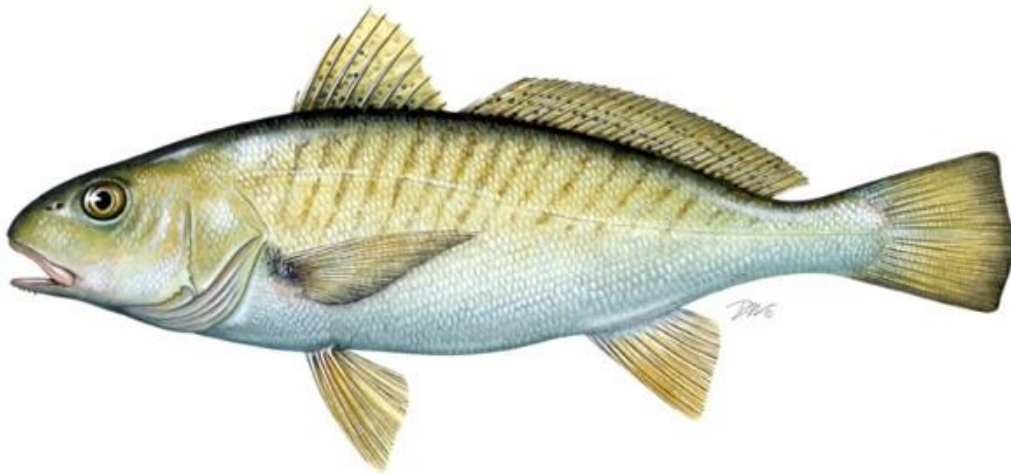


ATLANTIC STATES MARINE FISHERIES COMMISSION

REVIEW OF THE INTERSTATE FISHERY MANAGEMENT PLAN

FOR ATLANTIC CROAKER
(*Micropogonias undulatus*)

2011 FISHING YEAR



Prepared by the Plan Review Team

Approved by the South Atlantic State/Federal Fisheries Management
Board Approved August 2012

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I. Status of the Fishery Management Plan

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

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

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

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

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

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

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

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

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

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

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

II. Status of the Stock

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

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

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

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

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

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

III. Status of the Fishery

Total Atlantic croaker harvest from New Jersey through the east coast of Florida in 2011 is estimated at 14.8 million pounds (Tables 1 and 2, Figure 3). This represents a 64 percent decline in total harvest since the peak at 41.2 million pounds in 2001 (60% commercial decline, 75% recreational decline). The commercial and recreational fisheries harvested 81 and 19 percent of the total, respectively. The vast majority of landings are from the Mid-Atlantic region (98% in 2011), and the recent decline in total landings is a result of both commercial and recreational landings declines in that region, although some states showed increases in either or both sectors (Figure 4). Commercial and recreational landings in the South Atlantic region have been generally stable over the last decade; however, 2010 showed large decreases in the recreational

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

Atlantic coast commercial landings of Atlantic croaker exhibit a cyclical pattern, with low domains in the 1960s to early 1970s and the 1980s to early 1990s, and high domains in the mid-to-late 1970s and the mid-1990s to the present (Figure 3). This cyclical pattern was noted in the recent 2010 stock assessment, noting that the 50-year time series follows this pattern and that the current trend has been towards a low. Commercial landings increased from a low of 3.7 million pounds in 1991 to 30.1 million pounds in 2001 (Table 2); however, landings have declined consistently since 2003 to 11.9 million pounds in 2011, which registers below the 1960-2011 average of 13.6 million pounds. Within the management unit, the majority of 2011 commercial landings came from Virginia (46%) and North Carolina (43%). Maryland had the next highest level, with 6% of the coastwide landings.

From 1981-2011, recreational landings of Atlantic croaker from New Jersey through Florida have varied between 2.8 million fish (1.3 million pounds) and 13.2 million fish (11.1 million pounds; Tables 3 and 4, Figure 5). Landings general increased until 2001 before exhibiting a declining trend through 2011. The 2011 landings are estimated at 5.0 million fish and 2.7 million pounds, continuing the decline from 2010. Virginia was responsible for 68% of the 2011 recreational landings, in numbers of fish, followed by Maryland (9%), and Florida (7%). The number of recreational releases has increased over the time series, although continued a decreasing trend since 2007 (Figure 5). In 2011, anglers released 8.0 million fish, which is less than the ten-year (2001-2010) average of 11.9 million fish (Table 5). Anglers released an estimated 62% of the croaker catch in 2011 (Figure 5).

IV. Status of Assessment Advice

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

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

V. Status of Research and Monitoring

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

Fishery-Dependent Monitoring

- New Jersey: commercial fishery biological sampling since 2006 (274 length measurements and otolith ages in 2011)
- Maryland: commercial pound net fishery biological sampling (1,886 length measurements, 245 otoliths collected in 2011), at-sea sampling supplemented with dealer sampling beginning in 2009 (365 length and weight measurements in 2011); Maryland Charter Boat CPUE (1993-present; 2011 CPUE fell from 2010 but still above time-series mean)
- Virginia: commercial fishery biological sampling (5,822 length and weight measurements, 425 otolith ages, and 707 sex determinations in 2011)
- North Carolina: commercial fishery biological sampling since 1982 for length (2011 n = 7,098), weight (2011 n = 14,829), otolith, sex determination, and reproductive condition
- South Carolina: recreational fishery biological sampling via state finfish survey (108 length measurements in 2011)
- Georgia: recreational fishery biological sampling via carcass collections (11 fish in 2011)
- Florida: commercial fishery biological sampling (41 length measurements in 2011)

Fishery-Independent Monitoring

- New Jersey: nearshore ocean (within 12 nm) juvenile trawl surveys (1988-present; 2011 CPUE well above time-series average; nearshore Delaware Bay juvenile trawl survey (1991-present; 2011 CPUE low and below time-series average); Delaware River juvenile seine survey (1980-present; 2011 CPUE low and below time-series average)
- Delaware: offshore Delaware Bay adult finfish trawl survey (1966-present; 2011 n = 1,158; 49% increase in catch per nm towed over 2010 but still below time-series mean); nearshore Delaware Bay and River juvenile finfish trawl survey (1980-present; 2011 index (geometric mean) declined 74% from 2010 and fell below time-series mean)
- Maryland: Atlantic coast bays juvenile otter trawl survey (standardized from 1989-present); Chesapeake Bay juvenile trawl survey (standardized from 1989-present; 2011 CPUE increased from 2010 but still 10th lowest in time series); incidental catches in Maryland coastal bays juvenile seine survey (1972-present) and Chesapeake Bay juvenile seine survey (1959-present; 2011 indices increased or were stable relative to 2010)
- Virginia: VIMS Juvenile Finfish and Blue Crab Trawl Survey (1988-present; 2011 index value declined 68.5% from the 2010 value and 85% lower than the previous 3-year mean)
- North Carolina: Pamlico Sound juvenile trawl survey (1987-present; 2011 juvenile abundance index dropped by nearly 90% from 2010 and fell below time-series mean)
- South Carolina: estuarine electroshock survey for juveniles (1991-present; 2011 CPUE increased 36% but remained below time-series mean); SEAMAP shallow water (15-30 ft) trawl survey from Cape Hatteras to Cape Canaveral (1989-present; 2011 CPUE increased by 147% from 2010); inshore estuarine trammel net survey for adults (May-September, 1991-present; 2011 CPUE increased 72% from 2010, reversing decline seen from 2009 to 2010)

- Georgia: Marine Sportfish Population Health Survey (trammel and gill net, 2002-present; 2011 n = 125); Ecological Monitoring Survey (trawl, 2003-present; 2011 n = 15,733; CPUE declined by 44% from 2010)
- Florida: juvenile seine survey (1996-present; 2011 index continued variable trend with a decrease from 2010); juvenile trawl survey (2002-present; 2011 index continued variable trend with a decrease from 2010); adult haul seine survey (2001-present; 2011 index value continued overall increasing trend from 2001)

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

Ageing Workshop

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

VI. Status of Management Measures and Issues

Fishery Management Plan

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

De Minimis Requests

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

In the annual compliance reports, the following states requested *de minimis* status: Delaware (commercial fishery), South Carolina (commercial fishery), Georgia (commercial and recreational fisheries), and Florida (commercial fishery). The commercial and recreational *de*

minimis criteria for 2011 are based on 1% of the average coastwide 2009-2011 landings in each fishery: 142,395 pounds for the commercial fishery and 41,536 pounds for the recreational fishery. The Delaware commercial fishery qualifies for *de minimis* status with an average of 11,209 pounds. The South Carolina commercial fishery qualifies for *de minimis* status with an average of 41 pounds. The Georgia commercial and recreational fisheries qualify for *de minimis* status with averages of less than 1,000 pounds (confidential) and 19,911 pounds, respectively. The Florida commercial fishery qualifies for *de minimis* status with an average of 38,030 pounds.

Bycatch Reduction

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

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

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

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

Continuing to reduce the quantity of sub-adult croaker harvested should increase spawning stock biomass and yield per recruit.

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

Trigger Exercises

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

In 2011, the recreational landings dropped to 55.8% of the previous two-year average, triggering a stock assessment update or benchmark. The Atlantic Croaker Technical Committee reviewed the triggers, as well as discussed development of new triggers as tasked by the Board, at its June 2012 meeting in Charleston, South Carolina. While the commercial and recreational landings, along with the estimates of landings per unit effort, have shown decreases, the fishery-independent indices have not indicated major issues with the stock. Based on the available data and benefits and disadvantages of performing an update to the stock assessment, the Technical Committee recommended the Board not perform an assessment but rather allow the Technical Committee to further develop new assessment/management triggers. The 2012 Atlantic Croaker Trigger Report further details the Technical Committee's recommendations.

VII. Implementation of FMP Compliance Requirements for 2011

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

VIII. Recommendations

Management and Regulatory Recommendations

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

Research and Monitoring Recommendations

High Priority

- Develop and implement compatible and coordinated sampling programs for the South Atlantic shrimp trawl fishery in order to monitor and characterize Atlantic croaker bycatch in this fishery.

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

Medium Priority

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

IX. References

- Atlantic States Marine Fisheries Commission (ASMFC). 1987. Fishery Management Plan for Atlantic Croaker. Washington (DC): ASMFC. Fishery Management Report No. 10. 90 p.
- ASMFC. 2005a. Atlantic Croaker Stock Assessment & Peer Review Reports. Washington (DC): ASMFC. 370 p.
- ASMFC. 2005b. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Croaker. Washington (DC): ASMFC. Fishery Management Report No. 44. 92 p.
- ASMFC. 2010. Atlantic Croaker 2010 Benchmark Stock Assessment. Washington (DC): ASMFC. 366 p.

X. Figures

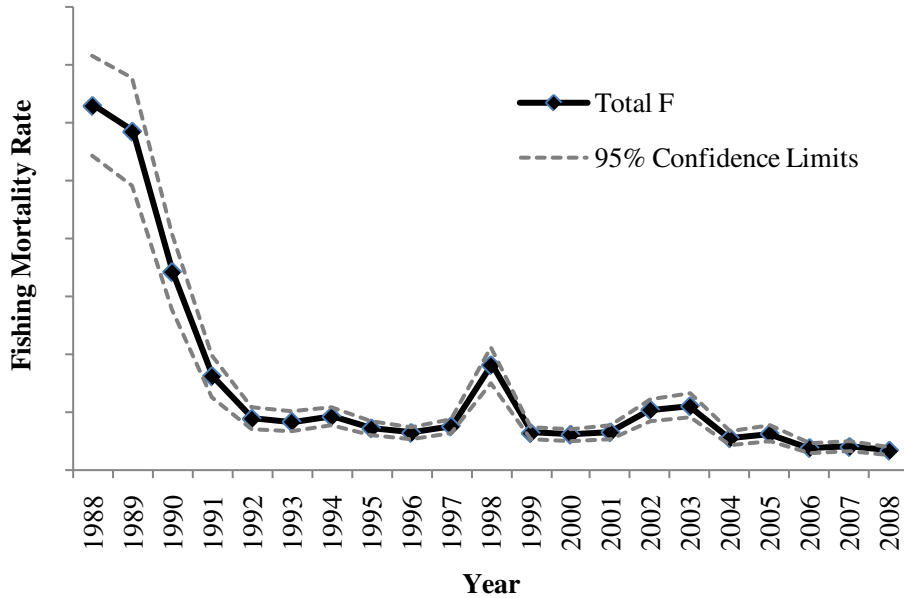


Figure 1. Trend in estimated total fishing mortality rate (F) of Atlantic croaker (Absolute estimates of F are unreliable because of uncertainty regarding the estimation of Atlantic croaker discards in the shrimp trawl fishery, and the application of estimates in modeling. Source: ASMFC 2010.)

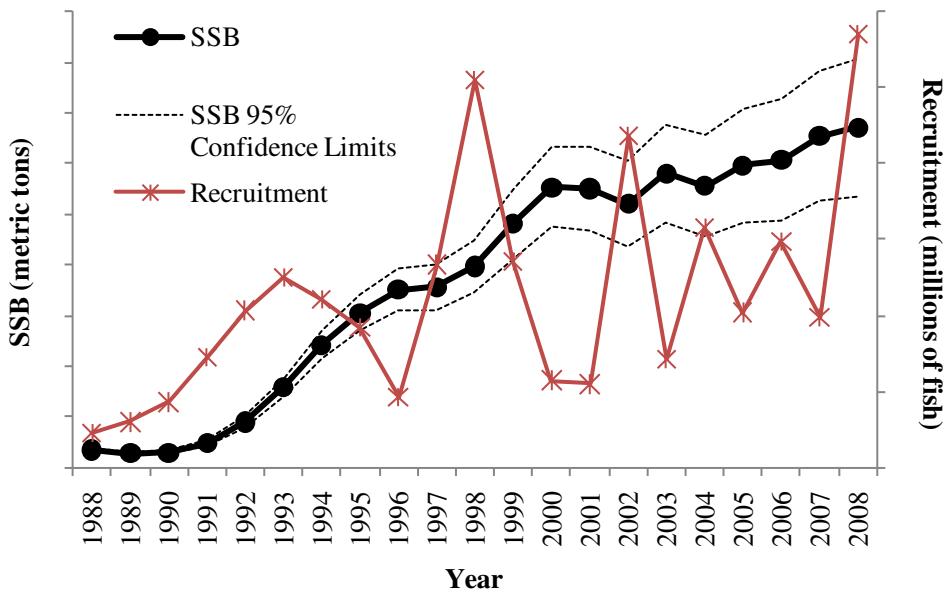


Figure 2. Trends in estimated spawning stock biomass (SSB, metric tons) and age-1 recruitment (numbers of fish) of Atlantic croaker (Absolute estimates of stock size are unreliable because of uncertainty regarding the estimation of Atlantic croaker discards in the shrimp trawl fishery, and the application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

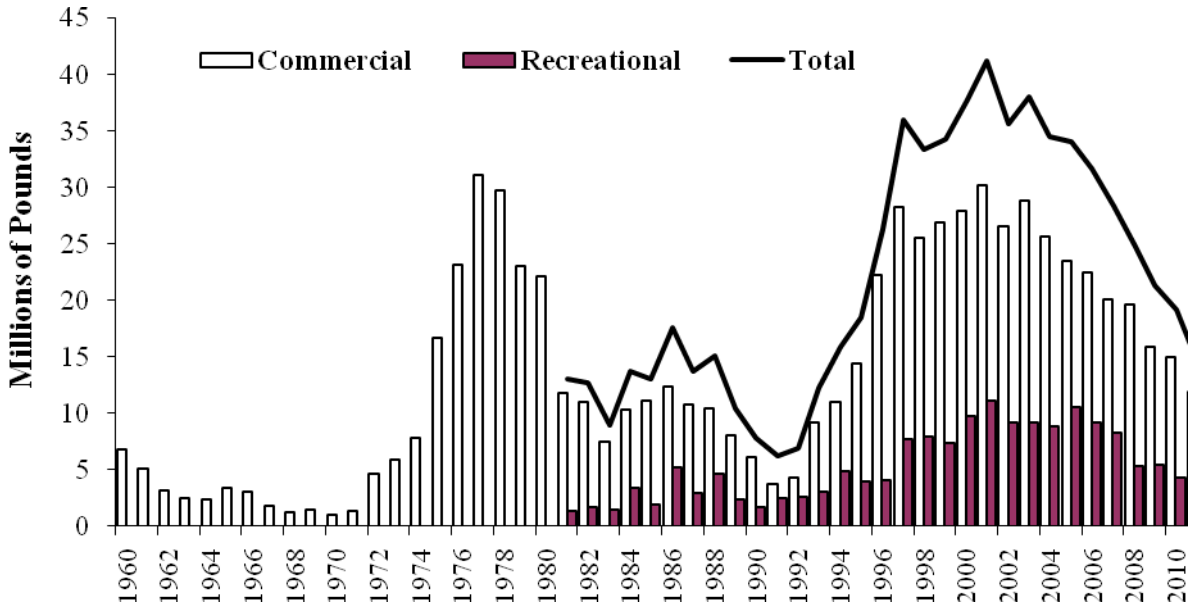


Figure 3. Atlantic croaker commercial, recreational, and total landings (pounds)
 (See Tables 2 and 3 for values and source information. Commercial landings estimate for 2011 is preliminary. Reliable recreational landings estimates are not available before 1981.)

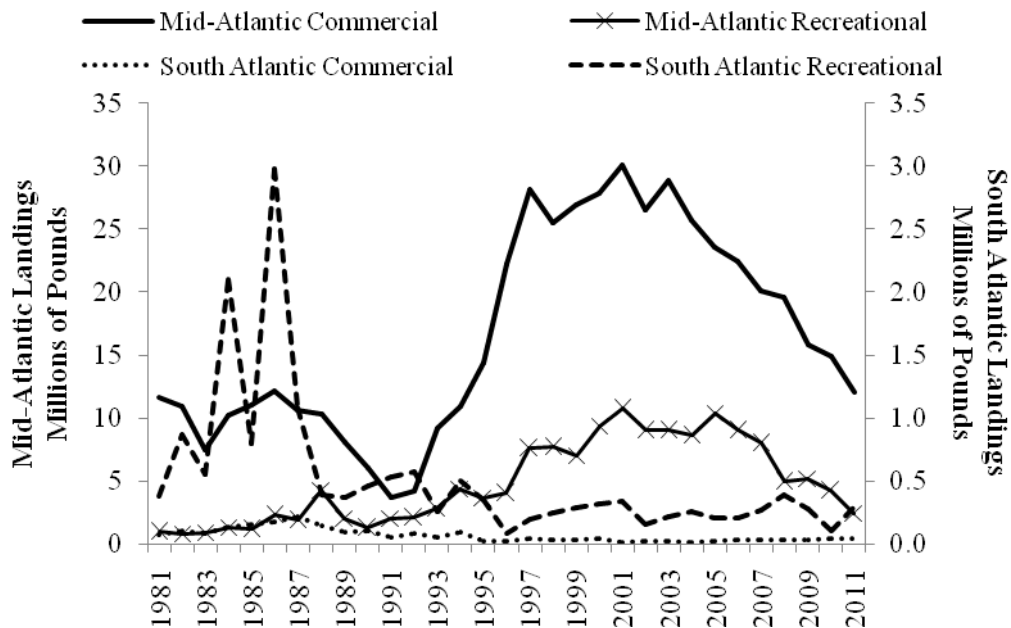


Figure 4. Mid-Atlantic (NJ-NC) and South Atlantic (SC-FL) landings (pounds)
 (See Tables 2 and 3 for values and source information.)

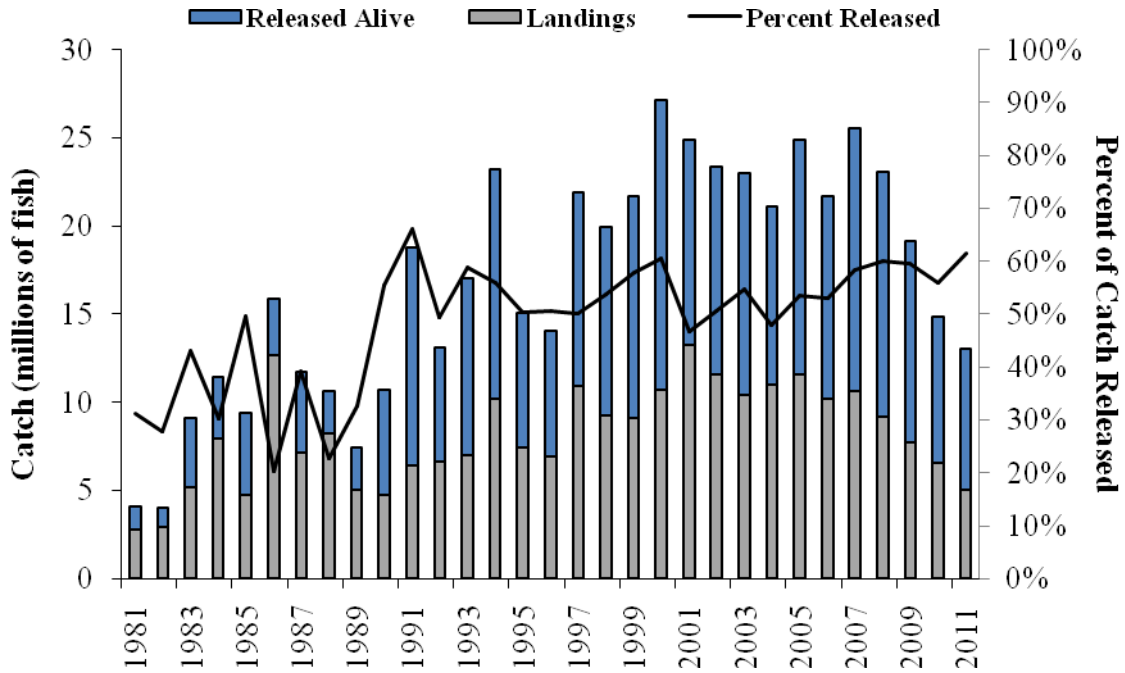


Figure 5. Recreational catch (landings and alive releases, in numbers) and the percent of catch that is released, 1981-2011
 (See Tables 4 and 5 for values and source information.)

XI. Tables

Table 1. Summary of state regulations for Atlantic croaker in 2011*

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

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

Table 2. Commercial harvest (pounds) of Atlantic croaker by state, 1981-2011

(Estimates for 2010 are preliminary. Sources: state compliance reports; personal communication with ACCSP, Arlington, VA.)

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

* confidential data

Table 3. Recreational harvest (pounds) of Atlantic croaker by state, 1981-2011

(Source: personal communication with NMFS Fisheries Statistics Division, Silver Spring, MD.)

Year	NJ	DE	MD	VA	NC	SC	GA	FL	Total
1981	582	2,317		535,297	426,240	67,284	9,665	305,547	1,346,932
1982			70,276	455,250	264,607	67,015	45,161	754,956	1,657,265
1983			32,053	486,006	395,402	14,158	25,412	510,599	1,463,630
1984			86,462	634,870	584,660	161,661	80,684	1,856,599	3,404,936
1985			17,169	843,414	278,214	72,780	40,421	684,449	1,936,447
1986		2,595	116,542	2,034,337	126,888	173,028	21,504	2,783,651	5,258,545
1987			191,628	1,306,814	352,346	64,696	14,947	1,005,053	2,935,484
1988		827	926,399	2,390,573	935,460	54,313	20,313	316,900	4,644,785
1989		284	19,189	1,329,680	658,567	80,580	21,138	268,335	2,377,773
1990		112	37,873	875,427	347,183	123,795	205,352	127,525	1,717,267
1991	4,264	10,972	117,210	1,728,021	157,660	16,173	54,116	460,453	2,548,869
1992		3,291	53,556	1,768,962	233,533	28,512	132,596	407,672	2,628,122
1993	844	9,641	476,866	1,993,915	282,910	18,005	55,604	180,517	3,018,302
1994	818	2,892	991,166	3,024,118	351,230	128,306	34,048	337,474	4,870,052
1995	9,515	82,864	567,149	2,675,381	326,135	25,386	20,862	301,918	4,009,210
1996	39,099	205,526	702,037	2,716,759	346,501	14,480	21,797	50,038	4,096,237
1997	278,758	340,198	1,117,999	5,522,195	309,457	53,863	26,272	113,096	7,761,838
1998	135,733	293,560	1,150,459	5,920,436	161,117	76,821	30,966	141,756	7,910,848
1999	301,957	522,201	1,024,398	4,969,283	212,991	26,356	32,375	231,692	7,321,253
2000	1,125,730	483,963	2,672,996	4,888,910	201,306	13,457	62,390	242,912	9,691,664
2001	1,132,214	304,127	1,278,699	7,674,759	355,009	10,750	7,844	320,487	11,083,889
2002	268,423	250,899	1,162,278	7,075,130	242,184	29,343	10,622	117,880	9,156,759
2003	682,698	262,114	2,069,176	5,674,111	317,606	59,399	71,881	79,396	9,216,381
2004	1,151,926	342,335	1,016,801	5,792,487	267,455	53,563	17,785	179,018	8,821,370
2005	1,189,849	846,084	942,702	7,240,971	143,963	42,088	13,913	147,117	10,566,687
2006	765,867	757,082	884,082	6,460,336	151,403	19,010	11,371	176,886	9,226,037
2007	409,392	334,850	1,056,471	6,111,612	87,013	39,368	13,624	207,821	8,260,151
2008	422,833	266,787	458,671	3,612,065	154,937	35,322	15,703	340,304	5,306,622
2009	79,405	206,238	1,048,153	3,708,788	123,901	39,112	27,831	209,821	5,443,249
2010	53,124	66,910	696,945	3,185,486	222,477	14,462	15,474	67,578	4,322,456
2011	29,234	84,145	356,339	1,837,183	119,935	128,963	16,428	146,101	2,718,328

Table 4. Recreational harvest (numbers) of Atlantic croaker by state, 1981-2011

(Source: personal communication with NMFS Fisheries Statistics Division, Silver Spring, MD.)

Year	NJ	DE	MD	VA	NC	SC	GA	FL	Total
1981	1,054	3,003	0	964,013	1,043,240	165,742	35,591	598,896	2,811,539
1982			10,452	273,039	596,493	193,554	169,749	1,682,619	2,925,906
1983			108,355	2,154,133	1,620,909	60,811	75,173	1,148,227	5,167,608
1984			211,035	2,047,720	2,147,871	588,114	202,364	2,781,742	7,978,846
1985			21,276	2,284,334	723,933	260,265	144,341	1,306,955	4,741,104
1986		4,694	123,578	6,384,966	356,742	599,442	69,887	5,118,552	12,657,861
1987	0	0	208,488	3,234,224	904,030	166,978	44,783	2,580,727	7,139,230
1988		1,186	1,005,452	4,048,690	2,256,128	144,057	64,093	685,778	8,205,384
1989		478	22,871	2,203,504	2,131,763	217,023	72,598	359,417	5,007,654
1990		281	100,673	2,374,679	1,063,452	346,631	585,380	304,064	4,775,160
1991	16,235	37,500	288,471	4,298,542	434,067	100,816	184,435	1,030,115	6,390,181
1992	0	9,854	117,427	4,524,040	723,823	74,051	440,185	754,595	6,643,975
1993	2,552	19,352	805,560	4,990,098	755,998	32,700	89,734	304,067	7,000,061
1994	1,567	5,718	1,633,581	6,494,691	1,179,735	188,520	102,974	599,032	10,205,818
1995	15,184	136,865	827,183	5,029,708	850,606	75,422	100,826	438,076	7,473,870
1996	35,037	235,389	775,115	4,997,021	662,240	37,464	61,957	116,575	6,920,798
1997	342,089	385,586	1,053,232	8,066,926	661,116	118,428	64,050	235,430	10,926,857
1998	143,404	391,231	1,126,058	6,730,181	387,427	170,528	64,953	234,360	9,248,142
1999	357,261	662,724	1,209,572	5,881,671	442,185	54,761	104,438	403,982	9,116,594
2000	1,023,442	517,886	2,674,880	5,486,159	391,056	32,332	128,922	455,870	10,710,547
2001	1,177,813	312,005	1,319,928	9,335,313	635,552	19,802	21,503	426,264	13,248,180
2002	253,472	261,634	1,223,385	9,129,060	408,944	66,409	36,497	177,751	11,557,152
2003	692,391	341,174	1,619,766	6,695,192	490,399	198,339	248,853	165,459	10,451,573
2004	1,172,210	494,104	870,844	7,292,880	474,180	135,842	44,825	497,921	10,982,806
2005	1,254,957	934,207	809,894	7,791,125	292,629	128,956	40,094	343,647	11,595,509
2006	698,428	863,288	833,190	7,069,449	434,735	38,682	40,378	247,383	10,225,533
2007	355,067	400,518	1,092,784	7,753,422	397,702	131,686	46,966	469,232	10,647,377
2008	475,373	349,229	689,154	6,524,884	372,778	100,460	45,598	636,050	9,193,526
2009	158,108	427,117	1,038,428	5,128,446	350,398	117,936	76,822	414,041	7,711,296
2010	91,155	118,248	848,050	4,815,408	443,870	35,381	58,391	168,248	6,578,751
2011	49,563	144,717	448,850	3,418,225	289,677	263,065	48,864	348,014	5,010,975

Table 5. Recreational releases (number) of Atlantic croaker by state, 1981-2011

(Source: personal communication with NMFS Fisheries Statistics Division, Silver Spring, MD.)

Year	NJ	DE	MD	VA	NC	SC	GA	FL	Total
1981			16,233	324,238	704,259	128,192	13,481	85,740	1,272,143
1982				77,756	641,327	107,340	111,630	188,277	1,126,330
1983			1,507,184	1,410,151	424,562	119,036	70,499	379,021	3,910,453
1984			70,192	673,080	1,701,418	746,905	37,573	236,432	3,465,600
1985			13,132	1,616,052	1,596,901	238,678	66,649	1,146,582	4,677,994
1986		1,757	43,399	2,578,268	137,841	84,335	40,623	318,511	3,204,734
1987	1,374	861	32,074	2,056,580	560,853	108,366	76,908	1,770,697	4,607,713
1988		582	273,231	832,284	984,219	112,271	20,021	200,630	2,423,238
1989		1,307	41,822	1,342,169	891,926	58,642	17,632	72,822	2,426,320
1990		1,268	88,688	3,922,564	1,351,152	111,085	317,497	168,144	5,960,398
1991	91,633	75,319	3,352,190	7,418,045	669,385	25,168	140,402	647,824	12,419,966
1992	4,103	43,583	856,292	4,167,137	954,494	26,729	178,267	251,343	6,481,948
1993	5,799	13,194	2,504,362	5,795,479	1,499,217	16,949	83,203	138,875	10,057,078
1994	17,253	14,069	1,628,824	7,676,780	3,110,528	141,513	99,026	331,736	13,019,729
1995	31,019	41,574	496,046	5,494,289	1,172,716	108,345	89,609	141,732	7,575,330
1996	17,585	76,851	403,776	5,151,206	1,218,799	64,494	60,282	126,300	7,119,293
1997	111,468	384,233	1,497,670	7,275,160	1,443,568	138,107	25,630	116,276	10,992,112
1998	221,324	839,932	3,021,780	4,990,541	1,060,928	266,068	159,928	152,744	10,713,245
1999	860,325	1,017,499	2,483,800	5,668,925	1,368,478	116,826	57,567	967,894	12,541,314
2000	688,746	694,813	4,967,856	7,811,048	1,569,385	96,402	169,903	428,131	16,426,284
2001	853,621	285,123	1,585,806	7,086,706	1,256,807	115,284	192,362	282,461	11,658,170
2002	369,003	361,355	2,523,276	7,107,656	925,806	92,498	194,474	217,054	11,791,122
2003	833,508	654,697	1,393,224	6,543,524	1,552,315	440,446	965,496	192,356	12,575,566
2004	834,774	483,358	819,473	5,790,892	1,346,147	446,843	164,791	239,198	10,125,476
2005	1,280,075	761,136	950,695	8,144,430	1,289,279	327,215	265,542	271,001	13,289,373
2006	634,663	1,033,973	1,791,610	4,598,534	2,288,461	643,834	310,877	196,377	11,498,329
2007	572,164	617,811	1,630,587	9,510,502	1,538,050	336,816	221,902	443,928	14,871,760
2008	1,809,786	609,057	2,068,910	7,034,592	1,386,713	191,941	336,635	457,469	13,895,103
2009	146,160	516,499	779,805	6,859,844	1,685,893	484,116	473,973	469,230	11,415,520
2010	190,087	181,713	924,851	4,552,860	1,762,893	149,370	258,020	299,348	8,319,142
2011	114,468	145,283	268,359	4,791,121	1,747,038	269,517	287,614	398,352	8,021,752