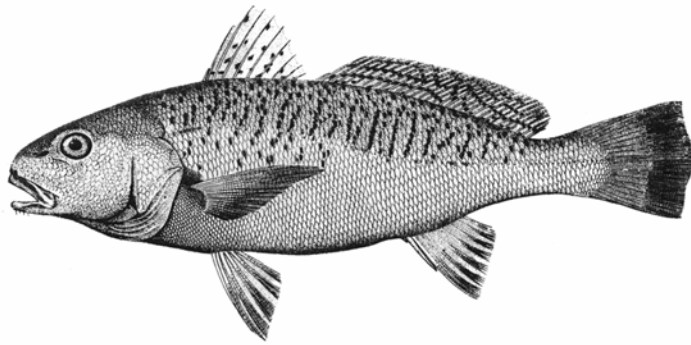


**REVIEW OF THE INTERSTATE FISHERY
MANAGEMENT PLAN FOR ATLANTIC CROAKER
(*Micropogonias undulatus*)
2001 FISHING YEAR**



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The Atlantic Croaker Plan Review Team

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Approved November 19, 2002

REVIEW OF THE INTERSTATE FISHERY MANAGEMENT PLAN FOR ATLANTIC CROAKER (*Micropogonias undulatus*)

I. Status of the Fishery Management Plan

The *Fishery Management Plan (FMP) for Atlantic Croaker* was adopted in 1987 and includes the states from Maryland through Florida. In reviewing the early plans created under the Interstate Fisheries Management Plan process, the Atlantic croaker plan was seen by the Atlantic States Marine Fisheries Commission (ASMFC) as in need of review and possible revision. A Wallop-Breaux grant from U.S. Fish and Wildlife Service was provided to conduct a comprehensive data collection workshop for croaker and spot which would lay the groundwork for a major amendment to the 1987 FMP. The October 1993 workshop at the Virginia Institute of Marine Science was attended by university and state agency representatives from six states. Presentations on fishery-dependent and fishery-independent data, population dynamics and bycatch reduction devices were made and discussed. All state reports and a set of recommendations were included in the workshop report (ASMFC 1993).

Subsequent to the workshop and independent of it, the South Atlantic State/Federal Fisheries Management Board of ASMFC reviewed the status of several plans in order to define the compliance issues to be enforced under the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA). The Board found recommendations in the Atlantic Croaker FMP to be vague and no longer valid. The Board recommended that an amendment be prepared to the Atlantic Croaker FMP to define management measures necessary to achieve the goals of the FMP. In their 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.

A Technical Committee was appointed in 1997 and began compiling data during the summer of 1998, the first step in preparing a stock assessment. The 1993 workshop proceedings provided the basis for a plan amendment, along with data collected by the states and federal agencies since then. The Technical Committee met in September, 1998 to review the available data and began preparing an assessment. A stock assessment subcommittee was appointed and is responsible for preparing the actual assessment. At that time, the subcommittee was informed of ongoing work at North Carolina State University to develop a coastwide Atlantic croaker assessment (Lee et al. 2001). The subcommittee reviewed the assessment in November 2001 and provided a report to the management board regarding its utility for developing an FMP amendment. A Plan Development Team will also need to be appointed by the South Atlantic Board in order to begin preparation of the amendment.

II. Status of the Stock

The area of greatest abundance on the Atlantic Coast extends from Chesapeake Bay to Florida, although significant catches are made in some years as far north as New York. The species is a major component in generalized fishery-independent trawl and seine surveys in several states. Annual recruitment is highly variable and dependent on natural environmental conditions. Mean density of croaker from the Southeast Area Monitoring and Assessment Program's (SEAMAP) spring shallow water trawl survey in the South Atlantic Bight averaged 71.6 individuals per hectare from 1989-1994. The mean density decreased to a time-series low in 1997, 18.9 individuals/ha. In recent years, the mean density fluctuated around 60

individuals per hectare (61.1 individuals/ha in 2001). The North Carolina estuarine trawl survey indices were low in the late 1980s and early 1990s, with an all time low in 1991. Several good yearclasses were sampled in the mid to late 1990s and 2000. Recruitment was not as high in 2001, with an index below the 15-year average. Virginia surveys indicate high juvenile abundance in the mid-70's with good year-classes in 1984 and 1985. Juvenile abundance was low in Virginia rivers during 1991 and 1993 but was high in 1996. Juvenile surveys in Maryland's portion of Chesapeake Bay indicated large year-classes during 1993-2000, with the exception of poor year-classes in 1995 and 1999, and an exceptionally large year-class in 1998. Juvenile surveys in Maryland's coastal waters indicated an increasing trend of Atlantic croaker abundance from the mid-1980s through 1999. Pound net surveys in Maryland's Chesapeake Bay and Potomac River indicated increasing mean length during 1993-98, consistent with the notion of an expanding stock. A total mortality rate of 55-60% has been calculated for Chesapeake Bay stocks. Analyses done at Virginia Institute of Marine Science (VIMS) indicate that croaker sampled in Chesapeake Bay may have a biological capacity to resist growth overfishing.

North Carolina declared croaker to be "of concern". A "concern" stock status is defined as those stocks that were once considered to be declining or depressed which have shown measurable and consistent improvement. Increased commercial CPUE's, landings, and age structure suggest the stock is in recovery but the annual juvenile abundance index is below average and landings in inside waters show no improvement. There have been socioeconomic changes within the inside fisheries that may attribute to the declines in commercial landings from inside waters. Recreational landings have increased by weight in inside waters but the actual number of fish are below the MRFSS 10-year average which indicates people are catching bigger fish but fewer than in previous years.

The most recent stock assessment indicates the population continues to increase and there has been a shift to larger fish in both the North Carolina commercial and coastwide recreational fisheries (Lee et al. 2001). This indicates that the age/size structure of the population is expanding.

Table 1. Commercial landings (in pounds) of Atlantic croaker by state, 1960-2000 (source: pers. comm. NMFS Fish. Stats. & Econ. Div.).

| Year | MA | RI | NY | NJ | DE | MD | VA | NC | SC | GA | FLEC | Total |
|------|-----|-----|-----|---------|------|---------|---------|----------|-------|-------|--------|----------|
| 1960 | | | | 8100 | 200 | 586000 | 3932700 | 2092800 | 20500 | 300 | 140700 | 6781300 |
| 1961 | | | | 56900 | | 48900 | 3082300 | 1753500 | 13300 | | 142700 | 5097600 |
| 1962 | | | | 4300 | | 11100 | 1293700 | 1662800 | 33300 | 600 | 161300 | 3167100 |
| 1963 | | | | | | 1500 | 122400 | 2275700 | 36200 | 700 | 113700 | 2550200 |
| 1964 | | | | | | 2400 | 394200 | 1866900 | 10400 | 400 | 101200 | 2375500 |
| 1965 | | | | | | 400 | 1531700 | 1753400 | 3400 | 2100 | 106800 | 3397800 |
| 1966 | | | | | | 800 | 1463200 | 1267000 | 1300 | 5100 | 330700 | 3068100 |
| 1967 | | | | | | 1200 | 323500 | 1282800 | | 6000 | 143800 | 1757300 |
| 1968 | | | | | | 100 | 6200 | 1200800 | | | 70000 | 1277100 |
| 1969 | | | | | | 400 | 63200 | 1368700 | 200 | 1800 | 49900 | 1484200 |
| 1970 | | | | 200 | | 100 | 127900 | 806800 | 2700 | 9400 | 66900 | 1014000 |
| 1971 | | | | 100 | | 200 | 264900 | 948200 | 1500 | 500 | 89800 | 1305200 |
| 1972 | | | | 400 | | 500 | 484100 | 4108600 | 400 | 2400 | 101100 | 4697500 |
| 1973 | | | 100 | 37100 | | 37300 | 1358300 | 4324100 | 3100 | 14900 | 102900 | 5877800 |
| 1974 | | | | 45100 | | 120300 | 1501700 | 6081700 | 39900 | 8500 | 65100 | 7862300 |
| 1975 | | | | 885100 | 1300 | 639700 | 4721300 | 10251700 | 3500 | 4000 | 61500 | 16568100 |
| 1976 | 100 | | | 700600 | 2600 | 1069100 | 5897600 | 15038000 | 1300 | 13600 | 78400 | 22801300 |
| 1977 | | 400 | | 1478600 | 8900 | 692300 | 8600600 | 18994800 | 600 | 7000 | 49500 | 29832700 |

| | | | | | | | | | | | | |
|------|-----|------|------|---------|-------|---------|----------|----------|------|-------|--------|----------|
| 1978 | | 100 | | 654900 | 7300 | 597000 | 8099100 | 19945471 | 730 | 563 | 39470 | 29344634 |
| 1979 | | 2600 | 6200 | 91000 | 3700 | 97400 | 2136600 | 20558193 | 7082 | 19137 | 38646 | 22960558 |
| 1980 | | | 900 | 12000 | | 7100 | 711600 | 21144152 | 5107 | 4721 | 50911 | 21936491 |
| 1981 | | | 200 | 23500 | | 2100 | 429800 | 11204580 | 2441 | 1038 | 72112 | 11735771 |
| 1982 | | | | 100 | | 7000 | 119300 | 10824762 | 318 | 2163 | 95357 | 11049000 |
| 1983 | 200 | | | 200 | | 500 | 150400 | 7249496 | 3150 | | 81737 | 7485683 |
| 1984 | | 100 | 3000 | 57700 | | 27100 | 817700 | 9170110 | 3068 | | 131375 | 10210153 |
| 1985 | 400 | | | 48800 | 100 | 9500 | 2171821 | 8693528 | 1177 | | 115641 | 11040967 |
| 1986 | | | | 106000 | 500 | 137500 | 2367000 | 9424706 | 558 | | 177414 | 12213678 |
| 1987 | | | | 357600 | 800 | 119300 | 2719500 | 7287920 | 618 | | 217932 | 10703670 |
| 1988 | | | | 30100 | 200 | 98700 | 1749200 | 8434415 | 1614 | | 140011 | 10454240 |
| 1989 | | | | 137100 | | 89500 | 947300 | 6823939 | 1950 | | 94909 | 8094698 |
| 1990 | | 20 | | 644 | | 3584 | 198195 | 5769512 | 1190 | 32 | 104402 | 6077579 |
| 1991 | | 10 | | 31292 | 700 | 6183 | 164126 | 3436960 | 480 | 59 | 56761 | 3696571 |
| 1992 | | | | 51600 | 800 | 10685 | 1339388 | 2796612 | | 210 | 73369 | 4272664 |
| 1993 | | | | 183414 | 2500 | 158062 | 5264974 | 3267652 | | | 51465 | 8928067 |
| 1994 | | | | 117256 | 3000 | 218744 | 5773430 | 4615791 | | | 96018 | 10824239 |
| 1995 | | | | 334654 | 13000 | 549716 | 6991044 | 6021326 | | | 22879 | 13932619 |
| 1996 | | | 1 | 621889 | | 810435 | 9442959 | 9961862 | | | 26045 | 20863191 |
| 1997 | | | 1309 | 2032365 | 10509 | 1455707 | 12790922 | 10711696 | | | 36572 | 27039080 |
| 1998 | | | 31 | 1029332 | 10368 | 1375646 | 12006988 | 10865928 | | | 26418 | 25314711 |
| 1999 | | 4 | 2 | 2071046 | 14729 | 1584412 | 12849954 | 10185535 | | | 26441 | 26732123 |
| 2000 | | 40 | 285 | 2130465 | 11121 | 1501655 | 12889406 | 10122634 | | | 34278 | 26689884 |
| 2001 | | | 315 | 1389837 | 22736 | 2233160 | 12929191 | 12017424 | | | 14857 | 28607530 |

III. Status of the Fishery

Atlantic coast commercial landings of croaker have varied from one million pounds in 1970 to 64 million pounds in 1945. Commercial landings increased steadily each year from a low of 3.7 million pounds in 1991 to 27 million pounds in 1997 (Table 1). North Carolina landings have continued to grow since 1993, with the highest landings in 2001. However, the largest increase in landings has occurred in Virginia, where only 164,000 pounds were reported in 1991, but 12.8 million pounds were landed in 1997 and Virginia's commercial landings have remained at 12-13 million pounds since. Coastwide landings of Atlantic croaker have remained steady at 25 to 28 million pounds from 1997 to 2001. Croaker remain a major component of the seine, trawl, gill net and pound net fisheries in Virginia, North Carolina and Maryland.

Atlantic croaker is the major component of the North Carolina "scrap fishery". A number of regulations instituted by North Carolina, such as banned flynet fishing south of Cape Hatteras, the introduction of BRDs in shrimp trawls, incidental finfish limits taken by shrimp and crab trawls in inside waters, and culling panels in long hauls may have indirectly reduced catches of juvenile croaker and changed the size and age distributions of the harvest. In Georgia, trawl-caught croaker is sold as unsorted mixed fish along with spot, whiting, and small flounder, therefore, commercial landings are a tenuous measurement there. Small croaker were previously a major part of the bycatch of the south Atlantic shrimp trawl fishery, however the use of TED's and BRD's has reduced this bycatch.

Recreational landings of croaker from Massachusetts through the Atlantic coast of Florida have varied

from 2.8 million to a high of 12.7 million fish during 1981-2001 (Table 2). Recreational landings remained steady at 9-10 million fish each year from 1997-2000. Landings increased to 12.7 million fish in 2001. The recent high level of overall recreational landings are reflected in major increases in the recreational fisheries in the mid-Atlantic region, particularly New Jersey, Delaware, Maryland and Virginia.

IV. Status of Assessment Advice

A quantitative stock assessment of Atlantic croaker has not been conducted by the stock assessment subcommittee. The current management plan (1987) identified the lack of data needed for a stock assessment as one of the major problems facing management of this species. An assessment has been conducted by personnel with North Carolina State University and was reviewed by the technical committee in November 2001. The ISFMP Policy Board has recommended that the croaker assessment be peer reviewed as soon as an assessment has been approved. The Croaker Stock Assessment Subcommittee should update this assessment as soon as possible with data from 1999-2001 prior to undergoing peer review.

The results from the most recent stock assessment suggest that biomass increased from 1991 through 1996, partly due to several strong year-classes (Lee et al. 2001). The downward trend in the population biomass in 1997-98 as estimated by the assessment, should be re-evaluated given the uncertainty inherent in the most recent years of any assessment. This estimated downturn is expected to disappear in an updated assessment with the addition of data from 1999-2001, given the steady landings, evidence of additional strong year-classes, and the expansion of the population age/size structure seen from the fisheries. A yield-per-recruit analysis suggested that increasing the age at entry into the fishery to age-3 would maximize yield-per-recruit. The current age at entry into the fisheries is estimated to be age-1. The model also estimated the most recent (1998) fishing mortality (F) over all ages to be 0.77, and the F for age-1 fish to be 1.22. Maximum yield-per-recruit was estimated to occur at $F = 0.85$ if natural mortality (M) is set at 0.20, while maximum yield-per-recruit at the default M of 0.35 would occur at $F = 0.55$. Future analyses should include developing alternative biological reference points for comparison and evaluation for Amendment 1.

Table 2. Atlantic croaker recreational landings (numbers of A + B1 fish) by state, 1981-2001 (source: pers. comm. NMFS Fish. Stats. & Econ. Div.).

| Year | MA | NJ | DE | MD | VA | NC | SC | GA | FLEC | Total |
|------|------|---------|--------|---------|---------|---------|--------|--------|---------|----------|
| 1981 | | 1054 | 3003 | 0 | 964013 | 1043240 | 165742 | 35591 | 598896 | 2811539 |
| 1982 | | | | 10452 | 273039 | 596493 | 193554 | 169749 | 1682619 | 2925906 |
| 1983 | | | | 108355 | 2154133 | 1620909 | 60811 | 75173 | 1148227 | 5167608 |
| 1984 | | | | 211035 | 2047720 | 2147871 | 588114 | 202364 | 2781742 | 7978846 |
| 1985 | | | | 21276 | 2284334 | 723933 | 260265 | 144341 | 1306955 | 4741104 |
| 1986 | | | 4694 | 123578 | 6384966 | 356742 | 599442 | 69887 | 5118552 | 12657861 |
| 1987 | | | | 208488 | 3234224 | 904030 | 166978 | 44783 | 2580727 | 7139230 |
| 1988 | | | 1186 | 1005452 | 4048690 | 2256128 | 144057 | 64093 | 685778 | 8205384 |
| 1989 | | | 478 | 22871 | 2203504 | 2131763 | 217023 | 72598 | 359417 | 5007654 |
| 1990 | | | 281 | 100673 | 2374679 | 1063452 | 346631 | 585380 | 304064 | 4775160 |
| 1991 | | 16235 | 37500 | 288471 | 4298542 | 434067 | 100816 | 184435 | 1030115 | 6390181 |
| 1992 | | | 9854 | 117427 | 4524040 | 723823 | 74051 | 440185 | 754595 | 6643975 |
| 1993 | | 2552 | 19352 | 805560 | 4990098 | 755998 | 32700 | 89734 | 304067 | 7000061 |
| 1994 | | 1567 | 5718 | 1633581 | 6494691 | 1179735 | 188520 | 102974 | 599032 | 10205818 |
| 1995 | | 15714 | 139324 | 800463 | 5129268 | 853425 | 75514 | 104418 | 418986 | 7537112 |
| 1996 | | 33917 | 268320 | 818597 | 5188429 | 629579 | 36517 | 58169 | 113576 | 7147104 |
| 1997 | | 342089 | 385586 | 1053232 | 8066926 | 661116 | 118428 | 64050 | 235430 | 10926857 |
| 1998 | 1477 | 143404 | 391231 | 1126058 | 6730181 | 387427 | 170528 | 64953 | 234360 | 9249619 |
| 1999 | | 357261 | 662724 | 1209572 | 5881671 | 442185 | 54761 | 104438 | 403982 | 9116594 |
| 2000 | | 1023442 | 517886 | 2674880 | 5486159 | 391056 | 32332 | 128922 | 455870 | 10710547 |
| 2001 | | 1177813 | 312005 | 1319928 | 9335313 | 635552 | 19802 | 21503 | 426264 | 12676180 |

Table 3. Atlantic croaker recreational landings (pounds of A + B1 fish) by state, 1981-2001 (source: pers. comm. NMFS Fish. Stats. & Econ. Div.).

| Year | MA | NJ | DE | MD | VA | NC | SC | GA | FLEC | Total |
|------|------|---------|--------|---------|---------|--------|--------|--------|---------|----------|
| 1981 | | 582 | 2317 | 0 | 535297 | 426240 | 67284 | 9665 | 305547 | 1346932 |
| 1982 | | | | 70276 | 455250 | 264607 | 67015 | 45161 | 754956 | 1657265 |
| 1983 | | | | 32053 | 486006 | 395402 | 14158 | 25412 | 510599 | 1463630 |
| 1984 | | | | 86462 | 634870 | 584660 | 161661 | 80684 | 1856599 | 3404936 |
| 1985 | | | | 17169 | 843414 | 278214 | 72780 | 40421 | 684449 | 1939447 |
| 1986 | | | 2595 | 116542 | 2034337 | 126888 | 173028 | 21504 | 2783651 | 5258545 |
| 1987 | | | | 191628 | 1306814 | 352346 | 64696 | 14947 | 1005053 | 2935484 |
| 1988 | | | 827 | 926399 | 2390573 | 935460 | 54313 | 20313 | 316900 | 4644785 |
| 1989 | | | 284 | 19189 | 1329680 | 658567 | 80580 | 21138 | 268335 | 2377773 |
| 1990 | | | 112 | 37873 | 875427 | 347183 | 123795 | 205352 | 127525 | 1717267 |
| 1991 | | 4264 | 10972 | 117210 | 1728021 | 157660 | 16173 | 54116 | 460453 | 2548869 |
| 1992 | | | 3291 | 53556 | 1768962 | 233533 | 28512 | 132596 | 407672 | 2628122 |
| 1993 | | 844 | 9641 | 476866 | 1993915 | 282910 | 18005 | 55604 | 180517 | 3018302 |
| 1994 | | 818 | 2892 | 991166 | 3024118 | 351230 | 128306 | 34048 | 337474 | 4870052 |
| 1995 | | 9874 | 84218 | 551432 | 2728523 | 325267 | 25463 | 21512 | 288514 | 4034803 |
| 1996 | | 37849 | 232446 | 737348 | 2807267 | 329544 | 14116 | 20675 | 48391 | 4227636 |
| 1997 | | 278758 | 340198 | 1117999 | 5522195 | 309457 | 53863 | 26272 | 113096 | 7761838 |
| 1998 | 1790 | 135733 | 293560 | 1150459 | 5920436 | 161117 | 76821 | 30966 | 141756 | 7912638 |
| 1999 | | 301957 | 522201 | 1024398 | 4969283 | 212991 | 26356 | 32375 | 231692 | 7321253 |
| 2000 | | 1125730 | 483963 | 2672996 | 4888910 | 201306 | 13457 | 62390 | 242912 | 9691664 |
| 2001 | | 1132214 | 304127 | 1278699 | 7674759 | 355009 | 10750 | 7844 | 320487 | 11083889 |

V. Status of Research and Monitoring

Catch and effort data are collected by state commercial and recreational statistics programs. More complete and timely data should be available as the Atlantic Coastal Cooperative Statistics Program is further developed and implemented. Fishery-independent data, from Cape Hatteras to Cape Canaveral, are collected in the SEAMAP program. Recruitment indices are available from ongoing juvenile surveys in Delaware, Maryland, Virginia, North Carolina, Florida and through the SEAMAP program. Researchers at VIMS have conducted studies on temperature tolerance, developed a juvenile recruitment model based on the effect of winter water temperature and offshore wind velocities, and developed population dynamics parameters to evaluate growth overfishing potential. The Virginia Marine Resources Commission and state of North Carolina have evaluated the use of culling panels in pound nets for the release of small spot and croaker. North Carolina also conducted a study to evaluate the use of culling panels in long hauls and swipe nets (Gearhart 2000). The study proved that shifts occurred in the length frequency distribution of many species including croaker, which resulted in rule changes to begin the use of culling panels in some areas of North Carolina since 1999. NCDMF is also in the process of requesting an Exempted Fishing Permit from the NMFS to characterize the flynet fishery south of Cape Hatteras utilizing TEDs in the gear. The current proposal is being reconsidered by NMFS and the NCDMF is hoping to begin this study this winter (2002-03) if a permit is granted.

The Potomac River Fisheries Commission has implemented the use of culling panels for pound nets on a

voluntary basis which allows escapement of smaller fish (100% <9"). Gear research for bycatch reduction in shrimp trawls may continue in the future under interstate and federal sponsorship. A number of studies from the University of Delaware were published which investigated the link between recruitment and low temperatures, genetic stock identification, and geographic variation in life history traits/population dynamics. A scale-otolith comparison study for aging croaker was recently completed by NCDMF. NCDMF also initiated a fishery-independent gill net study in Pamlico Sound in 2001 to examine species abundance and gather age/length data.

VI. Status of Management Measures and Issues

The FMP for Atlantic croaker identifies the following management measures (recommendation 1 as amended) 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.

Although the ISFMP Policy Board judged that the FMP management recommendations were too vague and did not furnish objective compliance criteria, progress has been made on developing bycatch reduction devices (BRD's). The October 1993 spot and croaker workshop proceedings summarized experimental bycatch reduction work and examined the population implications of bycatch reduction (ASMFC 1993). It was clear that there were economically viable shrimp gears that reduce finfish bycatch. North Carolina has implemented minimum mesh size restrictions in shrimp trawls (1 ½" tailbag) since 1991, flynets (4" main body, 3" extension, and 1 ¾" tail bag) in 1997, and the closure of ocean waters south of Cape Hatteras to the South Carolina state line for flynets in 1995, all of which may indirectly affect the fishing impact on croaker.

Currently no regulations directly govern fishing practices for Atlantic croaker in North Carolina. However, the regulation limiting the scrapfish catch to 5,000 pounds per vessel per day has an indirect effect since croaker comprise a large percentage by weight of the scrapfish landed by NC commercial fishing gears. BRDs were required in all North Carolina shrimp trawls in the fall of 1992 by proclamation. Flynet fishery restrictions such as a minimum mesh size (3" square or 3.5" diamond) in 1992 and the closure of ocean waters south of Cape Hatteras to flynets in 1994, also affected the fishing impact on croaker. The NCDMF is actively working with long haul and pound net fishermen to develop escape panels for these fisheries. A reduction in the average catch of the scrapfish species occurred in the 1996 haul seine fishery when several crews began to consistently use escape panels in their nets. Reducing the quantity of sub-adult croaker harvested should increase spawning stock biomass and yield per recruit. The Potomac River Fisheries Commission requires large mesh bycatch reduction panels in all pound nets. It is estimated that the panels allow the release of 100% of captured croaker below the minimum legal size of nine (9) inches.

The states of Florida through North Carolina have promoted and require the use of TED's (turtle excluder devices) and BRD's (bycatch reduction devices) in state waters. None of the states have minimum trawl mesh sizes or culling panels in directed gears however, Florida has a maximum shrimp trawl size. Evaluation of the beneficial effects of BRD's to the croaker population, which is a component of a mixed species fishery, may be available from work conducted on weakfish during preparation of Amendment 3 to that FMP and should be compiled. A target reduction in bycatch of croaker may be a suitable objective

criteria in an amended plan. Size limits that are in place in the states have been there for several years and do not represent a response to the FMP. In order to minimize recreational discard mortality, a new amendment may evaluate the concept of encouraging the use of hook types which minimize such mortality.

VII. Implementation of FMP Compliance Requirements as of October 1, 2002

There are no regulatory compliance requirements in the 1987 Atlantic Croaker FMP.

VIII. Recommendations of FMP Review Team

General

- Compile and analyze existing data for updating the stock assessment.

Table 4. Summary of current state and federal regulations for Atlantic croaker.

| State/Agency | Recreational | Commercial | Other |
|----------------------|-------------------|-------------------|---|
| New York | none | none | |
| New Jersey | none | none | trawling prohibited from 0-2 miles from shore |
| Delaware | 8" | none | |
| Maryland | 9"; 25 fish limit | 9" | trawling restricted in Ches. Bay; closed 1/1-3/15 |
| PRFC | 25 per person/day | | |
| Virginia | none | none | trawling prohibited in state waters |
| North Carolina | | | Flynets excluded south of C. Hatteras and mesh size restrictions; culling panels required in long haul seines/pound nets; TEDs required in flounder trawls in most state waters; TED/BRD requirements and min. mesh restrictions in shrimp trawls |
| South Carolina | none | none | gear-related restrictions; TED/BRD requirements; license to land/sell |
| Georgia | 8"; 25 fish limit | 8"; 25 fish limit | BRD requirement; no trawling in sounds |
| Florida | none | none | net ban in state waters |
| Federal (EEZ waters) | | | |

Management and Regulatory Recommendations

Management recommendations in the 1987 Croaker FMP should be adopted and implemented by appropriate regulations or legislation. They are as follows:

- Promote the development and use of trawl efficiency devices (TED's and BRD's) through demonstration in the southern shrimp fishery, and fish separators in the finfish trawl fishery; and
- Promote increases in yield per recruit through delaying entry to croaker fisheries to age one or older.

Amendments

- Develop an amended Atlantic Croaker FMP with objective compliance criteria.

Research and Monitoring Recommendations

High Priority

- Determine migratory patterns and mixing rates through cooperative, multi-jurisdictional tagging studies.
- Conduct an aging workshop to develop criteria for aging croaker otoliths, comparison study of scales vs. otoliths.
- Studies of croaker growth rates and age structure need to be conducted throughout the species range.
- Age-size data that are representative of all gear types in the fisheries should be developed on an annual basis.
- 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.
- 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).

Medium Priority

- Conduct stock identification research on croaker (partially met: Lankford et al. 1999).
- 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.
- Identify essential habitat requirements.

Low Priority

- 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.

Identified Management Issues

- Develop appropriate management goals, objectives and biological reference points.

Research needs identified as being met

- Cooperative coastwide croaker juvenile indices should be developed and validated to clarify stock status. (Lee et al. 2001)
- Cooperatively develop a yield per recruit analysis to establish a minimum size that maximizes YPR (Barbieri et al. 1997, Lee et al. 2001)

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**Table 5. Numbers of recreational releases (B2 fish) of Atlantic croaker by state, 1981-2001
(source: pers. comm. NMFS, Fish. Stats. and Econ. Div.).**

| Year | MA | RI | NY | NJ | DE | MD | VA | NC | SC | GA | FLEC | Total |
|------|-------|-----|------|--------|---------|---------|---------|---------|--------|--------|---------|----------|
| 1981 | | 246 | 4369 | 0 | 0 | 16233 | 324238 | 704259 | 128192 | 13481 | 85740 | 1276758 |
| 1982 | | | | | | 0 | 77756 | 641327 | 107340 | 111630 | 188277 | 1126330 |
| 1983 | | | | | | 1507184 | 1410151 | 424562 | 119036 | 70499 | 379021 | 3910453 |
| 1984 | | | | | | 70192 | 673080 | 1701418 | 746905 | 37573 | 236432 | 3465600 |
| 1985 | | | | | | 13132 | 1616052 | 1596901 | 238678 | 66649 | 1146582 | 4677994 |
| 1986 | | | | | 1757 | 43399 | 2578268 | 137841 | 84335 | 40623 | 318511 | 3204734 |
| 1987 | | | | 1374 | 861 | 32074 | 2056580 | 560853 | 108366 | 76908 | 1770697 | 4607713 |
| 1988 | | | | | 582 | 273231 | 832284 | 984219 | 112271 | 20021 | 200630 | 2423238 |
| 1989 | | | | | 1307 | 41822 | 1342169 | 891926 | 58642 | 17632 | 72822 | 2426320 |
| 1990 | | | | | 1268 | 88688 | 3922564 | 1351152 | 111085 | 317497 | 168144 | 5960398 |
| 1991 | | | | 91633 | 75319 | 3352190 | 7418045 | 669385 | 25168 | 140402 | 647824 | 12419966 |
| 1992 | | | | 4103 | 43583 | 856292 | 4167137 | 954494 | 26729 | 178267 | 251343 | 6481948 |
| 1993 | | | | 5799 | 13194 | 2504362 | 5795479 | 1499217 | 16949 | 83203 | 138875 | 10057078 |
| 1994 | | | | 17253 | 14069 | 1628824 | 7676780 | 3110528 | 141513 | 99026 | 331736 | 13019729 |
| 1995 | | | | 29976 | 41387 | 478421 | 5611653 | 1181356 | 106541 | 91474 | 138013 | 7678821 |
| 1996 | | | | 17023 | 82132 | 418084 | 5255144 | 1165365 | 62900 | 57005 | 122338 | 7179991 |
| 1997 | | | | 111468 | 384233 | 1497670 | 7275160 | 1443568 | 138107 | 25630 | 116276 | 10992112 |
| 1998 | 10422 | | | 221324 | 839932 | 3021780 | 4990541 | 1060928 | 266068 | 159928 | 152744 | 12713667 |
| 1999 | | | | 860325 | 1017499 | 2483800 | 5668925 | 1368478 | 116826 | 57567 | 967894 | 12541314 |
| 2000 | | | | 688746 | 694813 | 4967856 | 7811048 | 1569385 | 96402 | 169903 | 428131 | 16426284 |
| 2001 | | | | 853621 | 285123 | 1585806 | 7086706 | 1256807 | 115284 | 192362 | 282461 | 11658170 |