloon otter trawl, 1.5" (38.1mm) stretched mesh and 0.25" (6.35mm) cod liner is towed along the bottom for five minutes during daylight hours. Water quality is measured at each station with a YSI 650 hydrographic meter. Both Bay and major tributaries are sampled with a random stratified design. Stratification is based on depth and latitudinal regions in the Bay (random stations only), or depth and longitudinal regions in the rivers (random and fixed stations). The Survey random stratified converted index (RSCI) incorporates gear and vessel changes to provide a continuous time series for various species for five decades. Individual species indices are derived based on modal analyses and aging studies, as well as monthly catch rates. The Fall Atlantic Croaker YOY index (Fall YOY) is composed of the following months and respective individual fish total lengths (TL): October (0-80 mm), November (0-100 mm) and December (0-100 mm). The following Spring Atlantic Croaker Recruit Index (Spring Recruit) is composed of the following months and respective TL: May (0-135 mm), June (0-160 mm), July (0-180 mm) and August (0-220 mm). Numbers of individuals caught are log transformed (ln(n+1)) prior to abundance calculations. Resultant average catch rates (and the 95% confidence intervals as estimated by $\pm$ 2 standard errors) are then back-transformed to the index geometric means.

B) The Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP**)**
ChesMMAP is a bay-wide bottom trawl survey, begun in 2002 and continued through in 2005. Project objectives are to:

1. Conduct a bay-wide bottom trawl survey targeting adult fishes.
2. Determine characteristics and efficiency of the sampling gear.
3. Convert relative abundance estimates to absolute abundance using catch data in combination with data provided by net mensuration gear and a hydroacoustic transducer.
4. Subsample stomachs of specimens to determine diet composition and quantify trophic interactions.
5. Subsample catches for age, length, weight, and sex determination to quantify age- and size-structures and sex ratios.
6. Serve as a platform for other bay related studies.

5) North Carolina

A) Young-of-Year in internal waters since 1972.
B) Young-of-Year (comparable to SEAMAP) in Pamlico Sound since 1987.
C) An adult fishery independent survey using gill nets in Pamlico Sound since 2001 and in the Neuse and Pamlico River systems since June 2003.

D) Since 1991 the North Carolina Division of Marine Fisheries (NCDMF) has conducted commercial fish house sampling in which length and weight data are collected. In addition, otolith structures are collected in both fish house and fishery independent surveys (i.e. gill net sampling). Ages assigned in our aging lab and data are used for catch at age assignments that will aid in future stock assessments.

6) South Carolina
   A) SEAMAP Cruise- This survey occurs in the spring, summer, and fall from Cape Hatteras to Cape Canaveral. Collects catch and age data.
   B) State small boats recreational survey.
   C) Fall groundfish survey's southern leg (NJ to Cape Hatteras). Collect catch data and length data, as well as samples for age, sex, and condition.

7) Georgia Data Collection
   A) Data from 2002 on- 36 fixed stations across the coast of GA in nearshore and outside waters.
   B) Recreational catches in carcass freezer project.
   C) Young-of-Year survey

8) NMFS juvenile ingress study at Beaufort, NC laboratory since 1985. This study provides a measure of reproductive input if you have no correlation to recruitment.

9) Northeast Fishery Science Center Groundfish Survey (1982- present).
Collects catch rates, age composition and size.

3.3.1 Catch and Landings Information

Commercial Catch and Effort Data

The ACCSP's standard for commercial catch and effort statistics is mandatory, trip-level reporting of all commercially harvested marine species, with fishermen and/or dealers required to report standardized data elements for each trip by the tenth of the following month.

Recreational Catch and Effort Data

The ACCSP has selected the Marine Recreational Fisheries Statistics Survey (MRFSS) as the base program for recreational fishing data collection for shore and private boat fishing. The MRFSS provides statistics for finfish, but does not cover shellfish fisheries, which will require development of new surveys. The MRFSS combines data from two independent surveys to produce estimates of fishing effort, catch, and participation.

Household Telephone Survey for Effort Data

For private/rental boats and shore, fishing effort data should be collected through a random digit-dialed telephone survey of coastal county households until a comprehensive license-based sampling frame is established. A "wave" is a two-month sampling period, such as January through February (Wave 1) or March through April (Wave 2). The

random-digit dialing survey for effort data is conducted in two-week periods that begin the last week of each wave and continue through the first week of the next wave.

Intercept Survey for Catch Data

Catch data for private/rental boats and shore fishing should be collected through an access-site intercept survey. State Partners are encouraged to increase their involvement in conducting the intercept survey. The ACCSP is addressing transition of conduct of the intercept survey for catch from a contractor to a cooperative agreement involving states at varying levels.

For-hire Catch and Effort Data

The ACCSP has selected the NOAA Fisheries For-Hire Survey as the preferred methodology for collecting data from charterboats and headboats (partyboats), also called the "for-hire" sector. The For-Hire Survey is similar to the MRFSS with two major improvements. It uses: 1) a telephone survey to collect fishing effort data from vessel representatives and 2) a validation process for the self-reported data. Catch data are collected in conjunction with the MRFSS with the addition of on-board samplers for headboats.

The independent survey components of the For-Hire Survey include 1) a vessel effort survey; 2) an effort validation survey; 3) an access-site intercept survey for catch data; and 4) at-sea samplers on headboats for catch data. Using the data collected through these surveys, NOAA Fisheries generates catch and effort estimates for for-hire fisheries.

Vessel Telephone Survey for Effort Data

The vessel effort survey uses a coastwide directory of for-hire vessels as the sampling frame for for-hire fishing effort. The directory is continually updated as intercept and telephone interviewers identify changes in the fleet. Optimal sampling levels will be determined following evaluation of the Atlantic coast For-Hire Survey results from the first three years. Until the optimal sampling level is determined, a minimum of 10% of for-hire vessels or three charterboats and three headboats (whichever is greater), will be randomly sampled each week in each state. A vessel representative, usually the captain, is called and asked to provide information on the fishing effort associated with that vessel during the previous week. Vessel representatives are notified in advance that they have been selected for sampling and an example form is provided. To be included in the sample frame for particular wave, a vessel record must include: 1) at least one vessel representative's telephone number; 2) the name of the vessel or a vessel registration number issued by a state or the U.S. Coast Guard; 3) the county the boat operates from during that wave, and 4) designation as either a charter or guide boat (both called "charter") or headboat.

Validation Survey for Effort Data

To validate the self-reported effort data collected through the vessel telephone survey, field samplers periodically check access sites used by for-hire vessels to directly observe vessel effort. Interviewers record the presence or absence of a for-hire vessel from its dock or slip, and if the vessel is absent, they try to ascertain the purpose of the trip. Those

observations are compared to telephone data for accuracy and to make any necessary corrections.

Catch Data

Vessels that meet the ACCSP definition of a charterboat, "typically hired on a per trip basis," are sampled for catch data through an intercept site survey of anglers at access points, similar to the MRFSS. The intercept survey has been in progress since 1981.

Some Partners collect for-hire effort data using VTRs, which are mandatory for some vessels and contain all minimum data elements collected by the For-Hire Survey. In areas where the survey runs concurrently with VTR programs, captains selected for the weekly telephone survey are permitted to fax their VTRs in lieu to being interviewed by phone.

At-sea Sampling of Headboats

At-sea samplers collect catch data aboard headboats, defined by the ACCSP as "any vessel-for-hire engaged in recreational fishing that typically is hired on a per person basis." Samples collected at-sea are supplemented by dockside sampling.

3.3.2 Biological Information

The ACCSP has set standards for how biological data should be collected and managed for commercial, recreational, and for-hire fisheries. Trained field personnel, known as port agents or field samplers, should obtain biological samples. Information should be collected through direct observation or through interviews with fishermen. Detailed fishery statistics and/or biological samples should be collected at docks, unloading sites, and fish houses. Biological sampling includes species identification of fish and shellfish; extraction of hard parts including spines and otoliths; and tissue samples such as gonads, stomachs, and scales. The ACCSP should strive to collect physical and environmental information related to trips sampled for biological data through at-sea samplers, fishery-independent sampling, or other programs.

3.3.3 Bycatch, Releases and Protected Species Interactions Data

The ACCSP's bycatch standards include both quantitative and qualitative components. The quantitative components include at-sea sampling programs and collection of bycatch data through fisherman reporting systems. The qualitative components include sea turtle and marine mammal entanglement and stranding networks, beach bird surveys, and add-ons to existing recreational and for-hire intercept and telephone surveys. Specific fisheries priorities will be determined annually by the Bycatch Prioritization Committee.

3.3.4 Social and Economic Information

<u>Commercial Fisheries</u>

The ACCSP is testing its sociological and economic data collection standards for commercial harvesters. Standards for these kinds of data for dealers and fishing communities are in development with the Committee on Economics and Social Sciences. The ACCSP should collect baseline social and economic data on commercial harvesters using the following voluntary surveys:

- An annual fixed cost survey directed at the owner/operator,

- A trip cost survey to evaluate variable costs associated with a particular vessel's most recent commercial fishing trip to be directed at the vessel captain, and
- An annual owner/captain/crew/survey to gather sociological information.

Surveys may also be conducted using permit and registration data and vessel trip reports or sampling frames.

Recreational and For-hire Fisheries

The ACCSP's sociological and economic data for recreational and for-hire fisheries should come from periodic add-ons to existing telephone and intercept surveys. The standard is voluntary surveys of finfish fisheries conducted at least every three years.

3.4 HABITAT PROGRAM

Periodic review of various programs to monitor habitat and water quality could play an important role in understanding red drum population dynamics. The following topics should be examined: nutrient loading; long-term water quality monitoring; hypoxia events; incidence of red tides, harmful dinoflagellates and Pfisteria; habitat modification permits; and wetlands protection.

4.0 MANAGEMENT PROGRAM IMPLEMENTATION

There have been no coastwide regulations for Atlantic croaker. However, many states have implemented management measures for other species that have had an impact on Atlantic croaker. A summary of these regulations is listed below.

New Jersey

The New Jersey commercial weakfish regulations have an impact on the amount of Atlantic croaker that is harvested, because of the restrictions on gears and seasons.

Gill Net

The minimum mesh size is 3 1/4 inches (stretched) with the following exception: nets with a mesh size between 2 3/4 inches and 3 1/4 inches (stretched) may be fished within two nautical miles of the MHWL. Fishermen must obtain a small mesh permit and must submit monthly reports on catch and effort including the number, length and condition of all weakfish captured. Retention of sub-legal size weakfish taken by the small mesh nets is prohibited.

The gill net season will be closed from May 21 through September 2 and October 20-26. This closed season yields a 31.9% reduction as required under the Board's directive to use the corrected Evaluation Manual with respect to fishing after April 1, 1995. Fishermen are allowed a bycatch of 150 pounds of weakfish during the closed season as long as an equal (or more) poundage of other species is harvested.

There is also a limited entry on gill net permits in effect.

Trawl
The size limit for the trawl fishery remains at 13 inches from January 1 through August 31. The minimum mesh size for an otter trawl used in a directed fishery for weakfish is 3 3/8 inches stretched diamond mesh inside measurement or 3 3/8 inches stretched square mesh inside measurement.

The closed season for the otter trawl fishery will be from August 1 through October 12. During the open season, the possession of 100 pounds of weakfish aboard the vessel constitutes a directed fishery. Fishermen are allowed a bycatch of 150 pounds of weakfish during the closed season as long as an equal (or more) poundage of other species is harvested.

Pound Net
The season will be closed from June 7 through June 30, the same as in previous years. Fishermen are allowed a bycatch of 150 pounds of weakfish during the closed season as long as an equal (or more) poundage of other species is harvested.

Maryland
The Maryland weakfish regulations changed in 1995 requiring the use of 3 3/8 inches square or 3 ¾ inches diamond mesh for trawls. Prior to this period 3 inch mesh was the minimum size allowed. The weakfish season was shortened to obtain a required reduction in F.

In June of 1997, Maryland changed the Atlantic croaker size regulations from a 10 inch to a 9 inch commercial size limit and the recreational creel limit went from 20 to 25 fish with the size limit remaining at 9 inch.

PRFC
The Potomac River Fisheries Commission promotes the use of large mesh bycatch reduction panels in all pound nets, but use is voluntary (fishermen who use the escape panels are allowed to keep a by-catch of weakfish). It is estimated that the panels allow the release of 100% of captured croaker below 9 inches (ASMFC 2002).

Virginia
In 1989 Virginia instituted a ban on trawling in state waters. As of 1994, there has been limited entry into the pound net fishery. There are closed seasons for weakfish (as pertains to gill nets, landings of otter trawl and some pound nets). There are also pound net prohibitions as a result from the NMFS rule pertaining to sea turtle conservation.

North Carolina
Fishing effort [catch per unit effort (CPUE)] for Atlantic croaker in 1992-2002 for North Carolina increased greatly in the ocean trawl and sink net fisheries and the size and age distributions shifted to older larger fish (NCDMF 2004). Some of this increase is attributed to more fishing effort on Atlantic croaker as a result of the harvest restrictions placed on weakfish during this period. However, comparable increases did not occur in the inside sound water fisheries; the long haul and sciaenid pound net fisheries continue to show a decline in the harvest of Atlantic croaker. There have been socioeconomic

changes within the inside fisheries that may attribute to the decline in commercial landings from the inside waters fisheries. The magnitude of the catches in the ocean caused the overall commercial CPUE to rise significantly since 1992.

Currently, no regulations directly govern fishing practices for Atlantic croaker in North Carolina. However, many regulations indirectly impact the harvest of subadult Atlantic croaker (Appendix A. Table 13). Finfish trawling in internal waters has been limited since the late 1920's and prohibited since the early 1930's in North Carolina. The regulation (15A NCAC 3M .0162) limiting the catch of unclassified bait to 5,000 lbs per vessel per day had an indirect effect on Atlantic croaker, because the species comprise a large percentage by weight of the unclassified bait category landed in North Carolina by commercial fishing gears. Bycatch Reduction Devices (BRDs) were required in all shrimp trawls in the fall of 1992 by proclamation (and by the consent of the Marine Fisheries Commission (15A NCAC 3J .0104)). Since 1991, area restrictions and incidental finfish limits taken by shrimp and crab trawls in inside waters limit these gears from having no more than 500 pounds of finfish from December 1 through February 28 and 1,000 pounds of finfish from March 1 to November 30 (15A NCAC 3J .0104(a)). Minimum mesh size restrictions in shrimp trawls (1 ½ inch tailbag) have been in effect since 1991 as well as for flynets since 1992 (Proclamation FF-26-92), and the closure of ocean waters south of Cape Hatteras to the South Carolina state line to flynets in 1994 (Proclamation FF-18-94). The NCDMF conducted a study to evaluate the use of culling panels in long hauls and swipe nets in the late 1990's (Gearhart 2000). The study proved that shifts occurred in the length frequency distribution of many species including Atlantic croaker, which resulted in permanent rule changes to use of culling panels in some areas of North Carolina since 1999. Finfish restrictions, limiting finfish to 50% by weight of the overall targeted catch, in shrimp and crab trawl operations have been in Rule since 1996 (15A NCNC 3J .0202 (5)(a). All of these regulations may indirectly affect the fishing impact on Atlantic croaker and change the size and age distributions of the harvest.

Attendance requirements for small mesh (<5" stretched mesh) estuarine gill nets in inside waters from May 1 to October 31 has been a requirement since 1998 initiated by the red drum fishery management plan (15A NCAC 3J .0103 (h)). The Fisheries Reform Act (FRA) of 1997 mandated a new licensing system, which was implemented in July 1999 capping and limiting the entry into the commercial fisheries of North Carolina. The FRA also created a Recreational Commercial Fishing License (RCGL), which allows people to use very limited amounts of specified commercial gear (15A NCAC 3O .0302) to catch seafood for personal consumption or recreational purposes. Holders of the RCGL must comply with recreational size and creel limits and the catch from RCGL activities may not be sold. Appendix A shows an overview of regulations in North Carolina that indirectly impact the harvest of subadult Atlantic croaker.

Georgia

1957 Georgia implemented a gill net ban for all species except shad and diamondback terrapins. In 1990 all sounds were closed to the large trawl shrimp fishery and in 1996

bycatch reduction devices (BRDs) use became mandatory in the large trawl shrimp fishery.

Florida

There are no regulations directed at Atlantic croaker in Florida, however the limitation on the use of entangling gear has substantially effected any harvest by commercial fishermen, pushing all food shrimp trawling outside 1 mile offshore and prohibiting the use of entangling gear in state waters. Fishermen can use a net measuring up to 500 sq ft with stretched-mesh size up to 2".

4.1 RECREATIONAL FISHERIES MANAGEMENT MEASURES

There are no ASMFC management measures restricting the recreational harvest of Atlantic croaker in Amendment 1. Some states in the management unit have adopted more conservative measures and are encouraged to keep these regulations in place. Delaware has implemented an 8-inch size limit, Maryland has a 9-inch size limit and 25 fish bag limit, The Potomac River Fisheries Commission (PRFC) has a 25 fish per person/day limit and Georgia has an 8 inch size limit and 25 fish bag limit.

4.2 COMMERCIAL FISHERIES MANAGEMENT MEASURES

There are no ASMFC management measures to restrict commercial harvest of Atlantic croaker in Amendment 1. Some states in the management unit have adopted more conservative measures and are encouraged to keep these regulations in place. Georgia has implemented an 8-inch size limit with no possession limit. Maryland has implemented a 9-inch size limit in their commercial fishery.

4.3 HABITAT CONSERVATION AND RESTORATION

Each state should implement a protection plan for Atlantic croaker habitat within its jurisdiction to ensure the sustainability of the spawning stock that is produced or resides within its state boundaries. Each program should inventory the historical and present range of croaker, specify the habitats that are targeted for restoration, and impose or encourage measures to preserve the quantity and quality of Atlantic croaker habitats.

1. States should notify in writing the appropriate federal and state regulatory agencies of the locations of habitats used by Atlantic croaker for each life stage. Regulatory agencies should be advised of the types of threats to Atlantic croaker populations and recommend measures that should be employed to avoid, minimize, or eliminate any threat to current habitat quality or quality.
2. State fishery regulatory agencies, in collaboration with state water quality agencies, should monitor hypoxic conditions in state waters (including estuaries and tidal basins) and report changes in Atlantic croaker abundance or habitat use.
3. Where sufficient knowledge is available, states should designate Atlantic croaker habitat areas of particular concern for special protection. These locations should be designated High Quality Waters or Outstanding Resource Waters and should be accompanied by requirements that limit degradation of habitat, including minimization of non point source runoff, prevention of significant increases in contaminant loadings, and prevention of the introduction of any new categories of

contaminants into the area (via restrictions on National Pollutant Discharge Elimination System (NPDES) discharge permits for facilities in those areas).

4. State fishery regulatory agencies should develop protocols and schedules for providing input on water quality regulations and on Federal permits and licenses required by the Clean Water Act, Federal Power Act, and other appropriate vehicles, to ensure that Atlantic croaker habitats are protected and to ensure that specific that water quality needs for Atlantic croaker are met.
5. Water quality criteria for Atlantic croaker spawning and nursery areas should be established, or existing criteria should be upgraded, so as to ensure successful reproduction. Any action taken should be consistent with Federal Clean Water Act guidelines and specifications.
6. All State and Federal agencies responsible for reviewing impact statements and permit applications for projects or facilities proposed for croaker spawning and nursery areas should ensure that those projects will have no or only minimal impact on local stocks. Any project that would result in the elimination of essential habitat should be avoided.
7. Federal and State fishery management agencies should take steps to limit the introduction of toxic compounds known to accumulate in Atlantic croaker and that pose threats to wildlife and human health.
8. Each State should establish windows of compatibility for activities known or suspected to adversely affect Atlantic croaker life stages and their habitats. Activities may include, but are not limited to, navigational dredging, bridge construction, and dredged material disposal, and notify the appropriate construction or regulatory agencies in writing.
9. Projects involving water withdrawal from nursery habitats (e.g. power plants, irrigation, water supply projects) should be evaluated to ensure that larval or juvenile impingement or entrainment is minimized, and that any modifications to water flow or salinity regimes maintain levels within croaker tolerance limits.
10. Each state should develop water use and flow regime guidelines to ensure the appropriate water levels and salinity levels are maintained for the long-term protection and sustainability of the stock. States should work to ensure that proposed water diversions or withdrawals from rivers upstream will not reduce or eliminate conditions favorable to Atlantic croaker.
11. The use of any fishing gear that is determined by management agencies to have a negative impact on Atlantic croaker habitat should be prohibited within habitat areas of particular concern (e.g. trawling in spawning areas or primary nursery areas should be prohibited).
12. States should work to reduce the input of contaminants to Atlantic croaker habitats.
13. States should work with the U.S. Fish and Wildlife Service, Divisions of Fish and Wildlife Management Assistance and Ecological Services, and National Marine Fisheries Service (NMFS), Offices of Fisheries Conservation and Management and Habitat Conservation, to identify hydropower dams that pose significant threats to maintenance of appropriated freshwater flows (volume and timing) to Atlantic croaker nursery and spawning areas and target these dams for appropriate recommendations during FERC re-licensing.

4.4 ALTERNATIVE STATE MANAGEMENT REGIMES

Once approved by the South Atlantic State/Federal Fisheries Management Board, states are required to obtain prior approval from the Board of any changes to their management program for which a compliance requirement is in effect. Other non-compliance measures must be reported to the Board but may be implemented without prior Board approval. A state can request permission to implement an alternative to any mandatory compliance measure only if that state can show to the Board's satisfaction that its alternative proposal will have the same conservation value as the measure contained in this amendment or any addenda prepared under Adaptive Management (*Section 4.6*). States submitting alternative proposals must demonstrate that the proposed action will not contribute to overfishing of the resource. All changes in state plans must be submitted in writing to the Board and to the Commission either as part of the annual FMP Review process or the Annual Compliance Reports.

4.4.1 General Procedures

A state may submit a proposal for a change to its regulatory program or any mandatory compliance measure under this amendment to the Commission, including a proposal for *de minimis* status. Such changes shall be submitted to the Chair of the Plan Review Team, who shall distribute the proposal to the Management Board, the Plan Review Team, the Technical Committee, the Stock Assessment Committee and the Advisory Panel.

The Plan Review Team is responsible for gathering the comments of the Technical Committee, the Stock Assessment Committee and the Advisory Panel, and presenting these comments as soon as possible to the Management Board for decision.

The South Atlantic State/Federal Fisheries Management Board will decide whether to approve the state proposal for an alternative management program if it determines that it is consistent with the "target fishing mortality rate applicable", and the goals and objectives of this amendment.

4.4.2 Management Program Equivalency

The Atlantic Croaker Technical Committee, under the direction of the Plan Review Team, will review any alternative state proposals under this section and provide to the South Atlantic State/Federal Fisheries Management Board its evaluation of the adequacy of such proposals.

4.4.3 *De minimis* Fishery Guidelines

The ASMFC Interstate Fisheries Management Program Charter defines *de minimis* as "a situation in which, under the existing condition of the stock and scope of the fishery, conservation, and enforcement actions taken by an individual state would be expected to contribute insignificantly to a coastwide conservation program required by a Fishery Management Plan or amendment" (ASMFC 2000).

States may petition the South Atlantic State/Federal Fisheries Management Board at any time for *de minimis* status. Once *de minimis* status is granted, designated states must submit annual reports including commercial and recreational landings to the Management Board justifying the continuance of *de minimis* status. States must include *de minimis* requests as part of their annual compliance reports.

States may apply for *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 two year period. A state that qualifies for *de minimis* based on their commercial landings will qualify for exemptions in their commercial fishery only, and a state that qualifies for *de minimis* based on their recreational landings will qualify for exemptions in their recreational fishery only.

4.5 ADAPTIVE MANAGEMENT

The South Atlantic State/Federal Fisheries Management Board may vary the requirements specified in this amendment as a part of adaptive management in order to conserve the Atlantic croaker resource. Specifically, the Management Board may change target fishing mortality rates and harvest specifications, or other measures designed to prevent overfishing of the stock complex or any spawning component. Such changes will be instituted to be effective on the first fishing day of the following year, but may be put in place at an alternative time when deemed necessary by the Management Board. These changes should be discussed with the appropriate federal representatives and Councils prior to implementation in order to be complementary to the regulations for the EEZ.

4.5.1 General Procedures

The Plan Review Team will monitor the status of the fishery and the resource and report on that status to the South Atlantic State/Federal Fisheries Management Board annually, or when directed to do so by the Management Board. The Plan Review Team (PRT) will consult with the Technical Committee, the Stock Assessment Committee, and the Advisory Panel, if any, in making such review and report. The report will contain recommendations concerning proposed adaptive management revisions to the management program.

The South Atlantic State/Federal Fisheries Management Board will review the report of the PRT, and may consult further with Technical Committee, the Stock Assessment Committee or the Advisory Panel. The Management Board may, based on the PRT Report or on its own discretion, direct the PRT to prepare an addendum to make any changes it deems necessary. The addendum shall contain a schedule for the states to implement its provisions.

The PRT will prepare a draft addendum as directed by the Management Board, and shall distribute it to all states for review and comment. A public hearing will be held in any state that requests one. The PRT will also request comment from federal agencies and the public at large. After a 30-day review period, the PRT will summarize the comments and prepare a final version of the addendum for the Management Board.

The Management Board shall review the final version of the addendum prepared by the PRT, and shall also consider the public comments received and the recommendations of the Technical Committee, the Stock Assessment Committee and the Advisory Panel; and shall then decide whether to adopt or revise and, then, adopt the addendum.

Upon adoption of an addendum implementing adaptive management by the Management Board, states shall prepare plans to carry out the addendum, and submit them to the Management Board for approval according to the schedule contained in the addendum.

4.5.2 Measures Subject to Change

The following measures are subject to change under adaptive management upon approval by the South Atlantic State/Federal Fisheries Management Board:

1. Fishing year and/or seasons;
2. Area closures;
3. Overfishing definition, MSY and OY;
4. Rebuilding targets and schedules;
5. Catch controls, including bag and size limits;
6. Effort controls;
7. Reporting requirements;
8. Gear limitations;
9. Measures to reduce or monitor bycatch;
10. Observer requirements;
11. Management areas and/or stock units;
12. Recommendations to the Secretaries for complementary actions in federal jurisdictions;
13. Research or monitoring requirements;
14. Maintenance of Stock Structure
15. Stock enhancement protocols;
16. Measures to address delayed implementation of compliance criteria by states; and
17. Any other management measures currently included in Amendment 1.

4.5.4 Schedule for State Implementation

Amendment 1 was approved and adopted by the Commission during November, 2005, at the Commission's Annual Meeting. All states in the management unit subject to the provisions of Amendment 1 shall fully implement the provisions of Amendment 1 by January 1, 2006.

4.6 EMERGENCY PROCEDURES

Emergency procedures may be used by the South Atlantic State/Federal Fisheries Management Board to require any emergency action that is not covered by or is an exception or change to any provision in Amendment 1. Procedures for implementation are addressed in the ASMFC Interstate Fisheries Management Program Charter, Section Six (c)(10) (ASMFC 2000).

4.7 MANAGEMENT INSTITUTIONS

The management institutions for Atlantic croaker shall be subject to the provisions of the ISFMP Charter (ASMFC 2000). The following is not intended to replace any or all of the provisions of the ISFMP Charter. All committee roles and responsibilities are included in detail in the ISFMP Charter and are only summarized here.

4.7.1 ASMFC and the ISFMP Policy Board

The ASMFC (Commission) and the ISFMP Policy Board are generally responsible for the oversight and management of the Commission's fisheries management activities. The Commission must approve all fishery management plans, and amendments, including this Amendment 1; and must also make all final determinations concerning state compliance or noncompliance. The ISFMP Policy Board reviews any non-compliance recommendations of the various Management Boards and Sections and, if it concurs, forwards them on to the Commission for action.

4.7.2 South Atlantic State/Federal Fisheries Management Board

The South Atlantic State/Federal Fisheries Management Board was established under the provisions of the Commission's ISFMP Charter (Section Four [b]) and is generally responsible for carrying out all activities under this amendment (ASMFC 2000).

The South Atlantic State/Federal Fisheries Management Board (Board) establishes and oversees the activities of the Plan Development or Plan Review Team, the Technical Committee and the Stock Assessment Subcommittee; and requests the establishment of the Commission's Atlantic Croaker Advisory Panel. Among other things, the Board makes changes to the management program under adaptive management and approves state programs implementing the amendment and alternative state programs under *Sections 4.5* and *4.6*. The Board reviews the status of state compliance with the FMP or amendment at least annually, and if it determines that a state is out of compliance, reports that determination to the ISFMP Policy Board under the terms of the ISFMP Charter.

4.7.3 Atlantic Croaker Plan Development / Plan Review Team

The Atlantic Croaker Plan Development Team (PDT) and the Atlantic Croaker Plan Review Team (PRT) will be composed of a small group of scientists and/or managers whose responsibility is to provide all of the technical support necessary to carry out and document the decisions of the South Atlantic State/Federal Fisheries Management Board. Both are chaired by an ASMFC FMP Coordinator. The Atlantic croaker PDT/PRT is directly responsible to the Board for providing information and documentation concerning the implementation, review, monitoring and enforcement of Amendment 1. The Atlantic Croaker PDT/PRT shall be comprised of personnel from state and federal

agencies who have scientific and management ability and knowledge of Atlantic croaker. The PDT will be responsible for preparing all documentation necessary for the development of Amendment 1, using the best scientific information available and the most current stock assessment information. The PDT will either disband or assume inactive status upon completion of Amendment 1. Alternatively, the Board may elect to retain PDT members as members of the PRT or appoint new members. The PRT will provide annual advice concerning the implementation, review, monitoring, and enforcement of Amendment 1 once it has been adopted by the Commission.

4.7.4 Atlantic Croaker Technical Committee

The Atlantic Croaker Technical Committee will consist of representatives from state or federal agencies, Regional Fishery Management Councils, Commission, university or other specialized personnel with scientific and technical expertise and knowledge of the Atlantic croaker fishery. The Board will appoint the members of the Technical Committee and may authorize additional seats as it sees fit. Its role is to act as a liaison to the individual state and federal agencies, provide information to the management process, and review and develop options concerning the management program. The Technical Committee will provide scientific and technical advice to the Management Board, PDT, and PRT in the development and monitoring of a fishery management plan or amendment.

4.7.5 Atlantic Croaker Stock Assessment Subcommittee

The Atlantic Croaker Stock Assessment Subcommittee shall be appointed by the Technical Committee at the request of the Management Board, and will consist of scientists with expertise in the assessment of the Atlantic croaker population. Its role is to assess the Atlantic croaker population and provide scientific advice concerning the implications of proposed or potential management alternatives, or to respond to other scientific questions from the Board, Technical Committee, PDT or PRT. The Stock Assessment Subcommittee will report to the Technical Committee.

4.7.6 Atlantic Croaker Advisory Panel

The Atlantic Croaker Advisory Panel was established according to the Commission's Advisory Committee Charter. Members of the Advisory Panel are citizens who represent a cross-section of commercial and recreational fishing interests and others who are concerned about Atlantic croaker conservation and management. The Advisory Panel provides the Board with advice directly concerning the Commission's Atlantic croaker management program.

4.7.7 Federal Agencies

4.7.7.1 Management in the Exclusive Economic Zone (EEZ)

Management of Atlantic croaker in the EEZ is within jurisdiction of the Mid Atlantic and South Atlantic Fishery Management Councils under the Magnuson-Steven Act (16 U.S.C. 1801 et seq.). In the absence of a Council Fishery Management Plan, management is the responsibility of the NMFS as mandated by the Atlantic Coastal Fishery Conservation and Management Act (16 U.S.C. 5105 et. Seq.).

4.7.7.2 Federal Agency Participation in the Management Process

The Commission has accorded the United States Fish and Wildlife Service (USFWS) and the NMFS voting status on the ISFMP Policy Board and the South Atlantic State/Federal Fisheries Board in accordance with the Commission's ISFMP Charter. The NMFS also participates on the Atlantic Croaker Technical Committee and Stock Assessment Subcommittee.

4.7.7.3 Consultation with Fishery Management Councils

In carrying out the provisions of Amendment 1, the states, as members of the South Atlantic State/Federal Fisheries Management Board, shall closely coordinate with the South Atlantic Fishery Management Council in order to cooperatively manage the Atlantic coast Atlantic croaker population. In accordance with the Commission's ISFMP Charter, a representative of the South Atlantic Fishery Management Council shall be invited to participate as a full member of the South Atlantic State/Federal Fisheries Management Board.

4.8 RECOMMENDATIONS TO THE SECRETARIES FOR COMPLEMENTARY ACTIONS IN FEDERAL JURISDICTIONS

There are no recommendations at the time. In the future, if the South Atlantic State/Federal Fisheries Management Board finds it necessary to make a recommendation they can do so under Adaptive Management.

4.9 COOPERATION WITH OTHER MANAGEMENT INSTITUTIONS

At this time, no other management institutions have been identified that would be involved with management of Atlantic croaker on the Atlantic Coast. Nothing in Amendment 1 precludes the coordination of future management collaboration with other management institutions should the need arise.

5.0 COMPLIANCE

Full implementation of the provisions of this amendment is necessary for the management program to be equitable, efficient and effective. States are expected to implement these measures faithfully under state laws. Although the Atlantic States Marine Fisheries Commission does not have authority to directly compel state implementation of these measures, it will continually monitor the effectiveness of state implementation and determine whether states are in compliance with the provisions of this fishery management plan. This section sets forth the specific elements states must implement in order to be in compliance with this fishery management plan, and the procedures that will govern the evaluation of compliance. Additional details of the procedures are found in the ASMFC Interstate Fisheries Management Program Charter (ASMFC 2000).

5.1 MANDATORY COMPLIANCE ELEMENTS FOR STATES

A state will be determined to be out of compliance with the provisions of this fishery management plan, according to the terms of Section Seven of the ISFMP Charter if:

- it fails to meet any schedule required by *Section 5.1.2*, or any addendum prepared under adaptive management (*Section 4.6*); or
- it has failed to implement a change to its program when determined necessary by the South Atlantic State/Federal Fisheries Management Board; or
- it makes a change to its regulations required under *Section 4* or any addendum prepared under adaptive management (*Section 4.6*), without prior approval of the South Atlantic State/Federal Fisheries Management Board.

5.1.1 Mandatory Elements of State Programs

To be considered in compliance with this fishery management plan, all state programs must include management controls on Atlantic croaker consistent with the requirements of *Sections 4.1, 4.2* and *4.3*; except that a state may propose an alternative management program under *Section 4.5*, which, if approved by the Management Board, may be implemented as an alternative regulatory requirement for compliance.

5.1.1.1 Regulatory Requirements

The following lists the specific compliance criteria that a state/jurisdiction must implement in order to be in compliance with Amendment 1:

1. All states must submit an annual compliance report containing commercial and recreational landings as well as any monitoring programs that intercept Atlantic croaker.

Once approved by the South Atlantic State/Federal Fisheries Management Board, states are required to obtain prior approval from the Board of any changes to their management program for which a compliance requirement is in effect. Other measures must be reported to the Board but may be implemented without prior Board approval. A state can request permission to implement an alternative to any mandatory compliance measure only if that state can show to the Board's satisfaction that its alternative proposal will have the same conservation value as the measure contained in this amendment or any addenda prepared under Adaptive Management (*Section 4.6*). States submitting alternative proposals must demonstrate that the proposed action will not contribute to overfishing of the resource. All changes in state plans must be submitted in writing to the Board and to the Commission either as part of the annual FMP Review process or the Annual Compliance Reports.

5.1.1.2 Monitoring Requirements

The PDT and Technical Committee will work to develop appropriate protocols for designing fishery-independent surveys for Atlantic croaker. Such surveys may be implemented under *Section 4.6* (Adaptive Management) through the Commission's addendum process including the opportunity for public comment.

5.1.1.3 Research Requirements

The PDT and Technical Committee will prioritize the research needs for Atlantic croaker. Appropriate programs for meeting these needs may be implemented under *Section 4.6*

(Adaptive Management) through the Commission's addendum process including the opportunity for public comment.

5.1.1.4 Law Enforcement Requirements

All state programs must include law enforcement capabilities adequate for successfully implementing that state's Atlantic croaker regulations. The adequacy of a state's enforcement activity will be monitored annually by reports of the ASMFC Law Enforcement Committee to the Atlantic Croaker Plan Review Team. The first reporting period will cover the period from January 1, 2006- December 31, 2006.

5.1.1.5 Habitat Requirements

There are no mandatory habitat requirements for Atlantic croaker. See *Section 4.4* for Habitat Recommendations.

5.1.2 Compliance Schedule

States must implement Amendment 1 according to the following schedule:

January 1, 2006: States must implement Amendment 1. States may begin implementing management programs prior to this deadline if approved by the Management Board.

Reports on compliance must be submitted to the Commission by each jurisdiction annually, no later than July 1st each year, beginning in 2007.

5.1.3 Compliance Report Content

Each state must submit an annual report concerning its Atlantic croaker fisheries and management program for the previous calendar year. A standard compliance report format has been prepared and adopted by the ISFMP Policy Board. States should follow this format in completing the annual compliance report.

5.2 PROCEDURES FOR DETERMINING COMPLIANCE

Detailed procedures regarding compliance determinations are contained in the ISFMP Charter, Section Seven (ASMFC 2000). The following summary is not meant in any way to replace the language found in the ISFMP Charter.

In brief, all states are responsible for the full and effective implementation and enforcement of fishery management plans in areas subject to their jurisdiction. Written compliance reports as specified in the Plan or Amendment must be submitted annually by each state with a declared interest. Compliance with Amendment 1 will be reviewed at least annually. The South Atlantic State/Federal Fisheries Management Board, ISFMP Policy Board or the Commission, may request the Atlantic Croaker Plan Review Team to conduct a review of plan implementation and compliance at any time.

The South Atlantic State/Federal Fisheries Management Board will review the written findings of the PRT within 60 days of receipt of a State's compliance report. Should the Management Board recommend to the Policy Board that a state be determined out of

compliance, a rationale for the recommended non-compliance finding will be included addressing specifically the required measures of Amendment 1 that the state has not implemented or enforced, a statement of how failure to implement or enforce the required measures jeopardizes Atlantic croaker conservation, and the actions a state must take in order to comply with Amendment 1 requirements.

The ISFMP Policy Board shall, within thirty days of receiving a recommendation of non-compliance from the South Atlantic State/Federal Fisheries Management Board, review that recommendation of non-compliance. If it concurs in the recommendation, it shall recommend at that time to the Commission that a state be found out of compliance.

The Commission shall consider any Amendment 1 non-compliance recommendation from the Policy Board within 30 days. Any state which is the subject of a recommendation for a non-compliance finding is given an opportunity to present written and/or oral testimony concerning whether it should be found out of compliance. If the Commission agrees with the recommendation of the Policy Board, it may determine that a state is not in compliance with Amendment 1, and specify the actions the state must take to come into compliance.

Any state that has been determined to be out of compliance may request that the Commission rescind its non-compliance findings, provided the state has revised its Atlantic croaker conservation measures or shown to the Board and/or Commission's satisfaction that actions taken by the state provide for conservation equivalency.

5.3 RECOMMENDED (NON-MANDATORY) MANAGEMENT MEASURES

The South Atlantic State/Federal Fisheries Management Board, through Amendment 1, requests that those states outside the management unit implement complementary regulations to protect the Atlantic croaker spawning stock.

5.4 ANALYSIS OF ENFORCEABILITY OF PROPOSED MEASURES

The ASMFC Law Enforcement Committee will, during the implementation of this amendment, analyze the enforceability of new conservation and management measures as they are proposed.

6.0 MANAGEMENT AND RESEARCH NEEDS

The following list of research needs have been identified in order to enhance the state of knowledge of the Atlantic croaker resource, population dynamics, ecology, and the various fisheries for Atlantic croaker. The Technical Committee, Advisory Panel, and Management Board will review this list annually and an updated prioritized list will be included in the Annual Atlantic Croaker FMP Review.

6.1 STOCK ASSESSMENT AND POPULATION DYNAMICS

- Determine migratory patterns and mixing rates through cooperative, multi-jurisdictional tagging studies, including tagging information from Cape Fear south. Examine otolith microchemistry data available and continue research in this area.

- Fishery-independent size, age, and sex specific relative abundance estimates should be developed to monitor long term changes in croaker abundance.
- Improve catch and effort statistics from the commercial and recreational fisheries.
- Evaluate bycatch and discard estimates from the commercial and recreational fisheries (i.e. shrimp fishery). Produce a general fishery independent index using state survey information. Develop a coast wide and or regional CPUE index.
- Conduct stock identification research on Atlantic croaker (partially met: Lankford et al. 1999) particularly in North Carolina to determine if a split at Cape Hatteras.
- Evaluate hook and release mortality under varying environmental factors and fishery practices and include in updated assessment.
- The effects of mandated bycatch reduction devices (BRD's) on croaker catch should be evaluated and compiled.
- In trawl fisheries or other fisheries that historically take significant numbers of croaker, states should monitor and report on the extent of unutilized bycatch and fishing mortality on fish less than age-1.
- The optimum utilization (economic and biological) of a long term fluctuating population such as croaker should be evaluated.
- Continue monitoring of juvenile croaker populations through fishery-independent surveys.

6.2 RESEARCH AND DATA NEEDS

6.2.1 Biological

- Studies of croaker growth rates and age structure need to be conducted throughout the species range.
- Age-size data that are representative of all seasons and areas in the fisheries should be developed on an annual basis.
- Examine reproductive biology of croaker with emphasis on developing maturity schedules and estimates of fecundity across the management unit (partially met: Barbieri et al. 1994).
- Conduct an aging workshop to develop criteria for aging croaker otoliths and a comparison study of scales vs. otoliths.
- 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.

6.2.2 Social and Economic

- The optimum utilization (economic and biological) of a long term fluctuating population such as croaker should be evaluated.

6.2.3 Habitat

Information Needs and Recommendations for Future Habitat Research

Although Atlantic croaker habitats have undergone loss and degradation, studies are needed to quantify the impact on Atlantic croaker populations. For example, there has

been some speculation in recent years that extensive areas of low dissolved oxygen in the Chesapeake Bay killed most of the benthic organisms in the deeper water where croaker feed. Unfortunately, no research has been conducted to confirm the impact of hypoxia on food resources in this region (R. Lukacovic, Maryland Department of Natural Resources, personal communication).

The early life history of the Atlantic croaker is not well documented, yet events during this phase could have a significant impact on recruitment. A better understanding of this life stage of the species is needed to identify its habitat requirements, allowing scientists to evaluate the relative impacts of natural and anthropogenic disturbances.

7.0 PROTECTED SPECIES

In the fall of 1995, Commission member states, the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) began discussing ways to improve implementation and enforcement of the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA) in state waters. In November 1995, the Commission, through its Interstate Fisheries Management Program (ISFMP) Policy Board, approved an amendment of its ISFMP Charter (section 6(b)(2)) so that protected species and their interactions with ASMFC managed fisheries are addressed in the Commission's fisheries management planning process. Specifically, the Commission's fishery management plans (FMP) will describe impacts of state fisheries on certain marine mammals and endangered species (collectively termed "protected species"), and recommend ways to minimize these impacts. The following section outlines: (1) the federal legislation that guides protection of marine mammals and sea turtles, (2) the protected species with potential fishery interactions; (3) the specific type(s) of fishery interaction; (4) population status of the affected protected species; and (5) potential impacts to Atlantic coastal state and interstate fisheries.

7.1 MARINE MAMMAL PROTECTION ACT (MMPA) REQUIREMENTS

The 1994 amendments to the MMPA established both short- and long-term goals for reducing mortality and serious injury, or bycatch, of marine mammals incidental to commercial fisheries. The amendments also established take reduction plans (TRPs) and stakeholder-based take reduction teams (TRTs) as the mechanisms for achieving these goals. The MMPA requires NMFS to convene TRTs to develop TRPs for each strategic stock that interacts with a Category I or II fishery, fisheries with "frequent" or "occasional" marine mammal bycatch, respectively. (Fisheries that have a remote likelihood of or no known bycatch of marine mammals are classified in Category III.) A strategic stock is defined as a stock: (1) for which the level of direct human-caused mortality exceeds the potential biological removal (PBR)[1] level; (2) which is declining and is likely to be listed under the ESA in the foreseeable future; or (3) which is listed as a threatened or endangered species under the ESA or as a depleted species under the MMPA. In the short-term (within six months of implementation), TRPs must reduce

[1] PBR is the number of human-caused deaths per year each stock can withstand and still reach an optimum population level. This is calculated by multiplying "the minimum population estimate" by "½ stock's net productivity rate" by "a recovery factor ranging from 0.1 for endangered species to 1.0 for healthy stocks."

marine mammal bycatch to levels below a marine mammals stock's potential biological removal level. In the long-term (within five years of implementation), TRPs must reduce marine mammal bycatch to insignificant levels approaching a zero mortality and serious injury rate taking into account the economics of the fishery, the availability of existing technology, and existing state or regional fishery management plans.

The 1994 amendments also required fishermen in Category I and II fisheries to register under the Marine Mammal Authorization Program (MMAP), the purpose of which is to provide an exception for commercial fishermen from the general taking prohibitions of the MMPA; to take on board an observer if requested to do so by the Secretary of Commerce; and to comply with any applicable TRP or emergency regulations. All commercial fishermen, regardless of the category of the fishery in which they participate, must report all marine mammal bycatch.

Section 101(a)(5)(E) of the MMPA requires the authorization of the incidental taking of individuals from marine mammal stocks listed as threatened or endangered under the ESA in the course of commercial fishing operations if it is determined that (1) incidental mortality and serious injury will have a negligible impact on the affected species or stock; (2) a recovery plan has been developed or is being developed for such species or stock under the ESA; and (3) where required under section 118 of the MMPA, a monitoring program has been established, vessels engaged in such fisheries are registered in accordance with section 118 of the MMPA, and a take reduction plan has been developed or is being developed for such species or stock. Permits are not required for Category III fisheries; however, any serious injury or mortality of a marine mammal must be reported.

7.2 ENDANGERED SPECIES ACT REQUIREMENTS

The taking of endangered birds, sea turtles, and marine mammals is prohibited under Section 9 of the ESA. In addition, NMFS or the USFWS may issue Section 4(d) protective regulations necessary and advisable to provide for the conservation of threatened species. There are several mechanisms established in the ESA to avoid the takings prohibition in Section 9. First, a 4(d) regulation may include less stringent requirements intended to reduce incidental take and thus allow for the exemption from the taking prohibition. Section 10(a)(1)(B) of the ESA authorizes NMFS to permit, under prescribed terms and conditions, any taking otherwise prohibited by Section 9 of the ESA, if the taking is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Finally, Section 7(a) requires NMFS to consult with each federal agency to ensure that any action that is authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any listed species. Section 7(b) authorizes incidental take of listed species after full consultation and identification of reasonable and prudent alternatives or measure to monitor and minimize such take.

7.3 PROTECTED SPECIES WITH POTENTIAL FISHERY INTERACTIONS

There are numerous species that inhabit the range of the Atlantic croaker management unit covered under this FMP that are protected under the MMPA and ESA. Sixteen species are classified as endangered or threatened under the ESA, while the remainder are protected by the provisions of the MMPA.

Listed below are protected species found in coastal and offshore waters of the Atlantic Ocean throughout the range of the Atlantic croaker fishery. Species of Concern are also listed, but do not carry any procedural or substantive protections under the ESA.

Endangered

Right whale	(*Eubalaena glacialis*)
Humpback whale	(*Megaptera novaeangliae*)
Fin whale	(*Balaenoptera physalus*)
Sperm whale	*(Physeter macrocephalus)*
Blue whale	*(Balaenoptera musculus)*
Sei whale	*(Balaenoptera borealis)*
Green turtle2	*(Chelonia mydas*)
Leatherback turtle	(*Dermochelys coriacea*)
Kemp's ridley turtle	(*Lepidochelys kempii*)
Hawksbill turtle	*(Eretmochelys imbricata)*
Shortnose sturgeon	(*Acipenser brevirostrum*)
Atlantic Salmon 3	(*Salmo salar*)
Bermuda petrel	*(Pterodroma cahow)*

Threatened

Green turtle	(*Chelonia mydas*)
Loggerhead turtle	(*Caretta caretta*)
Rosate tern	(*Sterna dougallii)*

MMPA

Includes all marine mammals above in addition to:

Minke whale	(*Balaenoptera acutorostrata*)
Long-finned pilot whale	(*Globicephala melas*)
Short-finned pilot whale	(*Globicephala macrorhynchus*)
Killer whale	(*Orcinus orca*)
False killer whale	(*Pseudorca crassidens*)
Cuvier's beaked whale	(*Ziphius cavirostris*)
Mesoplodon beaked whale	(*Mesoplodon* spp.)
Dwarf sperm whale	(*Kogia simus*)
Pygmy sperm whale	(*Kogia breviceps*)
Pantropical spotted dolphin	(*Stenella attenuata*)
Risso's dolphin	(*Grampus griseus*)
Spotted dolphin	(*Stenella attenuata*)
Common dolphin	(*Delphinus delphis*)
White-sided dolphin	(*Lagenorhynchus acutus*)
Striped dolphin	(*Stenella coeruleoalba*)
Bottlenose dolphin	(*Tursiops truncatus*)

2 The breeding populations of green turtles in Florida and on the Pacific coast of Mexico are listed as endangered, the remainder of the population is listed as threatened.

3 The Gulf of Maine distinct population segment (DPS) of Atlantic salmon is endangered, while all other Atlantic salmon is considered a species of concern.

Harbor porpoise	(*Phocoena phocoena*)
Harbor seal	(*Phoca vitulina*)
Grey seal	(*Halichoerus grypus*)
Harp seal	(*Phoca groenlandica*)

Species of Concern

Dusky shark	(*Carcharhinus obscurus*)
Sand tiger shark	(*Odontaspis Taurus*)
Night shark	(*Carcharinus signatus*)
Atlantic sturgeon	(*Acipenser oxyrinchus oxyrinchus*)
Atlantic salmon	(*Salmo salar*)
Rainbow smelt	(*Osmerus mordax*)
White marlin	*(Tetrapturus albidus*)
Warsaw grouper	*(Epinephelus nigritus)*
Largetooth saw fish	(*Pristis pristis)*
Barndoor skate	(*Raja laevis)*
Alabama shad	(*Alosa alabamae)*
Mangrove rivulus	(*Rivulus marmoratus)*
Saltmarsh topminnow	(*Fundulus jenkinsi)*
Key silverside	(*Menidia conchorum)*
Opossum pipefish	(*Microphis brachyurus lineatus)*
Striped croaker	(*Bairdiella sanctaeluciae)*
Specked hind	(*Epinephelus drummondhayi)*
Goliath grouper	(*Epinephelus itijara)*
Nassau grouper	(*Epinephelus striatus)*
Elkhorn coral	(*Acropora palmate)*
Staghorn coral	(*Acropora cervicornis)*
Ivory bush coral	(*Oculina varicose)*
Fused-staghorn coral	(*Acropora prolifera)*
Common loon	(*Gavia Immer)*

Thirty nine species of seabirds regularly occur within the areas fished for croaker and are likely to interact with some gear type used in the fishery (Table 9). Ten of the species of seabirds breed along the central Atlantic coast and are present only in the summer, three species breed in summer and winter in the area, and 26 species winter in the mid Atlantic region where and when the Atlantic croaker fishery occurs. All of these birds are protected under the Migratory Bird Treaty Act.

The roseate tern, Bermuda petrel, and piping plover are the only endangered or threatened bird species within the mid-Atlantic maritime region. The Bermuda petrel and roseate tern are unlikely to be impacted by the croaker fishery as they occur very rarely in coastal Mid-Atlantic waters. The piping plover could be impacted by beach seining activities on shore if they were run over by vehicles on the beach. However, most nesting areas are posted and beach access is prohibited during the nesting season.

7.4 PROTECTED SPECIES WITH EXISTING FISHERIES

Although all of the protected species listed above may be found in the general geographical area covered under the Atlantic croaker management plan, not all are affected by the fishery for several reasons. Some protected species may inhabit more inshore or offshore areas than those utilized by Atlantic croaker, which prefer a different depth or temperature zone than Atlantic croaker, or may migrate through the area at different times than the species regulated by this fishery management plan. In addition, certain protected species may not be vulnerable to capture or entanglement in certain fishing gear used in the Atlantic croaker fishery.

Recreational anglers and commercial fishermen alike seek Atlantic croaker. Atlantic croaker support important commercial and recreational fisheries along the Atlantic coast, particularly from Maryland to North Carolina, although significant catches have been recorded in some years as far north as New York.

Commercial catch statistics indicate that croaker landings from New York to Florida have fluctuated widely over the years, ranging from 64 million pounds in 1945 to less than 2.2 million pounds in 1971. Landings have increased since 1990, averaging about 27 million pounds from 1997 to 2003. Croaker are harvested by a variety of commercial gear. In 2003, commercial harvest was 11% by haul/beach seines, 35% by bottom trawl, 19% by pound net, and 33% by various types of gillnets4. Hook-and-line is the predominant recreational gear used.

7.4.1 Marine Mammals

Marine mammal interactions have been recorded in the primary fisheries (utilizing otter trawls, gillnets, haul/beach seines, and pound nets) that target Atlantic croaker, including the mid Atlantic coastal gill net fishery; North Carolina inshore gill net, mid Atlantic haul/beach seine, Virginia pound net, Chesapeake Bay inshore gill net, Delaware Bay inshore gill net, mid Atlantic mixed species trawl, U.S. mid Atlantic mixed species stop seine/weir/pound net (except the North Carolina roe mullet stop net), Southeastern U.S. Atlantic, haul/beach seine. Marine mammal interactions have also been documented with other minor gear types that take small amounts of Atlantic croaker for commercial use such as pots, traps, long haul seines, hook-and-line, and cast nets. In addition, it is possible for marine mammals to interact with recreational fishing gear such as cast nets, hook-and-lines, pots and traps.

The marine mammal stocks of greatest concern that interact with this fishery are the Gulf of Maine humpback whale, western North Atlantic long-finned and short-finned pilot whales, and western North Atlantic coastal and offshore bottlenose dolphins. The MMPA 2004 List of Fisheries (LOF) (69 FR 48408) classifies fisheries by the level of serious injury and mortality of marine mammals incidental to each fishery. Table 10 lists the predominant fisheries that target Atlantic croaker and the marine mammals known to interact with those fisheries.

4 Only gears taking more than 5% of the Atlantic croaker landings coast-wide based on 2003 landings have been included.

Subsequent sections discuss documented interactions with the primary species of concern, e.g., bottlenose dolphin, pilot whale, and humpback whale. These bycatch reports do not represent a complete list, but rather available records. It should be noted that without an observer program for many of these fisheries, actual numbers of interactions are difficult to obtain.

7.4.1.1 Gillnet

Bottlenose Dolphin

Offshore stock

Serious injuries and mortalities of the offshore stock of bottlenose dolphins were observed in the mid Atlantic coastal gill net fishery. In 1998, one mortality was observed, leading to an estimated mortality of four animals in 1998. From 1996 to 2000, NMFS estimated the mean annual mortality for the offshore stock of bottlenose dolphins as one dolphin per year in the mid Atlantic coastal gill net fishery.

Coastal stock

Gill net gear has a documented history of interactions with bottlenose dolphins, plus the geographic distribution of Atlantic croaker fisheries overlaps with that of the coastal bottlenose dolphin stock, thus making interactions highly probable. The mid Atlantic coastal gill net fishery extends from North Carolina to New York, and is a combination of small vessel fisheries that target a variety of fish species in addition to Atlantic croaker, including bluefish, winter flounder, spiny and smooth dogfish, kingfish, Spanish mackerel, spot, striped bass, and weakfish (Steve *et al.* 2001). The fishery operates in different seasons targeting various species in different states throughout the range of coastal bottlenose dolphins.

For the North Atlantic coastal stock of bottlenose dolphins, serious injury and mortality has also been observed in several coastal gill net fisheries. From 1996 to 2000, a total of 12 coastal bottlenose dolphin interactions were observed in the mid Atlantic coastal gill net fishery. Three of these interactions were observed for the summer Northern Migratory Management Unit (see section 7.5.1.1), which overlaps geographically with Atlantic croaker catch. From the three observed takes, NMFS estimated an average annual fishery-related mortality and serious injury as 30 dolphins per year. NMFS also estimated mean annual mortalities for the Summer Northern Migratory, Summer Northern North Carolina, and Winter Mixed Management Units combined (see section 7.5.1.1) as 233 dolphins per year (NMFS 2002).

Other inshore gill net fisheries that harvest Atlantic croaker have documented interactions with the coastal bottlenose dolphin stock, including the North Carolina inshore gill net and the Delaware Bay inshore gill net fisheries. However, little or no information is available to accurately assess overall marine mammal interactions with these fisheries.

Pilot Whale

Interactions between both short-finned and long-finned pilot whales and the mid Atlantic coastal gill net fishery have been documented. These two species are difficult to

distinguish at sea as separate species and, therefore, abundance estimates, PBR, and bycatch estimates are combined into one listing for pilot whales. No pilot whale interactions were observed in this fishery from 1993 to 1997, one pilot whale interaction was observed in 1998, and none were observed in 1999 and 2000. The estimated annual mortality in this fishery in 1998 was seven pilot whales. Average annual estimated fishery-related mortality attributable to this gill net fishery during 1996-2000 was one pilot whale per year.

Humpback Whale

Assessing the level of interactions between humpback whales and fisheries has been difficult and is derived from two primary sources -- observed takes and non-observed fishery entanglement records, including strandings records. Between 1996 and 2000, there were 14 documented humpback whale interactions with fishing gear (two mortalities and 12 serious injuries). Two of the 12 seriously injured humpbacks were observed entangled in gill net gear in the Bay of Fundy, Canada. Unfortunately, most of the records do not contain the detail necessary to assign entanglements to a particular fishery or location. More information is needed on fisheries interactions with humpback whales, specifically the location of the interaction and types of gear involved.

7.4.1.2 Virginia Pound Net

Bottlenose Dolphin

Data from the Chesapeake Bay suggest that the likelihood of bottlenose dolphin entanglement in pound net leads may be affected by the mesh size of the lead net (Bellmund *et al.* 1997), but the information is not conclusive. Stranding data for 1993-1997 document interactions between coastal bottlenose dolphins and pound nets in Virginia. Two bottlenose dolphin carcasses were found entangled in the leads of pound nets in Virginia during 1993-1997, for an average of 0.4 bottlenose dolphin strandings per year. A third record of an entangled bottlenose dolphin in Virginia in 1997 may have been attributable to this fishery. This entanglement involved a bottlenose dolphin carcass found near a pound net with twisted line marks consistent with the twine in the nearby pound net lead rather than with monofilament gillnet gear. Given that other sources of annual serious injury and mortality estimates (e.g., observer data) are not available, the stranding data (0.4 bottlenose dolphins per year) were used as a minimum estimate of annual serious injury and mortality and this fishery was classified as a Category II fishery in the 2004 List of Fisheries.

7.4.2 Sea Turtles

Interactions with sea turtles may occur when fishing effort overlaps with sea turtle distribution. Interactions with the commercial fishery could occur in the spring, summer, and fall, as turtles can be found in the Mid-Atlantic waters from April to November. Interactions with the recreational fishery are also possible whenever turtles are present in the area of the fishing. Juvenile and immature Kemp's ridleys and loggerheads utilize nearshore and inshore waters north of Cape Hatteras during the warmer months and can be found as far north as the waters in and around Cape Cod Bay. Sea turtles are likely to be present off the Virginia, Maryland, and New Jersey coasts by April or May, but do not arrive in great concentrations in New York and northwards until mid-June. Although uncommon north of Cape Hatteras, immature green sea turtles also use northern inshore

waters during the summer and may be found as far north as Nantucket Sound. Leatherbacks migrate north in the spring to productive foraging grounds off Nova Scotia. With the decline of water temperatures in late fall, sea turtles migrate south to warmer waters. When water temperatures are greater than approximately 11°C, sea turtles may be present in some areas where the Atlantic croaker fishery occurs.

The vast majority of Atlantic croaker landings are by haul/beach seines, bottom trawls, pound nets, and various types of gill nets. Hook-and-line is the predominant recreational gear used. The capture of sea turtles could occur in all gear sectors of this fishery.

7.4.2.1 Bottom Otter Trawl

Incidental takes of sea turtles in otter trawls have been documented extensively by NMFS, though little is known about incidental takes of sea turtles in bottom otter trawls targeting Atlantic croaker specifically. From 1995 through 2002, NMFS observer coverage for large and small mesh bottom trawls targeting various species has averaged approximately 1% of days fished in the Mid-Atlantic. In this area, 22 alive and 21 dead turtles (including leatherback, Kemp's ridley and loggerhead) were documented to be incidentally caught in bottom trawls (NEFSC, unpublished data).

Observers have documented takes of turtles in trawls targeting Atlantic croaker. Four loggerheads and 1 unidentified to species were taken in trawls targeting Atlantic croaker between 1996-1998. Two of the loggerheads were dead, 1 was alive, and 1 was injured. The unidentified turtle was released alive.

Observers have also documented takes of turtles in trawls targeting groundfish. In 1996, two loggerheads were taken in trawls targeting groundfish, 1 of which was alive, and 1 was injured.

Incidental takes of Kemp's ridleys and loggerheads have been reported in summer flounder trawl operations occurring from Virginia to North Carolina and in the shrimp trawl fishery in the southeastern U.S. In the winter of 1991/1992, a total of 2,711 hours of summer flounder trawl fishing were observed. Eighty-three sea turtles were captured including 50 loggerheads, 29 Kemp's ridleys, two greens, one hawksbill, and one unidentified turtle. Takes were more abundant south of Cape Hatteras and no takes were observed north of Cape Charles, Virginia. Consequently, since 1992, turtle excluder devices (TEDs) have been required in the summer flounder fishery south of Cape Charles. From 1995-2002, 30 turtles were observed in trawls targeting summer flounder. Twenty-six of these were loggerheads, 2 were Kemp Ridleys, and 2 were unidentified to species. Seventeen (65%) loggerheads were released alive, 5 (19%) were dead, 3 (12%) were injured, and 1 (4%) was resuscitated.

Turtle takes have also been observed in squid trawl fisheries. Three loggerhead turtles and 1 unidentified to species were observed in the long-finned squid bottom trawl fishery during the period of 1995-2002. Two of these were released alive, and 1 was dead. A live leatherback turtle was also taken in this fishery in 2001 and released alive. A live loggerhead turtle was also observed taken in trawls targeting short-finned squid in 1995.

The shrimp fishery which uses a bottom otter trawl and operates from mainly south of Virginia is estimated to incidentally take each year 19,000 greens, 167,100 loggerheads, 160,000 Kemp's ridleys, and 3,100 leatherbacks (NMFS 2002). These estimates represent multiple captures and the vast majority are nonlethal given TEDs are also required for this fishery.

Flynets are a type of high profile trawl used inshore to catch Atlantic croaker that are lumped under otter trawls in landings data.

7.4.2.2 Pound Nets

Pound nets are used to harvest Atlantic croaker in North Carolina, Virginia and Maryland. Sea turtles interact with pound nets in all three states but the interactions in North Carolina and Maryland are considered less harmful than those in Virginia due to differences in gear, depth of water, current velocity, proximity to foraging grounds, etc.

In Maryland, interactions between sea turtles and pound nets were documented in the Sea Turtle Tagging and Health Assessment Study, which took place from July to September in 2001 and from May to August in 2002. Thirty-five sea turtles were incidentally captured in pound nets in Maryland's Chesapeake Bay during the study. All of the turtles were reportedly found swimming in the pound of the net and not entangled in the leader. Nineteen of the turtles were examined; all appeared to be in good health and were not injured by the net (Kimmel 2003). Like in Maryland, the vast majority of North Carolina pound net/sea turtle interactions are non-lethal. There are anecdotal reports of the same turtles coming back to feed in the same North Carolina pound nets day after day. There are sea turtle tagging studies using pound nets to capture and release them.

Each spring, hundreds of sea turtles migrate north along the Atlantic coast and into the Chesapeake Bay, where they forage throughout the summer on the Bay's rich marine life. During May and June in recent years, NMFS documented sea turtles in pound net leaders, as well as high numbers of stranded sea turtles around the bay. To better understand the interactions between pound net gear and sea turtles, NMFS conducted pound net monitoring during the spring of 2002 and 2003. This monitoring documented 23 sea turtles either entangled in or impinged on pound net leaders, 18 of which were in leaders with less than 12 inches (30.5 cm) stretched mesh. Nine animals were found entangled in leaders, of which 7 were dead, and 14 animals were found impinged on leaders, of which one was dead. In this situation, impingement refers to a sea turtle being held against the leader by the current, apparently unable to release itself under its own ability. For these purposes, an animal was still considered impinged if it had its head and flipper poking through the mesh. An animal was considered entangled if a body part was tightly wrapped one or more times in the mesh. Based on these observations, NMFS passed a rule in 2004 banning "offshore" pound net leaders between May 6 through July 15 annually in a portion of the lower bay.

NOAA Fisheries has issued an Incidental Take Permit for the Virginia pound net fishery that anticipates that the level of incidental take that will occur in pound net leaders with less than 12 inches stretched mesh from May 6 to July 15 each year will not exceed 1 loggerhead, 1 Kemp's ridley, 1 green or 1 leatherback sea turtle. In the biological opinion

for the Virginia pound net fishery, NOAA fisheries determined that these interactions, should they occur, are not likely to jeopardize the continued existence of these species, or destruction or adverse modification of critical habitat.

NOAA Fisheries anticipates that no more than 505 loggerhead, 101 Kemp's ridley, and 1 green sea turtle, will be captured annually in all pound nets set in the action area. These takes are anticipated to be live, uninjured animals. No incidental take of leatherback sea turtles in the pounds is anticipated. NOAA fisheries anticipates that no more than 1 loggerhead, 1 Kemp's ridley, 1 green or 1 leatherback sea turtle will be either entangled or impinged in leaders from July 16 to May 5 each year. NOAA Fisheries anticipates that 1 loggerhead, 1 Kemp's ridley, 1 green or 1 leatherback sea turtle will be entangled in leaders outside the closed area with less than 12 inches stretched mesh from May 6 to July 15 each year. If during the course of the fishing operations, the level of takes exceeds these values, the additional level of take would represent new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided in the Incidental Take Permit.

7.4.2.3 Gill nets

Sink gill nets also have the potential to take listed sea turtles. This sector of the fishery would be most likely to interact with loggerhead, Kemp's ridley, and green sea turtles as these species are more likely to be found near the bottom. Sea turtles may become entangled in either the buoy lines of the gillnets at the surface or at depth or the nets themselves at depth. Turtles are unlikely to be able to break off sections of the gear and will probably not be able to stay at the surface while entangled. While turtles are vulnerable to forced submergence, some turtles have been recovered alive from sink gill net gear.

In May 1995, a dead loggerhead was observed in a 6.5 inch mesh gillnet targeting smooth dogfish off Virginia Beach, Virginia. In November 1995, a live loggerhead was taken off Ocean City, Maryland, in a 6.5-7.0 inch mesh targeting striped bass. There was 5% observer coverage in the sink gillnet fishery when these takes occurred. Additionally, in 1999 and 2000, nine sea turtles were observed taken in sink gillnets off the coasts of North Carolina and Virginia. These takes show that sea turtle takes could occur with gill net gear depending on time of year and location fished.

Stranded sea turtles (e.g. loggerhead and Kemp's ridley) have been documented partially or completely entangled in this type of gear. Data on sea turtle strandings and incidental takes along the Atlantic coast by fisheries from 1980 to 1996 compiled by the NMFS Southeast Fisheries Science Center has strongly implicated Atlantic gill net fisheries in incidental capture and strandings of sea turtles. Included in the stranding data were strandings with netting gear still attached to the turtle, or that showed constriction wounds and abrasions indicative of entanglement. Spring and fall gill net operations have been strongly implicated in coincident sea turtle stranding events from North Carolina through New Jersey. In 2000, large-mesh gill nets were determined to be the most likely cause of significant increases in the stranding of sea turtles along the eastern coast of North Carolina, resulting in a closure of gill net fisheries using stretched mesh size of 6

inches or greater in an area along North Carolina and Virginia in order to protect sea turtles.

7.4.2.4 Haul/Beach Seines

No information available.

7.4.2.5 Hook-and-line

Sea turtles have also been caught on recreational hook and line gear. For example, from May 24 to June 21, 2003, five live Kemp's ridleys were reported as being taken by recreational fishermen on the Little Island Fishing Pier near the mouth of the Chesapeake Bay. Many other similar anecdotal reports exist. These animals are typically alive, and while the hooks should be removed whenever possible and when it would not further injure the turtle, NOAA fisheries suspects that the turtles are probably often released with hooks remaining.

7.4.3 Seabirds

Thirty nine species of seabirds regularly occur within the areas fished for croaker and are likely to interact with some gear type used in the fishery (Table 9).

Some seabirds are vulnerable to entanglement in commercial fishing gear. The magnitude of the interaction has not been quantified for the croaker fishery, especially since fishing methods are variable and changing. Since the Atlantic croaker fishery spans seasons when birds are wintering, migrating, and breeding, occurs in both estuarine and marine waters, and employs a variety of gear types it is very difficult to assess the amount of bird bycatch that will occur in the fishery. In general, birds that forage by scavenging and surface seizing including the great black-backed, herring, ring-billed and laughing gulls are most likely to be caught on longlines while trying to steal the bait during deployment or retrieval of gear. The vulnerability of birds to longline gear is dependant on a large variety of factors including the ships size (baited hooks hanging in the air longer from larger ships), gear characteristics (weighted hooks, thawed bait, weighted lines), deterrent devices, the hunger of the birds, and fishing practices such as how and when offal is dumped. A variety of studies conducted world wide in recent years have determined that a variety of deterrent devices and modification of fishing methods can reduce bird bycatch on longlines to very low levels. Generally, on the eastern seaboard longline vessels have very low bycatch of birds, due to the small size of the vessels and lack of species susceptible to being caught.

Gill nets are just the opposite of longlines in that gear modifications have been shown only in a few instances to reduce the bycatch of birds. In the mid-Atlantic region during the winter and spring the most likely species of birds to be drowned in gillnets are red-throated loons, common loons, northern gannets, and 10 species of sea ducks and diving ducks. The number of birds caught each year is not well quantified, but most birds dive to at least 50 foot depths and some occur out to the edge of the continental shelf. In general the less time the gill net is in the water, the less likely the diving birds will become entangled. The practice of drop netting would seem to be the least likely to catch birds in the mid Atlantic region in fall through spring, while gill nets anchored in the early morning and late evening would catch the most birds.

During late Spring through early fall in the mid Atlantic are a few loons are likely to be caught, but far more abundant and likely to be caught are double-crested cormorants and low numbers of brown pelicans. Northern gannets have been caught in a variety of gears as they plunge dive and pursue fish, primarily during spring migration. Red-breasted mergansers and loons may be caught in beach seines especially in spring migration between Virginia Beach and Oregon Inlet. Loons and diving and sea ducks are present in coastal and estuarine waters throughout the winter.

7.5 POPULATION STATUS REVIEW OF RELEVANT PROTECTED SPECIES

7.5.1 Marine Mammals

Four marine mammal species are known to become entangled in gear used by the Atlantic croaker fishery, namely, bottlenose dolphin, harbor porpoise, pilot whale, and humpback whale. Except for harbor porpoise, these species are all classified as strategic stocks under the MMPA. The humpback whale is listed as endangered.

The status of these and other marine mammal populations inhabiting the northwest Atlantic Ocean has been discussed in great detail in the annual U.S. Atlantic Marine Mammal Stock Assessment Report. The reports present information on stock definition, geographic range, population size, productivity rates, potential biological removal levels (PBR – the number of human-caused deaths the stock can withstand annually and still reach and maintain an optimum population level), and fishery-specific mortality estimates and also compares the PBR to estimated human-caused mortality for each stock. To access the stock assessment report, see the NMFS website at http://www.nmfs.noaa.gov/prot_res/PR2/Stock_Assessment_Program/sars.html.

7.5.1.1 Bottlenose Dolphin, *Tursiops truncatus*

Coastal stock

Under the MMPA, the western North Atlantic coastal bottlenose dolphin stock is listed as depleted, and therefore strategic, due to several large mortality events in the past 20 years. There are insufficient data to determine a population trend for this stock. The species ranges along the Atlantic coast from New Jersey south to central Florida (NMFS 2002), and is known to stay within 12 km from shore north of and 27 km from shore south of Cape Hatteras, North Carolina (Garrison 2001). Data suggest that the population maintained historically high levels immediately prior to a 1987-88 mortality event (Keinath and Musick 1988), which was estimated to have decreased the population by as much as 53%. The stock is also considered strategic because human-caused mortality currently exceeds PBR for the stock. To address bottlenose dolphin bycatch, NMFS convened the Bottlenose Dolphin Take Reduction Team (BDTRT) in November 2001.

Within the western North Atlantic, the stock structure of coastal bottlenose dolphins is complex (NMFS 2002). The maintained hypothesis has been that there is a single coastal migratory stock, ranging seasonally from as far north as Long Island, New York to as far south as central Florida. Recent studies, however, suggest this hypothesis is incorrect and there is likely a complex mosaic of stocks. Evidence to support this hypothesis includes observed geographic distribution, recent genetic analyses, photo-identification studies, satellite telemetry, and stable isotope studies. The most recent data pertain to stocks in the waters off North Carolina, but fewer data are available for bottlenose dolphins south of

North Carolina, and the theory of stock separation in this area is tentative. Stock affiliation for coastal animals in inland waters (e.g., estuaries, bays, sounds) is also poorly understood.

As a result of these findings, and for the purposes of developing the Bottlenose Dolphin Take Reduction Plan (BDTRP), NMFS subdivided the known migratory coastal stock into eight different management units, partitioned geographically and seasonally. These management units include the: (1) summer Northern migratory (NJ/NY border to NC/VA border), (2) summer Northern North Carolina (VA/NC border to Cape Lookout, NC), (3) winter Mixed (NC coastwide), (4) summer Southern North Carolina (Cape Lookout, NC to Murrell's Inlet, SC), (5) South Carolina annual (Murrell's Inlet, SC to SC/GA border), (6) Georgia annual (coastwide, including estuarine waters), (7) Northern Florida annual (FL/GA border to Indian/Banana River Lagoon), and (8) Central Florida (Indian/Banana River Lagoon south). It is important to note that while there are eight seasonal management units described for the purposes of developing the BDTRP, there are currently only seven distinct bottlenose dolphin management units identified -- Northern migratory, Northern North Carolina, Southern North Carolina, South Carolina, Georgia, Northern Florida, and Central Florida. The Mixed Winter management unit represents the winter abundance estimate for the Northern Migratory, Northern North Carolina and Southern North Carolina management units when these three management units overlap in the same geographic region.

Abundance estimates for each management unit are outlined in Table 11. NMFS conducted abundance surveys during the summer and winter of 2002 in order to update previous abundance estimates from 1995. Current estimates are confounded somewhat by an overlap in distribution between the coastal and offshore bottlenose dolphin stocks, and the difficulty of distinguishing between the two stocks while surveying. However, these estimates are considered more robust than previous abundance estimates conducted in 1995 due to improved experimental design.

Offshore stock

The status of the western North Atlantic offshore bottlenose dolphin stock relative to its optimum sustainable population is unknown. The offshore stock is not listed as depleted nor is it considered a strategic stock. Data are currently insufficient to determine population trends for the offshore stock of bottlenose dolphin. The offshore stock range in the western Atlantic Ocean extends offshore along the entire continental shelf break from Georges Bank to Cape Hatteras, North Carolina. Recent data suggest that the range of the offshore stock may include waters beyond the continental slope, and that offshore bottlenose dolphins may move between the Atlantic and Gulf of Mexico (Wells *et al.* 1999). Based on recorded sightings, the offshore stock has a somewhat seasonal distribution pattern, with more southern sightings during the fall and winter, although sightings still occurred as far north as the southern edge of Georges Bank.

Abundance estimates for the offshore stock of bottlenose dolphins were derived from aerial and shipboard line transect sighting surveys. The minimum population estimate for this stock in 2002 is 24,897 dolphins. The best estimate of abundance is 30,633 dolphins.

7.5.1.2 Harbor Porpoise, *Phocoena phocoena*

The Gulf of Maine harbor porpoise was proposed to be listed as threatened under the ESA on January 7, 1993 (NMFS 1993), but NMFS determined this listing was not warranted (NMFS 1999). NMFS removed this stock from the ESA candidate species list in 2001. The PBR for the harbor porpoise is 747 animals (NMFS 2002). The total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR level, which means the human-induced mortality is not approaching a zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury has not exceeded the PBR level in recent years.

Harbor porpoises range from Labrador to North Carolina. The southern-most stock of harbor porpoise is referred to as the Gulf of Maine/Bay of Fundy stock and generally spends its winters in the Mid-Atlantic region. Harbor porpoises are generally found in coastal and inshore waters, but will also travel to deeper, offshore waters. The status of the harbor porpoise stock in U.S. waters relative to the optimum sustainable population is unknown. There are insufficient data to determine population trends for this species because harbor porpoises are widely dispersed in small groups, spend little time at the surface, and distribution varies unpredictably from year to year depending on environmental conditions (NMFS 2002).

Shipboard line transect sighting surveys have been conducted to estimate population size of the harbor porpoise stock. The best estimate of abundance for the Gulf of Maine/Bay of Fundy harbor porpoise stock is 89,700. The minimum population estimate is 74,695 individuals (NMFS 2002).

7.5.1.3 Pilot Whale, *Globicephala melas, Globicephala macrorynchus*

The two species of pilot whales in the Atlantic, long-finned and short-finned pilot whales, are difficult to distinguish to the species level at sea. The species tend to overlap from New Jersey to Cape Hatteras, North Carolina. Sightings north of this overlapping area are likely to be long-finned pilot whales, while sightings south of this area are more likely to be short-finned pilot whales.

Both long-finned and short-finned pilot whale abundance may have been affected by reduction in foreign fishing, curtailment of the Newfoundland drive fishery for pilot whales in 1971, and increased abundance of herring, mackerel, and squid stocks. The total number of long-finned and short-finned pilot whales off the eastern U.S. is unknown. Because long-finned and short-finned pilot whales are difficult to identify at sea, seasonal abundance estimates were reported for *Globicephala* species as a whole. The best abundance estimate for pilot whales (*Globicephala sp.*) is 14,524 and the minimum population estimate is 11,343 individuals.

Long-finned pilot whale

The status of long-finned pilot whales, *Globicephala melas*, relative to their optimum sustainable population is unknown, and there are insufficient data to determine a population trend for this species. Long-finned pilot whales are not listed under the ESA,

but are considered a strategic stock because the 1996-2000 estimated average annual fishery-related mortality exceeds the PBR level (108) for this species.

Long-finned pilot whales range from North Carolina north to Iceland and Greenland and east to North Africa. Off the northeast U.S. coast, pilot whales are distributed principally along the continental shelf edge in the winter and early spring. In late spring, pilot whales move onto Georges Bank and into the Gulf of Maine and more northern waters until late autumn. Pilot whales generally prefer areas of high relief or submerged banks, and also areas associated with the Gulf Stream north wall and thermal fronts along the continental shelf edge. Stock structure of the long-finned pilot whale is uncertain, although it has been proposed that two populations exist (a warm-water population and a cold-water population) related to sea surface temperature (Fullard *et al.* 2000).

Short-finned pilot whales

The status of short-finned pilot whales, *Globicephala macrorynchus*, relative to their optimum sustainable population, is unknown, and there are insufficient data to determine a population trend for this species. Short-finned pilot whales are not listed under the ESA, but are considered a strategic stock because the 1996-2000 estimated average annual fishery-related mortality exceeds the PBR level (108) for this species.

Short-finned pilot whales range worldwide in tropical to warm temperate waters with North Carolina considered the northern extent of their range in U.S. waters. Sightings within U.S. waters are primarily within the Gulf Stream and along the continental shelf and continental slope in the northern Gulf of Mexico. No information is available on stock structure for this species.

7.5.1.5 Humpback Whale, *Megaptera novaeangliae*

Humpback whales are listed as endangered under the ESA and are also protected by the MMPA. Recent abundance estimates indicate continued population growth of the Gulf of Maine stock. However, there are insufficient data to determine population trends of North Atlantic humpbacks and this particular stock may still be below its optimum sustainable population. Continued human-caused mortality, especially in the Mid-Atlantic region, may be limiting recovery.

The Gulf of Maine stock of humpback whales spends the spring, summer, and fall seasons feeding in the Gulf of Maine. In the winter, most humpbacks migrate to the West Indies to mate and breed, while others have been observed at higher latitudes in the waters off the Mid-Atlantic and southeast U.S.

Between 1992 and 1999, three approaches were used to estimate abundance of the Gulf of Maine stock of humpback whales: 1. Mark-recapture (652), 2. Minimum number known to be alive in a given year (497), and 3. Line transect (902). Although each approach has limitations, NMFS chose to use the line transect method as the best estimate for the Gulf of Maine stock of humpbacks (NMFS 2002). Therefore, the minimum population estimate for this stock is 647.

Similar to right whales, the major known sources of mortality and injury of humpback whales include entanglement in commercial fishing gear, such as the sink gillnet gear used to catch winter flounder, and ship strikes. Based on photographs of the caudal peduncle of Gulf of Maine humpback whales, Robbins and Mattila (1999) estimated that between 48% and 78% of animals exhibit scarring caused by entanglement. Several whales have apparently been entangled on more than one occasion. These estimates are based on sightings of free-swimming animals that initially survive the encounter. Because some whales may drown immediately, the actual number of interactions may be higher. In addition, the actual number of species-gear interactions is contingent on the intensity of observations from aerial and ship surveys. Humpback whales may also be adversely affected by habitat degradation, habitat exclusion, acoustic trauma, harassment, or reduction in prey resources due to effects resulting from a variety of activities including the operation of commercial fisheries. Because entanglements and vessel collisions have been documented in both U.S. and Canadian waters, estimated human-caused mortality and serious injury is divided between the U.S. (2.4) and Canada (0.6) for a total of 3.0 per year. The Atlantic Large Whale Take Reduction Plan (ALWTRP) established measures that attempt to reduce humpback whale bycatch.

7.5.2 Sea Turtles

All sea turtles that occur in U.S. waters are listed as either endangered or threatened under the ESA. The Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and hawksbill (*Eretmochelys imbricata*) are listed as endangered. The loggerhead (*Caretta caretta*) and green turtle (*Chelonia mydas*) are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific coast of Mexico, which are listed as endangered. All five of these species inhabit the waters of the U.S. Atlantic and Gulf of Mexico.

NOAA Fisheries recognizes five loggerhead subgroups within the western Atlantic including two primary subpopulations: (1) a northern nesting subpopulation that occurs from North Carolina to northeast Florida, about 29°N (approximately 7,500 nests in 1998); (2) a south Florida nesting subpopulation, occurring from 29°N on the east coast to Sarasota, Florida on the west coast (mean of 73,751 nests each year). The status of the northern population based on the number of loggerhead nests has been classified as stable or declining (TEWG 2000). Data from all beaches within the south Florida subpopulation where nesting activity has been recorded indicate substantial increases when data are compared over the last 25 years. However, an analysis limited to nesting data from the statewide sea turtle Index Nesting Beach Survey program from 1989 to 2002, a period encompassing index surveys that are more consistent and more accurate than surveys in previous years, has shown no detectable trend (Blair Witherington, Florida Fish and Wildlife Conservation Commission (FFWCC), pers. comm., 2002).

The Kemp’s ridley is one of the most endangered of the world’s sea turtle species. The only major nesting site for ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico. Estimates of the adult female nesting population reached a low of 300 in 1985. Conservation efforts by Mexican and U.S. agencies have aided this species by eliminating egg harvest, protecting eggs and hatchlings, and reducing at-sea mortality

through fishing regulations. From 1985 to 1999, the number of nests observed at Rancho Nuevo, and nearby beaches increased at a mean rate of 11.3% per year (TEWG, 1998). Current totals exceed 8,000 nests per year, allowing cautious optimism that the population is on its way to recovery.

Recent population estimates for green sea turtle in the western Atlantic area are not available. However, the pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the ten years of regular monitoring since establishment of index beaches in 1989.

Leatherback populations in the eastern Atlantic (*i.e.,* off Africa) and Caribbean appear to be stable, but there is conflicting information for some sites (Spotila, pers. comm) and it is certain that some nesting populations (*e.g.*, St. John and St. Thomas, U.S. Virgin Islands) have been extirpated (NMFS and USFWS 1995). Data collected in southeast Florida clearly indicate increasing numbers of nests for the past twenty years (9.1-11.5% increase), although it is critical to note that there was also an increase in the survey area in Florida over time (NOAA Fisheries SEFSC 2001).

7.5.3 Seabirds

The population status and trend data on many species of seabirds are limited especially for small portions of the coast such as the mid-Atlantic. Of the species likely to interact with the croaker fishery the status of the red-throated loon is the least known, but it thought to be declining in the Pacific and probably on the East Coast. The common loon is listed by the Fish and Wildlife Service as a species of concern. Common loons breed on lakes where they face a number of hazards including mercury and lead poisoning, poaching, disturbance, loss of habitat and gillnet fishing. In their migration, molting, and wintering habitat along coastal Atlantic waters the major threat to both loons is from gillnets and oil spills. Northern gannets, brown pelicans, and double-crested cormorants have increasing populations. Of the ducks likely to interact with the fishery, the red-breasted merganser, bufflehead, common goldeneye, ruddy duck, and hooded merganser have populations that are increasing or stable, while the black, surf, and white winged scoters, long-tailed duck, and greater and lesser scaup have populations that are declining or thought to be declining.

7.6 EXISTING AND PROPOSED FEDERAL REGULATIONS/ACTIONS PERTAINING TO RELEVANT PROTECTED SPECIES

7.6.1 Marine Mammals

7.6.1.1 Bottlenose Dolphin

From November 2001 through May 2002, NMFS convened the Bottlenose Dolphin Take Reduction Team (BDTRT) to develop consensus recommendations to reduce the incidental serious injury and mortality of western North Atlantic coastal bottlenose dolphins in relevant Category I and II fisheries. As previously stated, for the purposes of the BDTRT's deliberations, NMFS subdivided the coastal migratory stock into eight different management units, partitioned geographically and seasonally (see section 7.5.1.1). These management units are: (1) Northern migratory summer (NJ/NY border to

NC/VA border), (2) Northern North Carolina summer (VA/NC border to Cape Lookout, NC), (3) North Carolina mixed winter (NC coastwide), (4) Southern North Carolina summer (Cape Lookout, NC to Murrell's Inlet, SC), (5) South Carolina annual (Murrell's Inlet, SC to SC/GA border), (6) Georgia annual (coastwide, including estuarine waters), (7) Northern Florida annual (FL/GA border to Indian/Banana River Lagoon), and (8) Central Florida (Indian/Banana River Lagoon south). Each management unit was further assigned estimates for stock abundance, PBR, and bycatch (Table 12).

PBR is calculated by multiplying "the minimum population estimate" by "½ stock's net productivity rate" by "a recovery factor ranging from 0.1 for endangered species to 1.0 for healthy stocks." These numbers are gauged against annual bycatch estimates for the management units to determine whether management actions are effective in reducing bycatch below PBR levels, with the ultimate goal of attaining insignificant levels approaching a zero mortality and serious injury rate.

The highlighted management units above represent the management units (MU) on which the BDTRT focused the greatest amount of effort, since for each of these MU, estimated bycatch in commercial fisheries exceeded the allocated PBR for that MU (Table 12). Total bycatch is defined as the product of the bycatch rate, takes per unit effort (estimated from a sample of the fishery), and the total fishery effort. The BDTRT's May 7, 2003 Consensus Recommendations for these MUs included gear-tending requirements (i.e., proximity rule), prohibitions on overnight sets, and gear marking requirements.

Following submission of the BDTRT's Consensus Recommendations, NMFS released a notice of its intent to develop an Environmental Impact Statement (EIS) (67 FR 47772). Due to additional abundance information collected on the bottlenose dolphin stock in winter 2002, including adjusted higher levels for PBR for many management units, NMFS determined that preparing an EIS was not warranted and an environmental assessment (EA) was more appropriate. NMFS published the notice to prepare an EA in July 2003. The BDTRT reconvened in April 2003 to review the updated bottlenose dolphin abundance information and to revisit its Consensus Recommendations to ensure that they would meet the statutory goals of the MMPA. A proposed rule to implement the BDTRP was published in November 2004 and the BDTRT met in January 2005 to review and comment on the proposed rule. A final rule is forthcoming.

For additional information, please contact the National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division F/SER3 at 9721 Executive Center Drive North, St. Petersburg, FL 33702 or http://sero.nmfs.noaa.gov/.

7.6.1.2 Harbor Porpoise

On December 1, 1998, NMFS published a final rule to implement the Harbor Porpoise Take Reduction Plan for the Gulf of Maine and the mid Atlantic coastal waters. The Northeast sink gill net and mid Atlantic coastal gill net fisheries are the two fisheries regulated by the HPTRP (63 FR 66464, December 2, 1998; also defines fishery boundaries). Among other measures, the HPTRP uses time/area closures in combination with acoustical devices (e.g., pingers) in Northeast waters, and time/area closures along with gear modifications for both small mesh (greater than 5 inches (12.7 cm) to less than

7 inches (17.78 cm)) and large mesh (greater than or equal to 7 inches (17.78 cm) to 18 inches (45.72 cm)) gill nets in mid Atlantic waters. Although the HPTRP predominately impacts spiny dogfish and monkfish fisheries due to high rates of porpoise bycatch, other gillnet fisheries are also managed under the HPTRP.

Copies of the final rule are available from the Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910-3226. Additional information regarding the rule and its changes can also be accessed via the Internet at http://www.nero.nmfs.gov/porptrp/.

7.6.1.3 Pilot Whale

There are no take reduction measures currently in place for pilot whales in the Atlantic Ocean. However, NMFS plans to convene two new take reduction teams in 2005 and 2006 to address incidental takes of pilot whales in Atlantic pelagic longline and trawl fisheries. The Pelagic Longline TRT will convene in June of 2005 and the Trawl TRT will follow in 2006.

7.6.1.4 Humpback Whale

The Atlantic Large Whale Take Reduction Plan (ALWTRP) (64 FR 7529; February 16, 1999) addresses bycatch of large baleen whales, specifically North Atlantic right, humpback, and fin whales, in several fixed gear fisheries, including the Northeast sink gillnet and Mid-Atlantic coastal gillnet fisheries. The PBR level is set at zero for right whales. PBR for humpback and fin whales is 1.3 and 4.7, respectively. In 2000, there were eight observed entangled right whales (7 live, one dead) and 19 entangled humpback whales (14 live, 5 dead) (NMFS 2003). In light of these recent entanglements, NMFS reconvened the Atlantic Large Whale Take Reduction Team to solicit recommendations for reducing interactions between large whales and commercial fisheries; the ALWTRP is currently under revision.

The ALWTRP relies on a suite of measures to meet its goals under the MMPA, including modifications to gear and fishing practices, seasonal area management (SAM), and dynamic area management (DAM). The ALWTRP specifies both universal gear modifications and area- and season-specific gear modifications. Universal requirements include the following: 1. No floating line at the surface, 2. No wet storage of gear, and 3. Maintain knot-free buoy lines as much as possible. Area- and season-specific gear modification information for gillnet fisheries is available from NMFS Northeast Regional Office, contact information below.

The SAM program was established to protect predictable annual aggregations of right whales in waters off Cape Cod, MA and in the EEZ. The SAM program incorporates two zones, SAM West and SAM East. SAM West requirements are effective March 1 through April 30 of each year while SAM East requirements are effective May 1 through July 31 of each year. Fishermen setting gear in SAM areas must modify their gear according to ALWTRP regulations, e.g., they must use sinking or neutrally buoyant groundline and weak links.

The DAM program was established to protect unpredictable aggregations of right whales

in waters north of 40°N latitude. A DAM action is triggered by a reliable report of a congregation of at least three right whales within 75 square nautical miles such that density of whales is greater than 0.04 right whales per nautical mile. Once the DAM zone is defined, NMFS has three options: 1. Require all anchored gillnet and lobster trap/pot fishermen to remove their gear from the zone and not set additional gear 2. Require all anchored gill net and lobster trap/pot fishermen to modify their gear accordingly in order to continue fishing within the DAM zone or 3. Encourage all anchored gillnet and lobster trap/pot fishermen to voluntarily remove their gear from the DAM zone. The DAM zone is effective two days after publication of a notice in the *Federal Register* and remains in effect for 15 days.

Copies of various regulations regarding interactions between right whales and commercial fisheries are available from the Protected Resources Division, National Marine Fisheries Service, Northeast Regional Office, and One Blackburn Drive, Gloucester, MA 01930. Additional information on the ALWTRP is also available on the Internet at http://www.nero.nmfs.gov/whaletrp/.

7.6.2 Sea Turtles

Under the ESA, and its implementing regulations, taking sea turtles – even incidentally – is prohibited, with exceptions identified in 50 CFR 223.206. The incidental take of endangered species may only legally be authorized by an incidental take statement or an incidental take permit issued pursuant to section 7 or 10 of the ESA.

Existing NMFS regulations specify procedures that NMFS may use to determine that unauthorized takings of sea turtles are occurring during fishing activities, and to impose additional restrictions to conserve sea turtles and to prevent unauthorized takings (50 CFR 223.206(d)(4)). Restrictions may be effective for a period of up to 30 days and may be renewed for additional periods of up to 30 days each.

7.6.3 Seabirds

Under the Migratory Bird Treaty Act it is unlawful "by any means or in any manner, to pursue, hunt, take, capture, [or] kill" any migratory birds except as permitted by regulation (16 U.S.C. 703). The regulations at 50 CFR 21.11 prohibit the take of migratory birds except under a valid permit or as permitted in the implementing regulations. The US Fish and Wildlife Service's Policy on Waterbird Bycatch states "It is the policy of the U.S. Fish and Wildlife Service that the Migratory Bird Treaty Act of 1918, as amended, legally mandates the protection and conservation of migratory birds. Avian conservation is of significant concern to many in the United States. Substantial numbers of waterbirds (especially seabirds, but also waterfowl, shorebirds, and other related wading species) are killed annually in fisheries, making waterbird bycatch a serious conservation issue and a violation of the underlying tenets of the MBTA. The goal of the U.S. Fish and Wildlife Service is the elimination of waterbird bycatch in fisheries. The Service will actively expand partnerships with regional, national, and international organizations, States, tribes, industry, and environmental groups to meet this goal. The Service, in cooperation with interested parties, will aggressively promote public

awareness of waterbird bycatch issues, and gather the scientific information to develop and provide guidelines for management, regulation, and compliance."

7.7 POTENTIAL IMPACTS TO ATLANTIC COASTAL STATE AND INTERSTATE FISHERIES

Regulations under all three take reduction plans for Atlantic large whales, harbor porpoise, and bottlenose dolphin (still pending) have the potential to impact gill net fisheries that harvest Atlantic croaker. By far, the plan with the greatest impact is the Bottlenose Dolphin Take Reduction Plan (not yet in effect) because of high levels of observed interactions and estimated bycatch that have previously occurred.

7.8 IDENTIFICATION OF CURRENT DATA GAPS AND RESEARCH NEEDS

Given the significant impact of the pending BDTRP, priority areas for data and research are listed as follows for bottlenose dolphins in an effort to highlight the current needs for this species.

7.8.1 Bottlenose Dolphin Research Needs

Stock Identification and Status

- Continued research on stock structure to confirm existing stock delineations and incorporate dolphins in inland waters for improved stock identification.
- Precise abundance estimates extending throughout the range of the coastal stock from southern Florida to the New York/New Jersey border, including estuaries, during winter and summer.

Improving Assessment of Bycatch Levels

- Increase observer coverage to provide more accurate estimates of fishing-related mortality, including the development and use of alternative platforms. Expand observer coverage into state waters.
- Explore and expand stranding networks for collection of data pertinent to bottlenose dolphin/fishery interactions. Include training, equipment, support, and better communication among participants (stranding network members, managers, local authorities, scientists, and fishers).

Gear Modification Research

- Research the effectiveness of reflective nets for catching fish, as well as for reducing takes of *Tursiops truncatus*.
- Research comparing the behaviors of captive and wild dolphins around gillnets with and without acoustically reflective webbing.
- Research lowering the floatline of floating gill nets and reducing the depth of the net to investigate possible reductions of marine mammal interactions.
- Investigate the effects of twine stiffness and acoustically reflective webbing on dolphin bycatch.

- Investigate bridle alterations to prevent collapsing of the net and elimination of bridles on anchored gill net gear with respect to their potential effects on the likelihood of bottlenose dolphin interactions.
- Investigate the behavior of anchored gillnet gear with regard to likelihood of entanglement a) when net panels are laced together and b) when they are not laced together, leaving gaps between nets.
- Investigate the level of occurrence of crab pot tipping by bottlenose dolphins and determine if research is necessary to scientifically validate the use of inverted bait wells.
- Investigate the effects of different string designs (i.e., shallower net depth, hung in different parts of the water column) to determine if the amount of webbing can be reduced without affecting catch for different fisheries (especially small mesh in coastal waters).
- Investigate reducing slack in the webbing of pound nets that interact with bottlenose dolphins.
- Investigate floatation modification of nets used within North Carolina federal and state waters.
- Determine if dolphins that appear to be attracted to boats or nets in North Carolina waters are interacting with gill net gear, attempt to identify such dolphins, and investigate their behavior and mortality rate.
- Investigate the importance of time of day and time of set with respect to when dolphins are caught in gear, based on carcass temperature and soak times.

7.8.6 Sea Turtle Research Needs

- Research into gear development/deployment for gillnets and trawls used in this fishery should be conducted to ensure minimal impact on sea turtles.

- Fishermen should be instructed on handling and resuscitation procedures for turtles encountered in the course of fishing.

- In order to better understand sea turtle populations and the impacts of incidental take in Atlantic croaker fisheries, in-water abundance estimates of sea turtles are needed to achieve more accurate status assessments for these species and improve our ability to monitor them.

- Development of a monitoring program to document incidental take of sea turtles in the Atlantic croaker fishery should be considered.

7.8.6 Seabird Research Needs

This section describes research needs related to protected species that were identified during the development of this FMP.

- An in depth analysis of existing bird bycatch data for this fishery should be conducted, and summarized for the plan.

- A review of present croaker fishing methods and similar methods used in other fisheries should be made to determine the scope of possible bird interactions with the fishery.

- Fishing methods that reduce the bycatch of birds should be identified and implemented in the fishery.
  This study should include a review of data, interviews with observers and fishers, and independent scientific testing of methods that reduce bycatch. Gillnets containing barium sulfate have been shown to reduce bycatch in some birds and marine mammals. If a substantial bycatch exists in the fishery, these gillnets should be tested.

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Table 1. Commercial Landings of Atlantic Croaker in Pounds by Atlantic Coastal States, 1950-2003.

YEAR	E FL	GA	SC	NC	VA	MD	DE	NJ	NY	RI	MA	NH	TOTAL
1950	60,400	1,000	29,100	2,095,800	6,673,900	2,517,900	6,100	37,900					11,422,100
1951	121,300		22,000	2,102,100	4,223,400	1,850,600	4,900	50,000					8,374,300
1952	151,200		23,000	1,346,300	3,641,200	850,300	8,300	82,700					6,103,000
1953	94,000		6,900	1,433,900	4,060,100	462,400	43,300	156,700					6,257,300
1954	124,700		5,100	1,015,500	5,124,500	912,900	60,100	369,200					7,612,000
1955	201,600		32,200	992,600	9,752,100	1,704,600	667,200	741,300					14,091,600
1956	138,400		73,500	4,828,800	9,667,900	1,748,700	27,200	76,800					16,561,300
1957	131,200		1,700	2,915,900	14,197,600	1,400,000	166,900	103,500					18,916,800
1958	157,600	100	9,700	6,920,600	11,856,000	658,500	3,200	400					19,606,100
1959	85,500		9,000	3,056,600	7,655,400	838,300	8,700	1,800					11,655,300
1960	140,700	300	20,500	2,092,800	3,932,700	586,000	200	8,100					6,781,300
1961	142,700		13,300	1,753,500	3,082,300	48,900		56,900					5,097,600
1962	161,300	600	33,300	1,662,800	1,293,700	11,100		4,300					3,167,100
1963	113,700	700	36,200	2,275,700	122,400	1,500							2,550,200
1964	101,200	400	10,400	1,866,900	394,200	2,400							2,375,500
1965	106,800	2,100	3,400	1,753,400	1,531,700	400							3,397,800
1966	330,700	5,100	1,300	1,267,000	1,463,200	800							3,068,100
1967	143,800	6,000		1,282,800	323,500	1,200							1,757,300
1968	70,000			1,200,800	6,200	100							1,277,100
1969	49,900	1,800	200	1,368,700	63,200	400							1,484,200
1970	66,900	9,400	2,700	806,800	127,900	100		200					1,014,000
1971	89,800	500	1,500	948,200	264,900	200		100					1,305,200
1972	101,100	2,400	400	4,108,600	484,100	500		400				17,700	4,715,200
1973	102,900	14,900	3,100	4,324,100	1,358,300	37,300		37,100	100				5,877,800
1974	65,100	8,500	39,900	6,081,700	1,501,700	120,300		45,100					7,862,300
1975	61,500	4,000	3,500	10,251,700	4,721,300	639,700	1,300	885,100					16,568,100
1976	78,400	13,600	1,300	15,038,000	5,897,600	1,069,100	2,600	700,600			100		22,801,300
1977	49,500	7,000	600	18,994,800	8,600,600	692,300	8,900	1,478,600		400			29,832,700
1978	39,470	563	730	19,945,471	8,099,100	597,000	7,300	654,900		100			29,344,634
1979	38,646	19,137	7,082	20,558,193	2,136,600	97,400	3,700	91,000	6,200	2,600			22,960,558
1980	50,911	4,721	5,438	21,146,798	711,600	7,100		12,000	900				21,939,468
1981	72,112	1,038	2,441	11,205,342	429,800	2,100		23,500	200				11,736,533
1982	95,357	2,177	386	10,824,953	119,300	7,000		100					11,049,273
1983	81,737	1,097	3,200	7,249,680	150,400	500		200			200		7,487,014
1984	131,375		3,793	9,170,160	817,700	27,100		57,700	3,000	100			10,210,928
1985	115,641		1,256	8,695,544	2,171,821	9,500	100	48,800			400		11,043,062
1986	177,414		924	9,424,828	2,367,000	137,500	500	106,000					12,214,166
1987	217,932	553	698	7,289,191	2,719,500	119,300	800	357,600					10,705,574
1988	140,242	304	2,614	8,434,415	1,749,200	98,700	200	30,100					10,455,775
1989	96,534		1,950	6,824,088	947,300	89,500		137,100					8,096,472
1990	104,402	32	1,190	5,769,512	198,195	3,584		644		20			6,077,579
1991	56,761			3,436,960	164,126	6,183	700	31,292		10			3,696,032
1992	73,369	210		2,796,612	1,339,388	10,685	800	51,600					4,272,664
1993	51,465			3,267,652	5,264,974	158,062	2,500	183,414					8,928,067
1994	96,018			4,615,791	5,773,430	218,744	3,000	117,256					10,824,239
1995	22,879			6,021,326	6,991,044	549,716	13,000	334,654					13,932,619
1996	26,045			9,961,862	9,442,959	810,435		621,889	1				20,863,191
1997	36,572			10,711,704	12,790,922	1,455,707	10,509	1,994,446	1,309				27,001,169
1998	26,418			10,865,928	12,006,988	1,375,646	10,368	1,029,332	31				25,314,711
1999	26,441			10,185,535	12,849,954	1,584,412	14,729	2,071,046	2	4			26,732,123
2000	34,441			10,122,634	12,889,406	1,501,655	11,121	2,130,465	285	40			26,690,047
2001	14,857			12,017,459	12,929,191	2,233,160	22,736	1,389,837	315				28,607,555
2002	17,237			10,189,182	12,447,795	1,513,025	10,732	1,828,484	224	67			26,006,746
2003	16,053			14,429,221	10,936,274	1,532,038	16,561	1,575,735	1,837				28,507,719
Total	**5,102,229**	**108,232**	**415,502**	**358,946,441**	**250,465,567**	**30,302,252**	**1,138,256**	**19,715,894**	**14,404**	**3,341**	**700**	**17,700**	**666,230,518**

Table 2. Atlantic Croaker Landings and Revenue from Virginia Ports (2001-2004)*

Atlantic Croaker Landings and Revenue from Virginia Ports (2001-2004)*								
	2001		*2002*		*2003*		*2004*	
Port	**Pounds**	**Revenue**	**Pounds**	**Revenue**	**Pounds**	**Revenue**	**Pounds**	**Revenue**
HAMPTON	1,894,788	$328,964	2,329,569	$592,260	1,686,863	$343,124	924,105	$269,275
NORFOLK	17,944	$4,161	44,293	$15,847	27,911	$7,654	34,937	$7,252
CAPE CHARLES	*	*	1,804	$380	*	*	*	*
WACHAPREAGUE	1,089	$250	*	*	*	*	*	*
CHINCOTEAGUE	290,487	$73,379	219,651	$73,506	55,393	$13,815	10,684	$3,001
CITY OF SEAFORD	*	*	7,200	$1,305	*	*	*	*
OTHER ACCOMAC	1,655,822	$449,043	1,692,104	$543,837	1,532,415	$432,716	1,058,415	$374,355
NEWPORT NEWS	131,205	$22,166	14,764	$4,793	51,893	$9,418	135,776	$42,608
OTHER ESSEX	*	*	9,941	$3,697	12,065	$3,684	1,154	$342
OTHER CITY OF CHESAPEAKE	*	*	*	*	3,851	$950	*	*
OTHER GLOUCESTER	1,935,256	$431,683	1,966,202	$471,092	2,616,249	$657,850	1,292,875	$352,583
OTHER ISLE OF WIGHT	8,184	$2,262	2,364	$530	1,075	$425	*	*
OTHER JAMES CITY	6,836	$1,604	2,588	$906	7,038	$1,797	3,111	$1,091
OTHER KING & QUEEN	7,362	$2,042	1,249	$427	3,157	$883	*	*
OTHER KING GEORGE	1,686	$352	4,635	$1,399	5,595	$1,438	*	*
OTHER KING WILLIAM	*	*	5,922	$1,658	1,824	$536	*	*
OTHER LANCASTER	763,403	$190,662	586,771	$207,122	541,606	$148,611	469,773	$156,203
OTHER MATHEWS	1,524,589	$391,340	1,080,271	$367,655	765,017	$188,316	526,991	$162,291
OTHER MIDDLESEX	146,016	$37,568	107,217	$33,089	58,617	$16,081	68,480	$23,902
OTHER CITY OF SUFFOLK	5,014	$1,668	9,965	$3,522	10,583	$3,127	*	*
OTHER NORTHAMPTON	922,765	$232,949	1,086,240	$332,545	1,094,849	$279,564	972,456	$254,310
OTHER NORTHUMBERLAND	640,744	$163,802	739,993	$252,704	714,161	$196,274	499,232	$183,035
VIRGINIA BEACH/LYNNHAVEN	1,557,184	$450,651	1,416,691	$506,201	1,155,855	$302,197	1,275,391	$468,463
OTHER RICHMOND	5,440	$1,434	31,522	$9,062	4,837	$1,332	1,164	$363
OTHER SURRY	1,478	$395	4,553	$1,026	*	*	*	*
OTHER WESTMORELAND	44,796	$12,707	31,046	$9,660	38,956	$10,310	15,605	$5,106
OTHER YORK	106,741	$26,467	202,678	$56,023	217,046	$54,280	222,487	$61,242
LITTLE WICOMICO RIVER	519,740	$124,884	699,387	$264,899	236,037	$106,256	265,814	$119,655
HULL CREEK	192,121	$46,879	89,180	$34,920	91,221	$41,065	97,217	$43,757
LOWER MACHODOC CREEK	17,809	$3,944	*	*	*	*	*	*
NOMINI BAY	2,072	$561	*	*	*	*	*	*
COAN RIVER	21,731	$5,202	*	*	*	*	*	*
YEOCOMICO RIVER (N)	261,422	$60,175	45,451	$19,186	*	*	*	*
MUNDY POINT	242,017	$58,127	11,708	$4,673	*	*	26,697	$12,014

*Only ports with greater than 1000 pounds of landings during at least one year between 2001-2004 have been included. An asterisk means that there were 0 to 999 pounds of Atlantic croaker harvested in that port during the specified year.

Table 3. Atlantic Croaker Landings and Revenue from North Carolina Ports (2001-2004)*

	2001		*2002*		*2003*		*2004*	
Port	**Pounds**	**Revenue**	**Pounds**	**Revenue**	**Pounds**	**Revenue**	**Pounds**	**Revenue**
ATLANTIC	222,020	$27,640	*	*	*	*	*	*
AVON	82,683	$16,928	51,098	$16,843	292,494	$65,802	254,109	$56,031
ENGELHARD	619,997	$135,788	957,180	$148,840	600,302	$96,511	407,932	$75,292
BEAUFORT	907,587	$136,165	567,559	$95,730	797,598	$156,588	784,249	$115,184
WANCHESE	7,135,769	$1,065,415	6,843,032	$957,019	11,640,000	$1,582,495	5,896,927	$862,245
HATTERAS	1,014,343	$186,184	396,072	$76,239	231,474	$41,511	286,269	$43,887
ORIENTAL	1,866	$438	*	*	*	*	1,241	$352

*Only ports with greater than 1000 pounds of landings during at least one year between 2001-2004 have been included. An asterisk means that there were 0 to 999 pounds of Atlantic croaker harvested in that port during the specified year.

Table 4. Atlantic Croaker Landings and Revenue from New Jersey Ports (2001-2004)*

	2001		*2002*		*2003*		*2004*	
Port	**Pounds**	**Revenue**	**Pounds**	**Revenue**	**Pounds**	**Revenue**	**Pounds**	**Revenue**
PT. PLEASANT	80,215	$18,409	46,365	$18,103	53,961	$24,036	*	*
CAPE MAY	822,940	$146,532	1,169,158	$202,125	939,596	$177,347	93,984	$7,898
WILDWOOD	5,131	$1,142	11,413	$3,621	9,731	$2,968	*	*
SEA ISLE CITY	21,268	$7,419	6,708	$2,031	2,234	$657	*	*
OTHER ATLANTIC	2,110	$844	*	*	*	*	*	*
OTHER CUMBERLAND	1,457	$946	2,971	$980	2,543	$677	*	*
BELFORD	2,029	$1,158	6,914	$2,561	1,195	$848	*	*
WARETOWN	6,473	$3,383	7,929	$3,664	25,644	$15,383	*	*
TUCKERTON	11,671	$7,666	*	*	*	*	*	*
LONG BEACH/BARNEGAT LIGHT	436,497	$183,905	576,341	$289,774	540,834	$331,993	*	*

*Only ports with greater than 1000 pounds of landings during at least one year between 2001-2004 have been included. An asterisk means that there were 0 to 999 pounds of Atlantic croaker harvested in that port during the specified year.

Table 5. Atlantic Croaker Landings and Revenue from Maryland Ports (2001-2004)*

	2001		*2002*		*2003*		*2004*	
Port	**Pounds**	**Revenue**	**Pounds**	**Revenue**	**Pounds**	**Revenue**	**Pounds**	**Revenue**
OCEAN CITY	255,379	$64,808	86,867	$27,155	81,842	$29,052	194,930	$56,531
OTHER MARYLAND	1,271,941	$454,572	851,419	$266,961	650,294	$187,133	*	*
CUCKOLDS CREEK	1,712	$369	*	*	*	*	*	*
SMITH CREEK	219,884	$48,213	166,243	$67,577	169,623	$76,363	147,703	$66,507
ST. GEORGES CREEK	117,468	$27,034	88,771	$31,252	65,831	$29,639	278,486	$125,326
GOOSE BAY	*	*	6,097	$1,991	1,851	$839	1,043	$470
ISLAND CREEK	58,737	$13,560	86,271	$33,594	59,281	$26,687	97,761	$44,005
HERRING CREEK	*	*	9,659	$3,721	255,789	$115,112	369,917	$166,477
BRETON BAY	*	*	14,202	$4,673	*	*	*	*
COMBS CREEK	8,487	$1,784	*	*	1,142	$519	*	*
ST. PATRICK'S CREEK	297,920	$65,067	202,179	$74,318	245,163	$110,329	353,637	$159,144

*Only ports with greater than 1000 pounds of landings during at least one year between 2001-2004 have been included. An asterisk means that there were 0 to 999 pounds of Atlantic croaker harvested in that port during the specified year.

Table 6. Value of Commercial Landings of Atlantic Croaker in US dollars, 1950-2003.

Year	E FL	GA	SC	NC	VA	MD	DE	NJ	NY	RI	MA	NH	Total
1950	2,099	50	1,455	103,406	1,210,225	351,283	1,040	3,250					1,672,808
1951	12,130		1,100	112,531	655,990	264,763	783	3,343					1,050,640
1952	14,969		920	66,325	424,816	155,614	1,238	16,540					680,422
1953	10,340		276	69,118	402,822	76,162	5,198	20,095					584,011
1954	13,717		204	50,593	508,383	116,446	4,212	29,732					723,287
1955	20,979		3,864	53,636	798,522	200,107	43,456	62,545					1,183,109
1956	15,224		7,350	289,728	801,002	238,479	2,197	9,770					1,363,750
1957	15,744		89	219,543	1,541,111	134,390	18,430	12,304					1,941,611
1958	15,760	9	499	530,542	1,091,817	72,273	384	62					1,711,346
1959	8,550		430	228,331	1,215,370	172,667	1,324	392					1,627,064
1960	18,291	27	1,005	158,029	642,507	156,437	50	1,519					977,865
1961	18,551		532	143,774	564,620	13,980		14,533					755,990
1962	21,455	48	1,332	145,544	293,777	3,014		1,274					466,444
1963	17,394	84	1,473	152,442	30,420	385							202,198
1964	15,335	48	521	139,066	62,899	527							218,396
1965	18,394	248	167	107,913	154,090	76							280,888
1966	45,767	609	76	62,549	193,703	166							302,870
1967	24,940	480		65,101	57,337	204							148,062
1968	14,520			59,836	1,290	16							75,662
1969	11,445	191	20	62,089	9,567	62							83,374
1970	15,525	954	219	37,875	15,491	29		30					70,123
1971	19,578	48	143	53,605	33,463	36		14					106,887
1972	18,364	253	27	227,052	67,868	105		45				2,119	315,833
1973	23,815	1,570	426	372,198	160,774	5,765		7,388	8				571,944
1974	14,150	917	4,027	600,375	205,209	18,477		6,463					849,618
1975	16,997	559	404	904,219	512,906	52,973	317	64,382					1,552,757
1976	25,074	2,149	238	1,577,235	789,279	117,317	832	59,152			21		2,571,297
1977	16,009	1,606	110	2,076,370	910,279	68,468	1,841	123,431		74			3,198,188
1978	13,329	159	146	2,735,282	1,410,445	147,107	1,934	128,001		38			4,436,441
1979	11,223	5,562	1,424	4,345,433	493,772	40,614	1,558	27,745	3,236	949			4,931,516
1980	17,998	1,423	1,232	5,213,755	212,490	3,474		4,092	418				5,454,882
1981	28,731	446	762	3,944,643	124,866	612		5,097	90				4,105,247
1982	26,672	967	122	4,031,186	49,441	1,191		17					4,109,596
1983	35,065	513	959	2,842,139	45,353	214		47			16		2,924,306
1984	51,200		1,345	3,027,015	267,690	12,004		17,553	3,191	6			3,380,004
1985	53,754		429	2,936,732	554,191	3,818	30	12,619			357		3,561,930
1986	68,578		355	3,088,174	576,640	50,422	157	37,110					3,821,436
1987	90,786	185	283	2,956,025	1,060,709	40,552	260	112,445					4,261,245
1988	81,586	175	1,203	3,542,549	899,327	42,482	80	8,031					4,575,433
1989	48,001		1,044	3,380,041	533,036	52,379		49,911					4,064,412
1990	64,540	24	511	2,959,259	110,740	2,667		150		8			3,137,899
1991	33,571			1,518,888	90,735	5,141	245	8,653		1			1,657,234
1992	49,575	211		1,010,646	428,793	5,722	198	12,504					1,507,649
1993	39,029			990,961	1,846,467	80,800	575	39,711					2,997,543
1994	36,682			1,451,218	2,012,748	129,508	844	29,575					3,660,575
1995	17,190			2,002,495	2,527,690	288,575	4,494	70,648					4,911,092
1996	21,471			3,642,763	3,345,400	291,324		122,339	1				7,423,298
1997	26,309			4,116,610	3,567,206	497,880	2,985	401,910	564				8,613,464
1998	20,458			3,450,044	4,161,655	453,055	3,980	203,363	23				8,292,578
1999	23,714			3,120,036	3,499,416	482,034	4,896	413,019	1	2			7,543,118
2000	39,496			2,987,064	5,598,277	569,224	4,423	609,845	112	16			9,808,457
2001	13,568			3,080,386	3,126,152	675,770	6,651	371,411	173				7,274,111
2002	16,105			3,233,614	3,814,795	841,733	3,781	522,985	94	25			8,103,132
2003	14,485			2,924,151	2,822,496	576,227	4,803	535,909	934				6,879,005
Total	**1,428,232**	**19,515**	**36,722**	**87,200,134**	**56,536,067**	**7,184,750**	**123,196**	**4,180,954**	**8,845**	**1,119**	**394**	**2,119**	**156,722,047**

Table 7. Atlantic croaker recreational landings (numbers of A + B1 fish) by state, 1981- 2003 (source: pers. comm. NMFS Fish. Stats. & Econ. Div.).

Year	MA	NJ	DE	MD	VA	NC	SC	GA	FLEC	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	1,477	143,404	391,231	1,126,058	6,730,181	387,427	170,528	64,953	234,360	9,249,619
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
Total	**1,477**	**4,061,501**	**3,326,560**	**16,486,338**	**107,627,904**	**20,867,709**	**3,912,189**	**3,113,286**	**21,908,553**	**181,305,517**

Table 8. Atlantic croaker recreational landings (pounds of A + B1 fish) by state, 1981-2003 (source: pers. comm. NMFS Fish. Stats. & Econ. Div.).

Year	MA	NJ	DE	MD	VA	NC	SC	GA	FLEC	Total
1981		582	2,317	0	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		0	0	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		0	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	1,790	135,733	293,560	1,150,459	5,920,436	161,117	76,821	30,966	141,756	7,912,638
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
Total	**1,790**	**3,980,635**	**2,778,383**	**14,881,580**	**66,523,648**	**7,867,206**	**1,380,161**	**1,045,970**	**11,598,905**	**110,058,278**

Table 9. Seabirds of the Mid-Atlantic Region that are Likely to Interact with Gear Used in the Atlantic Croaker Fishery

Common Name	Scientific Name	Months of Vulnerability	Vulnerability (High, Medium, Low)	Habitat (F=fresh, O=ocean, E=estuary)
Common Loon	*Gavia immer*	09 - 04	High	O,E
Red-throated Loon	*Gavia stellata*	09 - 04	High	O,E
Red-necked Grebe	*Podiceps grisegena*	09 - 04	Medium	O,E
Horned Grebe	*Podiceps auritus*	09 - 04	Medium	O,E
Brown Pelican	*Pelecanus occidentalis*	03 - 10	Medium	O,E
Northern Gannet	*Sula bassanus*	09 - 04	High	O
Great Cormorant	*Phalacrocorax carbo*	09 - 04	Medium	O,E
Double-crested Cormorant	*Phalacrocorax auritus*	All Year	High	O,E
Great Blue Heron	*Ardea herodias*	All Year	Medium	F,E
Redhead	*Aythya americana*	11 - 03	Medium	E
Canvasback	*Aythya valisineria*	11 - 03	Medium	E
Greater Scaup	*Aythya marila*	11 - 03	Medium	E
Lesser Scaup	*Aythya affinis*	11 - 03	Medium	E
Common Goldeneye	*Bucephala clangula*	11 - 03	Medium	E
Bufflehead	*Bucephala albeola*	11 - 03	High	E
Long-tailed Duck	*Clangula hyemalis*	11 - 03	High	E,F,O
White-winged Scoter	*Melanitta fusca*	11 - 03	Medium	O,E
Surf Scoter	*Melanitta perspicillata*	11 - 03	High	O,E
Black Scoter	*Melanitta nigra*	11 - 03	High	O,E
Hooded Merganser	*Lophodytes cucullatus*	11 - 03	Medium	F,E
Common Merganser	*Mergus merganser*	11 - 03	Medium	F,E
Red-breasted Merganser	*Mergus serrator*	11 - 03	High	E,O
Ruddy Duck	*Oxyura jamaicensis*	11 - 03	High	E,F
Osprey	*Pandion haliaetus*	03 - 09	Low	F,E
Bald Eagle	*Haliaeetus leucocephalus*	All Year	Low	F,E
American Coot	*Fulica americana*	11 - 03	Medium	F,E
Little Gull	*Larus minutus*	12 - 03	Low	O
Great Black-backed Gull	*Larus marinus*	All Year	Low	E,O
Herring Gull	*Larus argentatus*	All Year	Low	E,O
Ring-billed Gull	*Larus delawarensis*	11 - 03	Low	E,O
Laughing Gull	*Larus atricilla*	04 - 09	Low	E,O
Bonaparte's Gull	*Larus philadelphia*	09 - 04	Low	E,O
Gull-billed Tern	*Sterna nilotica*	04 - 09	Low	F,E
Caspian Tern	*Sterna naspia*	04 - 09	Low	F,E,O
Royal Tern	*Sterna maxima*	04 - 09	Low	E,O
Common Tern	*Sterna hirundo*	04 - 09	Low	E,O
Forster's Tern	*Sterna forsteri*	04 - 09	Low	E,O
Least Tern	*Sterna antillarum*	04 - 09	Low	F,E
Black Skimmer	*Rynchops nigra*	04 - 09	Low	E,O

Table 10. Commercial Fisheries Taking Atlantic Croaker in the Atlantic Ocean (LOF 2004).[5]

Fishery Description	Marine Mammal Species and Stocks Incidentally Killed/Injured
Category I	
Mid-Atlantic coastal gillnet	Humpback whale Minke whale Bottlenose dolphin Harbor porpoise Harbor seal Harp seal Long-finned pilot whale Short-finned pilot whale White-sided dolphin Common dolphin
Category II	
North Carolina inshore gillnet	Bottlenose dolphin
Mid-Atlantic haul/beach seine	Bottlenose dolphin Harbor porpoise
Virginia pound net	Bottlenose dolphin
Category III	
Chesapeake Bay inshore gillnet	Harbor porpoise
Delaware Bay inshore gillnet	Humpback whale Bottlenose dolphin Harbor porpoise
Mid-Atlantic mixed species trawl	None documented
U.S. Mid-Atlantic mixed species stop seine/weir/pound net (except the North Carolina roe mullet stop net)	None documented
Southeastern U.S. Atlantic, haul/beach seine	None documented

[5] Excerpt from List of Fisheries for 2004**,** Federal Register 69 (153 August 2004): 48407- 48423.

Table 11. 2002 Abundance Estimates, Coefficient of Variation (CV), and Minimum Population Estimate (Nmin) for each management unit of the Western North Atlantic Coastal Bottlenose Dolphins (taken from Garrison *et al.* 2003)

Stock	Abundance	CV (%)	Nmin
Summer (May - October)			
Northern Migratory	17,466	19.1	14,621
Northern North Carolina			
Oceanic	6,160	51.9	3,255
Estuary	919	12.5	828
Both	7,079	45.2	4,083
Southern North Carolina			
Oceanic	3,646	111	1,863
Estuary	141	15.2	124
Both	3,787	106.9	1,987
Winter (November - April)			
Mixed Stock*	16,913	23	13,558
ALL YEAR			
South Carolina	2,325	20.3	1,963
Georgia	2,195	29.9	1,716
Northern Florida*	448	38.4	328
Central Florida*	10,652	45.8	7,377

* Winter Mixed stock represents the winter abundance estimate for the Northern Migratory, Northern North Carolina and Southern North Carolina populations combined. Northern Florida estimates are derived from the winter 1995 and summer 2002 surveys. Central Florida estimates are derived from the winter 1995 survey.

Table 12. Estimates of abundance, PBR and bycatch for each management unit of the Western North Atlantic Coastal Bottlenose Dolphins (taken from reports by Palka and Rossman 2003 and 2004; Palka 2003; Garrison 2001 and 2003)

Management Unit	Abundance Estimate	PBR	Bycatch Estimate
Northern Migratory summer (May – October)	17,466	73.1	30
Summer Northern North Carolina (May – October)	**7,079**	**20.4**	**29**
Summer Southern North Carolina (May – October)	3,787	9.9	0[1]
***Winter Mixed (November – April)**	**16,913**	**67.8**	**151**
South Carolina (annual)	2,325	20	unknown
Georgia (annual)	2,195	17	unknown
Northern Florida (annual)	448	3.3	0
Central Florida (annual)	10,652	74[2]	4

*Winter Mixed represents the winter abundance estimate for the Northern Migratory, Northern North Carolina and Southern North Carolina populations combined.

[1]No takes were officially recorded via the NMFS observer program, but stranding data indicate takes do occur

[2]The PBR for central Florida is based on the 1995 survey estimates, as no 2002 data is available.

9.0 APPENDICES

Appendix A: Table 13. Overview of regulations, which indirectly impact the harvest of subadult Atlantic croaker in North Carolina.

Action	Proclamation/Rule	Year started
Finfish trawling prohibited in Pamlico, Albemarle, and Croatan Sounds and their tributaries.		1928-1930
Finfish trawling prohibited in all NC waters including the ocean to three miles offshore.		1931-1933
Finfish trawling prohibited in internal waters and the ocean within one mile of the inlets.		1934-1938
Prohibited finfish trawling in internal waters		1939- about 1950
Prohibited finfish trawling in internal waters but allowed finfish to be taken only while shrimp trawling.		About 1950-1960
Prohibited finfish trawling in internal waters.		1961-1982
Finfish trawling prohibited in internal waters except that up to 1,000 pounds of finfish per trip was allowed to be taken “incidental” to crab or shrimp trawling.		1983-1991
Area restrictions and incidental finfish limits taken by shrimp and crab trawls in inside waters limit these gears from having no more than 500 pounds of finfish from December 1 through February 28 and 1,000 pounds of finfish from March 1 to November 30.	Rule: 15A NCAC 3J .0104(a)	1991
Finfish taken in shrimp and crab trawls: It is unlawful to possess finfish incidental to shrimp or crab trawl operations from December 1 through March 31 unless the weight of the combined catch of shrimp and crabs exceeds the weight if finfish except as provided in Sub-item (5)(b) pf this Rule.	Rule: 15A NCAC 3J .0202 (5)(a)	1997
Limits the catch of unclassified bait to 5,000 lbs per vessel per day	Rule: 15A NCAC 3M .0162	1991
Minimum mesh size restrictions in shrimp trawls (1 ½" tailbag) and crab trawls (3”).	Rule: 15A NCAC 03l. 0103 and 0292	1991
Bycatch reduction devices (BRDs) required in all shrimp trawls.	Proclamation and consent of the MFC. Rule: 15A NCAC 3J .0104	1992
Increase minimum mesh size restrictions in crab trawls to 4” in western Pamlico Sound.	By proclamation. (NC southern flounder FMP)	Fall 2005

Table 1. Continued.

Action	Proclamation/Rule	Year started
Minimum mesh size for flynets. (A minimum stretched mesh length of less than 3" hung on the square or 3 ½" hung on a diamond. [Flynets are defined as nets having the first body (belly) section consisting of 35 or more continuous meshes of 8" or greater (stretched mesh) webbing behind the bottom and top line. With tailbags less than 15 feet in length. Tailbags constructed of square mesh may have the terminal 3 feet of mesh hung on a diamond with a minimum stretched mesh length of 2".	Proclamation: FF-26-92 (ASMFC Weakfish FMP)	1992
Closure of ocean waters south of Cape Hatteras to the South Carolina state line to flynets.	Proclamation: FF-18-94 Rule: 15A NCAC 3J .0202 (4)	1994
No person may possess aboard or land from any vessel using a flynet more than 150 pounds of weakfish during any one day or trip, whichever is longer, unless all flynets onboard meet the following requirements: 1) The flynet has a large mesh in the wings that measure 8" to 64" (inside stretched mesh length; and 2) The first body section (belly) of the net has 35 or more meshes that are at least 8 inches (inside stretched mesh length); 3) The mesh decreases in size throughout the body of the net to a tailbag of a minimum length of 15 feet in length with a minimum inside stretched mesh length of 3 ½" hung on the square or 3 ¾" hung on a diamond. 4) Tailbags constructed of square mesh may have the terminal three feet constructed of material hung on a diamond with a minimum inside stretched mesh length of 2".	Proclamation: FF-14-96 (Revised) (implement restrictions required to comply with amendment 3 of the ASMFC weakfish FMP)	1996
Mandatory use of cull panels in long hauls and swipe nets south and west of a line from Bluff Point in Pamlico Sound to Ocracoke island.	Rule: 15A NCAC 3J .0109 (3)	1999
No person may possess aboard or land from any vessel using or having on board a gill net with a mesh length less than 2 7/8" stretched mesh, more than 150 pounds of weakfish during any one day or on any one trip, whichever is longer.	Proclamation: FF-14-96 (Revised) (implement restriction required to comply with amendment 3 of the ASMFC weakfish FMP)	1996

Table 1. Continued.

Action	Proclamation/Rule	Year started
Small mesh (< 5") commercial estuarine gill net attendance requirements from May 1 to October 31 in select areas in inside waters.	Rule: 15A NCAC 3J .0103 (h) (NC red drum FMP)	1998
Authorized gear allowed and restrictions applied to the Recreational Commercial Gear License.	Rule: 15A NCAC 3O .0302	1999