

Status of the Greater Amberjack, *Seriola Dumerili*, in the Southeastern United States Through 1995

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ABSTRACT

The condition of the U.S. Atlantic Ocean and Gulf of Mexico greater amberjack, *Seriola dumerili*, stocks are presented. Commercial landings of the Atlantic group ranged from 6,344 to 2,332,479 pounds from 1962 through 1995 and stabilized at 1.9 million pounds per year during the early 1990s. Gulf group commercial landings ranged from 5,616 to 2,337,329 pounds with greater variability than the Atlantic group over recent years. Recreational harvests showed more annual variability than commercial landings with significant declines in recreational catches for both stocks. Recreational catch declines may be partly related to federal and state bag limit regulations enacted in the early 1990s. Increases in average length observed in recent years in both stocks may be due to size limits adopted for commercial and recreational fisheries during the early 1990's. Recreational catch per unit of effort (CPUE) abundance varied without trend since 1981 while commercial abundance remained stable since 1993 for the Atlantic group. Recreational abundance of the Gulf group declined in the late 1980s concomitant with declining recreational catches however, recreational abundance remained stable since 1990 while catches continued to decline. Declining trends in commercial landings, recreational catches, and recreational CPUE began in the late 1980s for both groups and have continued through recent years for the Gulf group. Recreational CPUE remained stable in recent years. Larger changes in recreational catches and recreational abundance have occurred in the Gulf group than in the Atlantic group. Additional reductions in total annual harvest are expected with proposed changes in recreational bag limits and variable seasonal closures in the commercial fisheries. The relatively short time-series of information on changes in size, abundance, and total catch currently existing for the Atlantic Ocean and Gulf of Mexico greater amberjack stocks is a limiting factor to determine the true condition of the stocks.

KEY WORDS: Greater amberjack, *Seriola dumerili*, stock assessment, size/abundance trends

INTRODUCTION

A perceived decline in abundance of the greater amberjack, *Seriola dumerili*, in the recreational fisheries off the Carolinas and northwest Florida prompted an evaluation of the stock condition. This apparent decline had not been observed in the commercial fisheries. The Florida Marine Fisheries Commission initiated a series of workshops and public hearings in 1996 to address the extent of the decline (Williams, 1996). In addition, the Gulf of Mexico and the South Atlantic Fishery Management Councils requested current information on greater amberjack stock condition. Changes in fishery regulations, intended to provide additional protection for greater amberjack, were proposed on all four amberjack species in the southeastern United States by the councils (FMP Amendment 12, proposed rule).

Greater amberjack is a carangid, widely distributed in the western central Atlantic Ocean, including Bermuda, the Caribbean Basin, and off Central and South America. This coastal pelagic species occurs over most of the inner continental and insular shelves from the surface to depths exceeding 350 meters. Tagging experiments suggest two major stocks in U. S. waters exist, the Gulf and the Atlantic groups. While the species may make long range migrations most individuals make limited movements with movement between the two stocks only occurring about 1.5% of the time (McClellan and Cummings, in press).

Berry and Burch (1979) documented the commercial and recreational amberjack fisheries of the western central north Atlantic Ocean. Until the mid-1970s all amberjack species were avoided as a food fish because of ciguatera poisoning concerns and larval tapeworm infestations. Information regarding capture location of greater amberjacks infected with ciguatera suggests none were from the United States. Innovative cleaning practices, educated sportsmen and parasitological data has shown mature parasites are found only in large elasmobranchs and are not infectious to man or other mammals (Berry and Burch, 1979).

This paper presents information on the greater amberjack stock status. Information is presented for 1) commercial vessel landings; 2) recreational harvest by charter, private, shore, and headboat anglers; 3) observed mean individual length and weight; 4) estimated total numbers caught, 5) CPUE abundance from recreational charterboat, private vessel, and headboat fishing trips, and from the commercial reef fish fishery and; 6) impacts of changes in recreational bag limit and commercial season closures. The data used in this study are extracted from a compilation of fishery statistics and results from the stock assessment analyses of McClellan and Cummings (1996) and Cummings and McClellan (1996) for the Gulf of Mexico and Atlantic Ocean greater

amberjack stocks, respectively.

MATERIALS AND METHODS

Catch statistics were obtained from the National Marine Fisheries Service (NMFS), Southeast Fisheries Science Center (SEFSC), Research Management Division (RMD). Protocol as defined in McClellan and Cummings (1996) and Cummings and McClellan (1996) for defining stock groups were used. The geographic boundary of these management units is defined as the intersection of the outer boundary of the U.S. EEZ and 83° 00'W longitude, proceeds north to 24° 35'N latitude (Dry Tortugas), east to Marquesas Key, then through the Florida Keys to the mainland. In this paper, the western central North Atlantic Ocean greater amberjack stock is called the Atlantic group and the Gulf of Mexico stock is called the Gulf group. Commercial landings (pounds) were obtained from NMFS, RMD statistics division. Florida landings were not stratified by month and statistical shrimp grid before 1977 or by gear after 1993. Commercial landings coded as caught in NMFS, statistical shrimp grids' 001.0 and 001.2 were included in the Atlantic stock 1962 - 1993. Landings coded as caught in NMFS, statistical shrimp grids' 002.0 - 021.0 and 001.1 were included in the Gulf stock 1962-1993. Florida commercial landings for 1994 and 1995 from Monroe county were included in the Atlantic stock. Recreational harvest by charterboat, private vessel, and shore mode, was obtained from the NMFS Marine Recreational Fisheries Statistics Survey (MRFSS). Headboat catches were obtained from the NMFS, Beaufort laboratory and recreational catches in Texas were obtained from the Texas Parks and Wildlife Department (TPWD).

Samples of individual sizes and weights from the recreational and commercial fisheries were recorded by port samplers for some fishing trips. Size and weight data were used to compute sample average weight and length, and the variance of each. Commercial landings were converted from gutted to whole weight using the NMFS conversion factor of 1.04 (G. Davenport personal communication). Total pounds landed was divided by the sample average weight of the catch sample to yield an estimate of total catch in numbers. Estimated total numbers of fish caught in the catch was apportioned over length according to the proportional distribution of fish at length in the sample. Length samples were assigned to catches according to year and fishery (commercial, recreational, headboat). Lack of sufficient temporal, geographical, and fishery resolution prevented using finer resolution in assigning samples to catches. Weight-length equation parameters were taken from Burch (1979) for the Atlantic group [Weight (lbs.) = $6.40 \times 10^{-5} \times \text{fork length (mm)}^{2.842}$] and Manooch and Potts (in press) for the Gulf group [Weight (kg) = $5.3 \times 10^{-8} \times \text{fork length (mm)}^{2.810}$].

Observations of CPUE abundance data measured as catch per angler (CPA), catch per hour fished (CPH), and pounds per trip were available from MRFS

recreational intercepts; NMFS, Beaufort Laboratory Headboat trips; TPWD recreational intercepts; and NMFS commercial reef fish logbooks database. Differing survey methodologies were employed by the MRFSS and TPWD thus, CPUE data from the two surveys were summarized separately. Catch was computed from MRFSS angler intercepts as Type A catch (fish caught, retained, and observed by the interviewer) plus Type B1 catch (fish caught and returned dead to the water) plus Type B2 catch (fish returned alive to the water). Catch was computed from headboat and TPWD recreational trip data as the number of fish caught and reported on the catch trip form (headboat) or actually observed by the interviewer (TPWD). Recreational un-adjusted CPUE was calculated as total trip catch divided by effort where effort was either the number of anglers (CPA) or the number of hours fished (CPH).

Adjusted CPUE trends were detected using general linear model (GLM) regression theory (Robson 1966). The traditional log transformed multiplicative CPUE model ($CPUE = X^b$) was used in all GLM analyses. The GLM procedure regresses CPUE, the dependent variable, on one or more independent variables thought to affect CPUE. Individual CPUE data points were included into the model as the sum of the catch divided by the sum of the effort for each stratum in the data and the stratum mean CPUE weighted by the sample size in each stratum. Strata included year, month, fishery (private, charter), and area (county, state). Ninety-five percent confidence intervals on expected CPUE were calculated for each year effect to provide information on precision. GLM is a useful analytical procedure for describing trends in fishing success (CPUE) because it provides a way of reducing the total variation in CPUE due to various independent factors thought to affect catch rates. Factors commonly considered in explaining CPUE include the season, location of fishing grounds, vessel size, crew size, and bait type. Commercial CPUE data, available from reef fish logbooks were summarized by year, gear type, port of landing, and the average pounds caught per trip calculated for each partition. Standardized commercial CPUE trends were evaluated using the GLM approach as described for the recreational data. Factors included in the GLM analyses of the commercial data included year, month, gear, and the area of catch (NMFS, statistical grid).

Current management strategy for greater amberjack stocks includes a recreational three-fish per person bag limit, restriction of commercial sales during April and May to the bag limit, and size limits of 28 and 36 inches fork length (28 inches core length) for the recreational and commercial fisheries. Additional management options have been proposed because of the perceived decline in recreational abundance. Expected total reductions in recreational catch from more restrictive bag limits were calculated using charter/private and headboat data from 1995, the most recent complete year of data. Potential impacts to the commercial landings from seasonal closures were addressed using

data from the most recent period in which stable landings occurred, 1993 through 1995 for the Atlantic stock, and 1992 through 1995 for the Gulf stock. Seasonal closures of two, three, and four month periods from February through May, the primary months of spawning were considered.

RESULTS

Commercial Landings

Greater amberjack commercial landings in the Atlantic group ranged from 6,344 to 2,332,479 pounds (lbs.) over the 34-year period (Figure 1a). Major increases in landings occurred between 1985 and 1991. Ninety percent of the Atlantic group annual landings were made in Florida. Most of the catch was taken on the east coast of Florida between Cape Canaveral and Miami. Significant catches were also made off Islamorada, Florida in an area known as the "Humps". Catches were made between March and June (Table 1), the main months of spawning (Berry and Burch 1979). Hook and line gear accounted for about 90% of total landings, with about 5% of landings being made by spearguns after 1986 (Table 2). Total annual landings of the Atlantic group declined about 18% from 1991 to 1993 but appear to have stabilized at 1.9 million lbs. since 1993.

Commercial landings of the Gulf group of greater amberjack ranged from 5,616 to 2,337,329 lbs. (Figure 1b) with large increases occurring between 1983 and 1988. Catches of the Gulf group were landed mainly on the west coast of Florida with substantial volume landed in Louisiana. Catches were made mainly off areas east of the Mississippi River by hook and line gear between April and September (Tables 3 and 4). Beginning about 1981, significant landings from bottom longlines appear in the records, contributing annually about 15% of the total Gulf group landings by the late 1980s. Total annual landings of the Gulf group declined by 51% to 1,087,628 lbs. in 1990 and again in 1991 to 828,880 lbs. Declines in landings were largest in Florida. Between 1991 and 1994 landings of the Gulf group showed significant increases, but declined 36% between 1994 and 1995. Landings have declined for the Gulf more dramatically than in the Atlantic.

Table 1. Proportion of total pounds (whole weight) landed by year and month of the Atlantic Ocean greater amberjack stock in the southeastern United States, 1977 - 1995. Florida (west coast) landings from Monroe county for 1994 - 1995 were included in the Atlantic Ocean stock.

Year	Month												
	Unknown	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977		2.0%	5.1%	6.9%	11.2%	16.3%	8.0%	13.4%	6.4%	9.5%	4.5%	11.5%	5.2%
1978		1.3%	2.2%	8.8%	11.9%	9.9%	10.4%	7.9%	11.4%	11.4%	6.8%	11.0%	7.0%
1979		1.9%	1.2%	7.1%	7.0%	17.9%	17.3%	7.0%	8.1%	7.3%	11.7%	5.3%	8.2%
1980		3.6%	4.8%	3.7%	6.9%	11.4%	9.3%	10.1%	11.0%	13.4%	9.3%	5.0%	11.4%
1981		6.7%	6.7%	6.8%	7.8%	12.4%	7.4%	8.2%	9.4%	12.8%	7.5%	8.3%	6.3%
1982		2.6%	6.9%	11.7%	12.5%	14.6%	11.9%	8.8%	9.1%	6.5%	5.4%	3.2%	6.7%
1983		8.2%	3.6%	3.4%	7.5%	9.6%	20.7%	12.6%	8.9%	5.1%	8.0%	6.7%	5.8%
1984		5.7%	6.2%	7.0%	5.1%	9.7%	11.6%	13.7%	11.3%	7.0%	7.7%	6.6%	12.5%
1985		5.0%	3.8%	6.7%	5.8%	12.9%	10.5%	9.7%	10.5%	6.7%	7.2%	7.5%	9.9%
1986		5.1%	6.2%	3.6%	7.3%	9.3%	9.4%	10.7%	14.3%	10.0%	7.3%	8.5%	8.2%
1987		4.3%	7.3%	7.4%	9.3%	11.6%	7.5%	8.3%	9.4%	11.1%	8.8%	7.3%	7.8%
1988		5.5%	8.5%	8.9%	10.3%	10.4%	11.4%	9.5%	9.8%	5.6%	7.6%	5.2%	7.4%
1989		13.4%	8.7%	8.4%	9.1%	12.3%	9.5%	7.7%	7.6%	7.0%	6.2%	5.7%	4.6%
1990		18.2%	9.7%	6.4%	8.5%	7.2%	6.0%	7.4%	9.1%	8.1%	7.7%	5.8%	5.8%
1991		8.0%	6.7%	5.3%	6.4%	7.6%	7.4%	10.0%	13.7%	10.8%	8.4%	8.1%	7.7%
1992		3.8%	4.7%	3.5%	5.0%	7.7%	9.0%	9.8%	12.8%	15.6%	9.7%	7.6%	10.8%
1993		9.8%	7.8%	6.7%	6.7%	10.3%	7.8%	11.3%	10.0%	13.4%	6.6%	5.3%	5.9%
1994		5.0%	6.3%	6.1%	6.4%	12.8%	9.5%	10.8%	15.7%	8.4%	6.6%	5.5%	7.1%
1995		11.8%	9.2%	9.5%	6.4%	9.8%	11.3%	7.9%	6.9%	11.3%	3.5%	5.5%	6.8%
All years	2.9%	7.5%	6.9%	6.7%	7.5%	10.3%	9.3%	9.3%	10.1%	9.1%	7.1%	6.2%	7.2%

Table 2. Total pounds landed (whole weight) commercially by gear type for the Atlantic Ocean greater amberjack stock in the southeastern United States, 1977-1995. Florida landings were not available by gear after 1993. All landings reported from NMFS, statistical shrimp grids' 001.0 and 001.2 were included in the Atlantic Ocean stock 1977-1993. Florida (west coast) landings from Monroe county for 1994-1995 were included in the Atlantic Ocean stock.

Gear	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Hook & Lines	70075	44640	62391	48825	61818	158870	116743	205081	172314	481127
Surface Longlines	0	0	0	0	0	0	0	0	0	0
Bottom Longlines	0	0	0	0	0	484	765	1173	2016	29110
Dive Gear	0	0	0	0	0	0	0	0	0	13067
Gillnets	0	0	0	0	0	495	20	0	53	386
Trawls	162	0	1591	27807	44631	35851	14794	4587	5666	8619
Seines	0	0	0	0	0	0	0	1800	0	0
Unclassified	0	0	0	0	0	0	629	0	0	2723
All Gears	70237	44640	63982	76632	106449	195680	132952	212641	180050	515032

Gear	1987	1988	1989	1990	1991	1992	1993	1994	1995	Total
Hook & Lines	1344337	1235388	1203391	1848049	2213449	2067069	1767218	324114	331235	13275007
Surface Longlines	0	0	137	0	71	606	42	17	259	1132
Bottom Longlines	6364	4858	6618	21155	20575	26371	22692	7698	23336	144085
Dive Gear	30107	18373	70807	18066	81153	120181	108815	36371	12319	498192
Gillnets	633	1551	1399	412	1275	1644	971	694	577	9724
Trawls	2342	4461	2952	117	155	114	654	0	0	145884
Seines	0	97	0	0	8	0	0	29	40	1974
Unclassified	6357	1237	7252	26657	15793	1240	689	1626235	1539675	3225764
All Gears	1390140	1265965	1292556	1914456	2332478	2217225	1901081	1997158	1907441	17301764

Table 3. Proportion of pounds landed (whole weight) commercially by year and month of the Gulf of Mexico greater amberjack stock in the southeastern United States, 1977-1995. All landings reported from NMFS, statistical shrimp grids' 002.0-021.0 and 001.1 were included in the Gulf of Mexico stock, 1977-1993. Florida (west coast) landings from Monroe county for 1994-1995 were included in the Atlantic Ocean stock.

Year	Month												
	Unknown	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977		2.0%	5.1%	6.9%	11.2%	16.3%	8.0%	13.4%	6.4%	9.5%	4.5%	11.5%	5.2%
1978		1.3%	2.2%	8.8%	11.9%	9.9%	10.4%	7.9%	11.4%	11.4%	6.8%	11.0%	7.0%
1979		1.9%	1.2%	7.1%	7.0%	17.9%	17.3%	7.0%	8.1%	7.3%	11.7%	5.3%	8.2%
1980		3.6%	4.8%	3.7%	6.9%	11.4%	9.3%	10.1%	11.0%	13.4%	9.3%	5.0%	11.4%
1981		6.7%	6.7%	6.8%	7.8%	12.4%	7.4%	8.2%	9.4%	12.8%	7.5%	8.3%	6.3%
1982		2.6%	6.9%	11.7%	12.5%	14.6%	11.9%	8.8%	9.1%	6.5%	5.4%	3.2%	6.7%
1983		8.2%	3.6%	3.4%	7.5%	9.6%	20.7%	12.6%	8.9%	5.1%	8.0%	6.7%	5.8%
1984		5.7%	6.2%	7.0%	5.1%	9.7%	11.6%	9.7%	11.3%	7.0%	7.7%	6.6%	12.5%
1985		5.0%	3.8%	6.7%	5.8%	12.9%	10.5%	13.7%	10.5%	6.7%	7.2%	7.5%	9.9%
1986		5.1%	6.2%	3.6%	7.3%	9.3%	9.4%	10.7%	14.3%	10.0%	7.3%	8.5%	8.2%
1987		4.3%	7.3%	7.4%	9.3%	11.6%	7.5%	8.3%	9.4%	11.1%	8.8%	7.3%	7.8%
1988		5.5%	8.5%	8.9%	10.3%	10.4%	11.4%	9.5%	9.8%	5.6%	7.6%	5.2%	7.4%
1989		13.4%	8.7%	8.4%	9.1%	12.3%	9.5%	7.7%	7.6%	7.0%	6.2%	5.7%	4.6%
1990		18.2%	9.7%	6.4%	8.5%	7.2%	6.0%	7.4%	9.1%	8.1%	7.7%	5.8%	5.8%
1991		8.0%	6.7%	5.3%	6.4%	7.6%	7.4%	10.0%	13.7%	10.8%	8.4%	8.1%	7.7%
1992		3.8%	4.7%	3.5%	5.0%	7.7%	9.0%	9.8%	12.8%	15.6%	9.7%	7.6%	10.8%
1993		9.8%	7.8%	6.7%	4.9%	10.3%	7.8%	11.3%	10.0%	13.4%	6.6%	5.3%	5.9%
1994		5.0%	6.3%	6.1%	6.4%	12.8%	9.5%	10.8%	15.7%	8.4%	6.6%	5.5%	7.1%
1995		11.8%	9.2%	9.5%	6.4%	9.8%	11.3%	7.9%	6.9%	11.3%	3.5%	5.5%	6.8%
All years	2.9%	7.5%	6.9%	6.7%	7.5%	10.3%	9.3%	9.3%	10.1%	9.1%	7.1%	6.2%	7.2%

Table 4. Total pounds landed (whole weight) commercially by gear type for the Gulf of Mexico greater amberjack stock in the southeastern United States, 1977-1995. Florida landings were not available by gear type after 1993. All landings were reported from NMFS, statistical shrimp grids' 002.0-021.0 and 001.1 were included in the Gulf of Mexico stock, 1977-1993. Florida (west coast) landings from Monroe county for 1994-1995 were included in Atlantic Ocean stock.

Gear	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Hook & Lines	125216	165360	161304	188374	236062	204674	259433	519376	731059	1042457
Surface Longlines	0	0	0	0	0	0	0	0	0	0
Bottom Longlines	0	0	2912	5283	24950	43634	50646	68802	124171	228436
Dive Gear	0	0	0	0	0	0	0	0	0	515
Gillnets	9360	2184	4680	2373	286	728	107	69	306	129
Trawls	0	0	0	0	0	0	0	0	1760	160
Seines	0	0	0	2220	0	0	0	0	0	0
Unclassified	0	0	312	0	0	0	7	0	0	0
All Gears	134576	167544	169208	188251	261298	249036	310193	588247	857296	1271697

Gear	1987	1988	1989	1990	1991	1992	1993	1994	1995	Total
Hook & Lines	1398429	1930952	1849368	876855	510211	925400	801427	5761	5030	10894291
Surface Longlines	0	1286	4762	1081	90	5423	466	0	0	13108
Bottom Longlines	285775	367336	334537	191054	99407	103293	44990	338	0	1747128
Dive Gear	19436	29272	21692	6340	13060	16416	23300	0	0	129516
Gillnets	22	6	0	0	0	1218	1064	38	87	22528
Trawls	5404	8477	6059	156	0	51	255	0	0	22162
Seines	0	0	0	11757	0	0	0	0	0	14047
Unclassified	54432	0	4903	1202	208947	423461	571464	1163141	896760	3426629
All Gears	1763498	2337329	2221321	1088445	831715	1475262	1542966	1169305	903920	16269410

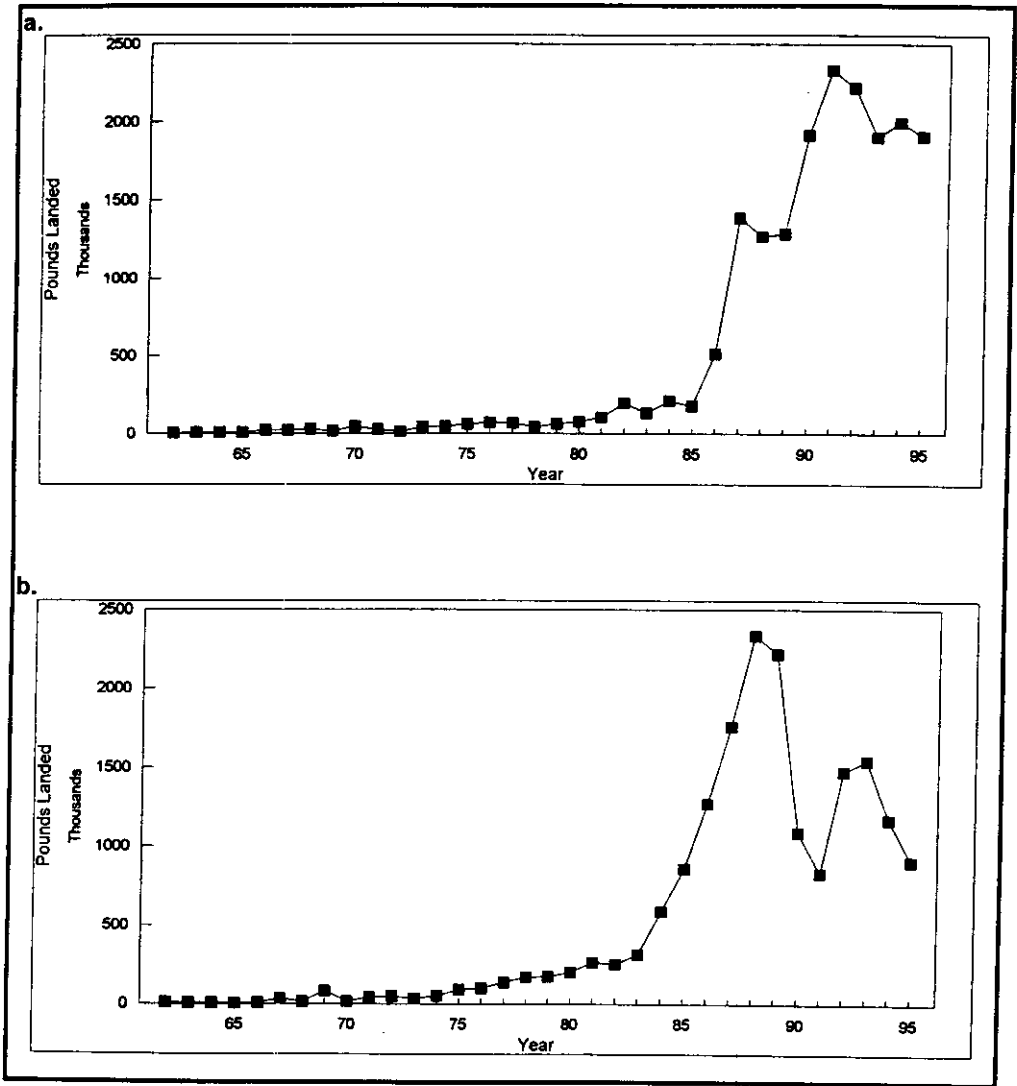


Figure 1. Total pounds landed (whole weight) annually for the a) Atlantic Ocean and b) Gulf of Mexico greater amberjack stocks.

Recreational Harvest

Total annual recreational greater amberjack harvest of the Atlantic stock ranged from 14,911 fish in 1982 to 100,326 fish in 1987 (Figure 2a). Harvest include catches by private anglers, shore fishermen, charterboats, and headboats. Recreational catches showed more annual variability than did commercial landings. Recreational catches of the Atlantic group showed a declining trend in the private, charter, and shore fisheries since 1987 except during 1994 (Figure 2b). The annual rate of decline ranged from 10% to 30% since 1987. Fish were caught recreationally mainly by fishermen in Florida, and before 1991 private anglers caught about 25% more than charterboat fishermen. Since 1991 however, charterboat fishermen have caught about 50% more than private anglers except in one year, 1992. Catches by the headboat fleet traditionally have been much lower than the other recreational fisheries, averaging 10% to 15% of the total recreational harvest (Figure 2b). Recreational catches suggest a declining trend in the headboat fishery as in the private, charter, and shore fisheries.

Recreational harvest of the Gulf stock ranged from about 61,669 in 1984 to 688,011 fish in 1987 (Figure 3a). Variability between the Gulf group fisheries was high and much greater than for the Atlantic group. Charterboat anglers have traditionally landed more fish of the Gulf group with most of the harvest coming from Florida west coast anglers. After the 1987 peak in recreational harvest, a significant declining trend is apparent through 1995 in the headboat fishery (83%) and in the charter/private angler catches (90%) (Figure 3b). Declines in recreational harvest have been larger for the Gulf group.

Biostatistical Sampling

Individual length and weight sampling of recreational and commercial fisheries occurred at a low level over the entire history of recorded catches. Recreational gears were sampled more intensely than commercial gears in nearly all years in both stocks and headboat anglers were always sampled at a higher rate than either commercial or recreational fishermen. Sampling rates ranged from 0.1% to 0.7% for the Atlantic group private/charter fisheries while the headboat fishery was sampled at a rate of about 1.6% since 1986 (Table 5a). Commercial length samples were almost nonexistent before 1990. During 1992 and 1993, sampling of commercial fisheries increased to 1.6%, however, subsequent years sampling rates declined by more than 50% to 0.6% and remain at that level. Between 1988 and 1995, the total numbers of fish sampled in the headboat catch remained stable however, headboat catches declined dramatically. The effect of this was to create artificial stability (or increase in some years) in the headboat fishery sampling rate. The number of individuals sampled in the commercial and other recreational fisheries declined steeply over the same period while commercial and private and charterboat catches declined more gradually.

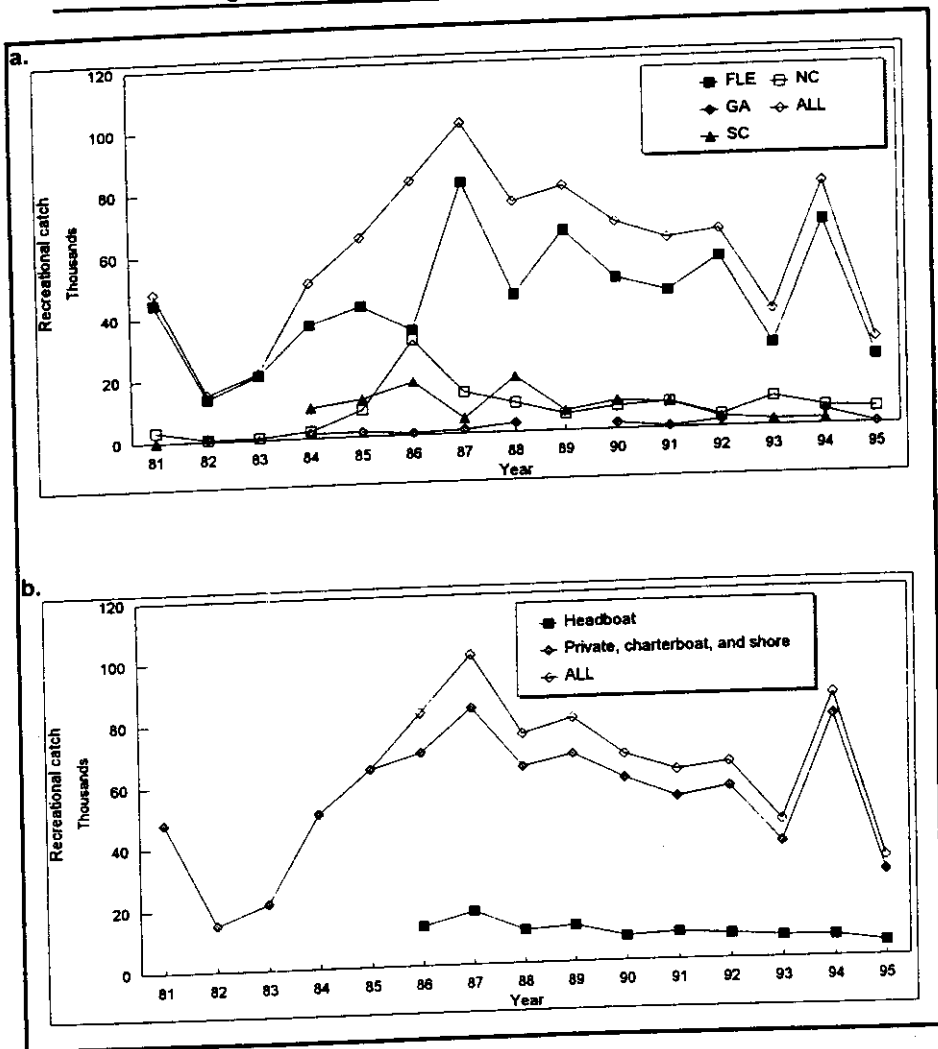


Figure 2. Estimated recreational catch (numbers) of the Atlantic Ocean greater amberjack stock by a) year and state and b) year and fishery

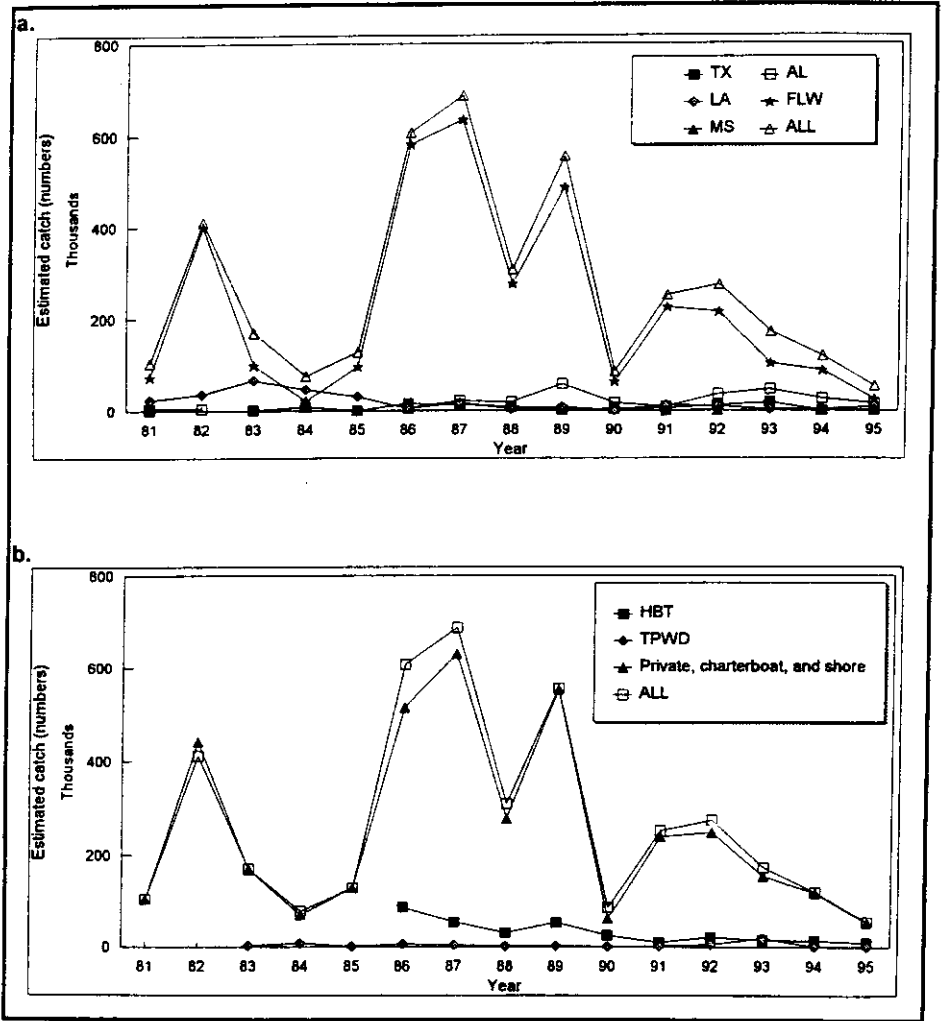


Figure 3. Estimated recreational catch (numbers) of the Gulf of Mexico greater amberjack stock by a) year and state and b) year and fishery.

Table 5. Estimated total number of the a) Atlantic Ocean and b) Gulf of Mexico greater amberjack caught and number of fish sampled, and sampling fraction by fishery. Sampling fraction of combined fisheries was calculated as the weighted percent of the separate fisheries. * = Insufficient length data was not available to estimate total catch; ** = Between 1981 and 1985 headboat catches were included in MRFSS charter/partyboat catch estimates; *** = Total catch does not include commercial fishery from 1981-1984, and headboat catches for 1981-1985 from MRFSS charter/partyboat was used in calculating the total catch of all fisheries combined; **** = NMFS, Headboat Survey was initiated in the Gulf of Mexico in 1986 and was included in the charter, private, and shore MRFSS estimates, and; ***** = Total catch does not include the commercial fishery from 1981-1982.

Year	Atlantic Ocean						Gulf of Mexico												
	Catch (Numbers)	Number sampled	Sampling Fraction	Catch (Numbers)	Number sampled	Sampling Fraction	Catch (Numbers)	Number sampled	Sampling Fraction	Catch (Numbers)	Number sampled	Sampling Fraction	Catch (Numbers)	Number sampled	Sampling Fraction	Catch (Numbers)	Number sampled	Sampling Fraction	Weighted Percent
1981	0	0	0%	48,116	326	0.7%	0	0	0%	104,264	82	0.1%	0	0	0%	104,264	86	0.1%	
1982	0	0	0%	14,807	97	0.2%	0	0	0%	441,892	106	0.0%	0	0	0%	441,892	97	0.0%	
1983	0	0	0%	21,510	15	0.1%	0	0	0%	170,383	111	0.1%	0	0	0%	164,546	278	0.1%	
1984	0	0	0%	50,166	38	0.1%	0	0	0%	77,141	117	0.2%	0	0	0%	107,245	228	0.2%	
1985	14,325	24	0.2%	84,204	84	0.1%	0	0	0%	128,819	109	0.1%	0	0	0%	167,242	237	0.2%	
1986	45,640	64	0.1%	68,180	58	0.1%	0	0	0%	86,022	608	0.7%	0	0	0%	682,358	238	0.2%	
1987	90,835	61	0.1%	83,086	96	0.1%	0	0	0%	52,800	545	1.0%	0	0	0%	778,657	263	0.2%	
1988	82,860	112	0.1%	63,767	216	0.3%	0	0	0%	29,654	407	1.4%	0	0	0%	871,813	158	0.2%	
1989	85,299	80	0.1%	87,454	236	0.3%	0	0	0%	52,516	1428	2.7%	0	0	0%	793,779	184	0.2%	
1990	78,056	330	0.3%	58,212	280	0.5%	0	0	0%	24,853	238	1.0%	0	0	0%	124,326	113	1.0%	
1991	103,518	332	0.3%	52,690	120	0.2%	0	0	0%	9,865	189	1.9%	0	0	0%	271,814	74	1.2%	
1992	88,765	1,084	1.6%	58,811	127	0.2%	0	0	0%	62,027	361	0.8%	0	0	0%	318,453	152	1.0%	
1993	87,504	1,048	1.6%	7,002	155	0.4%	0	0	0%	18,733	388	2.0%	0	0	0%	232,621	121	0.4%	
1994	78,189	441	0.6%	78,342	138	0.2%	0	0	0%	14,055	245	1.7%	0	0	0%	170,890	124	0.4%	
1995	80,054	433	0.7%	27,982	80	0.2%	0	0	0%	6,869	277	3.3%	0	0	0%	82,935	111	0.7%	

Average length of the Atlantic group of greater amberjack caught by private anglers, charterboat fishermen, and shore fishermen was variable from 1978 through 1988. Recreational average size showed a decline in 1988 and has remained at 90 cm since 1989 (Figure 4a). Sample sizes for 1995 were low ($n = 60$ fish measured). Average length from headboat catches declined from 1974 to 1983, was variable without trend from 1984 through 1990, and showed slight increases beginning around 1991. Since 1993, headboat average length has been stable at 83 cm. Average length of commercially landed fish showed a continued increase from 1984 through 1992 and has been variable since. Average weight was more variable and subject to low sample sizes (Figure 4b).

Length sampling rates of the Gulf group ranged from 0.0% to 0.9% for the private and charterboat fisheries and from 0.7% to 3.2% for the headboat fishery (Table 5b). Commercial length samples were sparse before 1987 and erratic after that. The rate of sampling was about 1% until 1990 with sampling declining from 2% to 1.1% between 1992 and 1993, increasing between 1993 and 1994, and declining again in 1995 by 50%.

Average length of Gulf fish caught by private anglers, charterboat fishermen, and shore anglers in the Gulf was variable without trend from 1981 through 1987 (Figure 5a). Average length showed slight increases between 1988 and 1994 and averaged 78 cm in 1995. Recreational sample sizes were low in 1995. Average length landed by headboat anglers was variable without trend between 1980 and 1990 and increased since 1991 averaging 79 cm in 1995. Average length of fish landed by commercial vessels increased continuously from 1984, except in 1988. Average length from the commercial fishery was 97 cm in 1995. Average weight varied more and was subject to low sample sizes (Figure 5b).

Estimated Total Numbers Caught

Biostatistical length samples, commercial landings and recreational harvest data were sufficient to estimate total catch of the Atlantic group since 1985 (Table 5a). Total catch by the commercial, recreational (private, charter, shore) and headboat fisheries ranged from 89,226 to 198,975 fish declining since 1991. About 91,656 fish were caught in 1995, a 43% decline from the 1994 value. The 1995 commercial catch was 58% of that in 1991 and has varied without trend since 1992, averaging about 60,000-70,000 fish annually. Most of the decline in total harvest was from the recreational sector. Harvest by recreational charter, private, and shore anglers varied from 14,907 to 78,342 fish from 1981-1995, declining to 27,582 fish in 1995. The decline in recreational catch

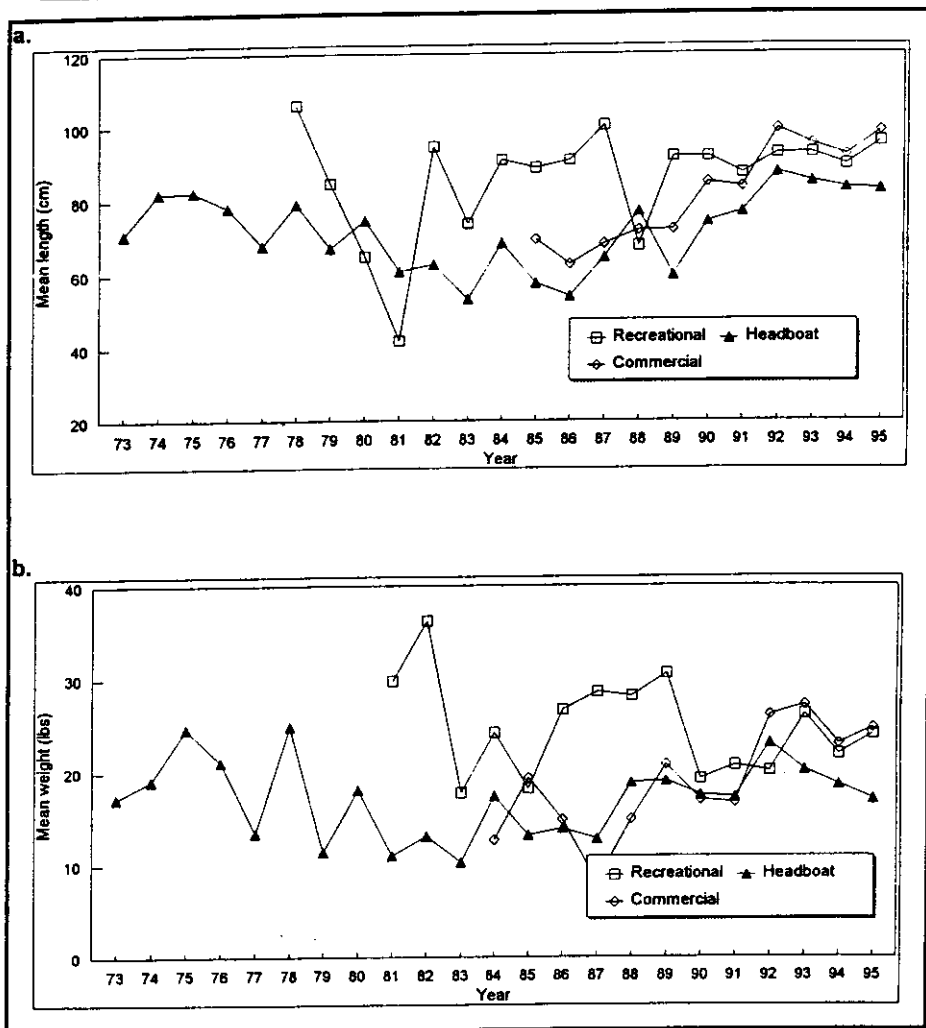


Figure 4. Observed a) mean length (cm) and b) whole weight (lbs.) by year and fishery of the Atlantic Ocean greater amberjack stock.

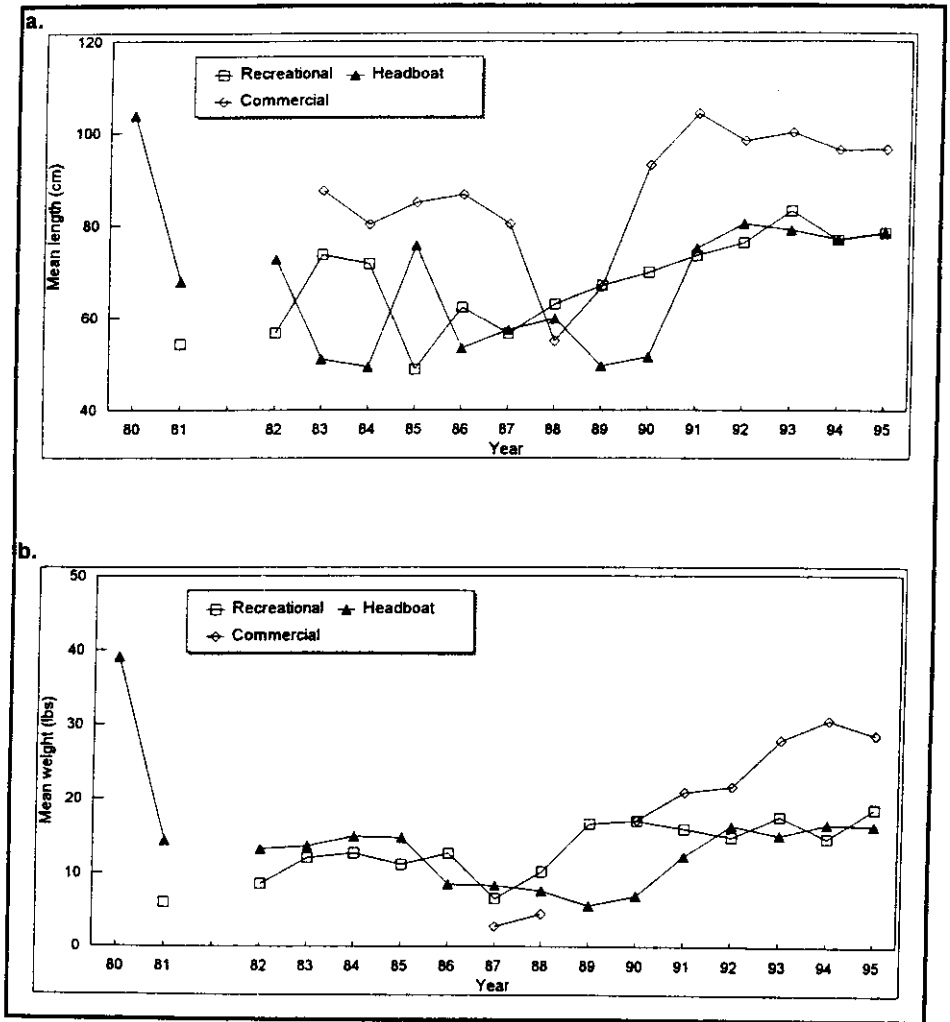


Figure 5. Observed a) mean length (cm) and b) whole weight (lbs.) by year and fishery of the Gulf of Mexico greater amberjack stock.

is apparent since 1990. The 1994 catch estimate is anomalous and may reflect biases in sampling. Headboat catches averaged less than 10% of the total annual catch, showing consistent declines since 1987. Total annual recreational catches (charter, private, shore, and headboat) declined (from 84% to 34%) since 1985.

Length samples, commercial landings, and recreational catches data for the Gulf group were sufficient to estimate total catch since 1981 (Table 5b). Total estimated catch of the Gulf group ranged from 92,935 to 776,657 fish from 1983 through 1995 showing a declining trend since 1990. Estimated total catch were 92,935 fish in 1995, the lowest on record. Commercial harvest ranged from 14,173 to 363,060 fish showing increasing trends through 1988. Commercial catches have been variable without trend since 1990 at 30,000 to 40,000 fish. Recreational catches (charter, private, shore and headboat) increased from 104,284 fish in 1981 to 688,017 fish in 1990 and declined to 61,668 fish in 1995. Headboat catches were less than 10% of the total annual harvest since 1987 with consistent declines since 1986. Headboat catches were generally larger for the Gulf group than the Atlantic group. The proportion that recreational catches (charter, private, shore, and headboat) made of the total annual catch varied from 46% to 92% generally without trend.

Recreational CPUE Abundance Patterns

CPUE abundance trends were measured as CPA and CPH from headboat, private angler, and charterboat vessels. There were more intercepts available from the headboat fishery than the other recreational fisheries as sampling by the MRFSS survey for CPUE was low particularly in later years. CPA has been higher for the private and charterboat anglers than for headboat fishermen in most years. Arithmetic mean un-adjusted CPA and CPH of the Atlantic group varied without trend throughout the period for all recreational fishermen (Cummings and McClellan 1996).

The GLM model for the Atlantic group for charterboat, headboat, and private angler CPA data included individual terms for year, month, state, and fishery (private, charter). Year was significant in explaining CPA ($p=0.015$, $df=14$) while month, state, and fishery were not important ($p>0.25$) factors in the GLM. These results suggest that greater amberjack recreational CPA varied without trend from 1981 through 1995 (Figure 6a). Headboat data were fit to a model that included terms for year, month, and state that were all significant variables in explaining CPA ($p=0.0001$, $df=46$). Results show a similar trend in headboat CPA as for the private/charter fishery. The amount of the total variability explained by the separate regression models was 11% for the private/charterboat data and 28% for the headboat data.

Unadjusted mean recreational CPA and CPH of the Gulf group varied without trend over the period, 1981 through 1995, for private/charterboat anglers

while CPA declined about 50% in the headboat fishery from 0.8 to 0.3 fish per angler. TPWD recreational data suggest CPA varied without strong trend between 1983 and 1995 while CPH declined about 50% from 1985-1995 from 0.9 to 0.2 fish per trip (McClellan and Cummings, 1996).

The GLM model fit to the Gulf group recreational private/charterboat CPA data included separate terms for year, month, state, and fishery, all variables that were significant in explaining CPA ($p = 0.0001$, $df = 29$). Standardized CPA from the private/charterboat fisheries was variable with a decline occurring from 1991-1994 (Figure 6b). Headboat CPA data were fit to a model containing terms for year, month, and state; all significant factors in the GLM model ($p = 0.0001$, $df = 27$). Results suggest headboat CPA declined from 1986 through 1990 and varied without trend after that. Headboat CPA declined from 1986 through 1990 and has been stable since 1991. The amount of the total variation in CPA explained by the GLM models was reasonably high for the headboat data (56%) but lower (39%) for the private/charterboat data. Values for 1984 and 1985 are in question because of the large confidence intervals.

Commercial CPUE Abundance Patterns

Commercial reef fish vessel logbook data suggest catch rates of the Atlantic group were variable over the period 1992-1995, depending upon the gear used and the area of capture, varying from about 100 to 650 pounds per trip. Hook and line gear were used most often to capture greater amberjack in the Atlantic group however, powerheads and spearguns were also used. Within a gear category CPUE remained constant across years except handlines that suggest a slight decline from 1994 to 1995.

A GLM model fit to the commercial logbook data included terms for year, month, gear, and port of landing, all significant terms in explaining CPUE ($p < 0.005$, $df = 9,495$). The amount of the total variation for the Atlantic group explained by the GLM regression model was 12%. Regression results suggest a decline in CPUE (pounds per trip) of Atlantic fish landed between 1992 and 1993 and stable CPUE at 110 lbs. per trip since 1993. This trend is similar to that observed for unstandardized commercial CPUE of all gears combined through 1994 (Figure 7b).

Commercial CPUE in the Gulf group varied over the period 1992 through 1995 depending upon the gear and area of capture ranging from about 100 to 300 pounds per trip (Figure 8a). Annual un-adjusted CPUE remained stable within a gear category during this period through 1994. Most of the logbook records showed hook and lines were the predominant gear used, with many trips coming from longlines.

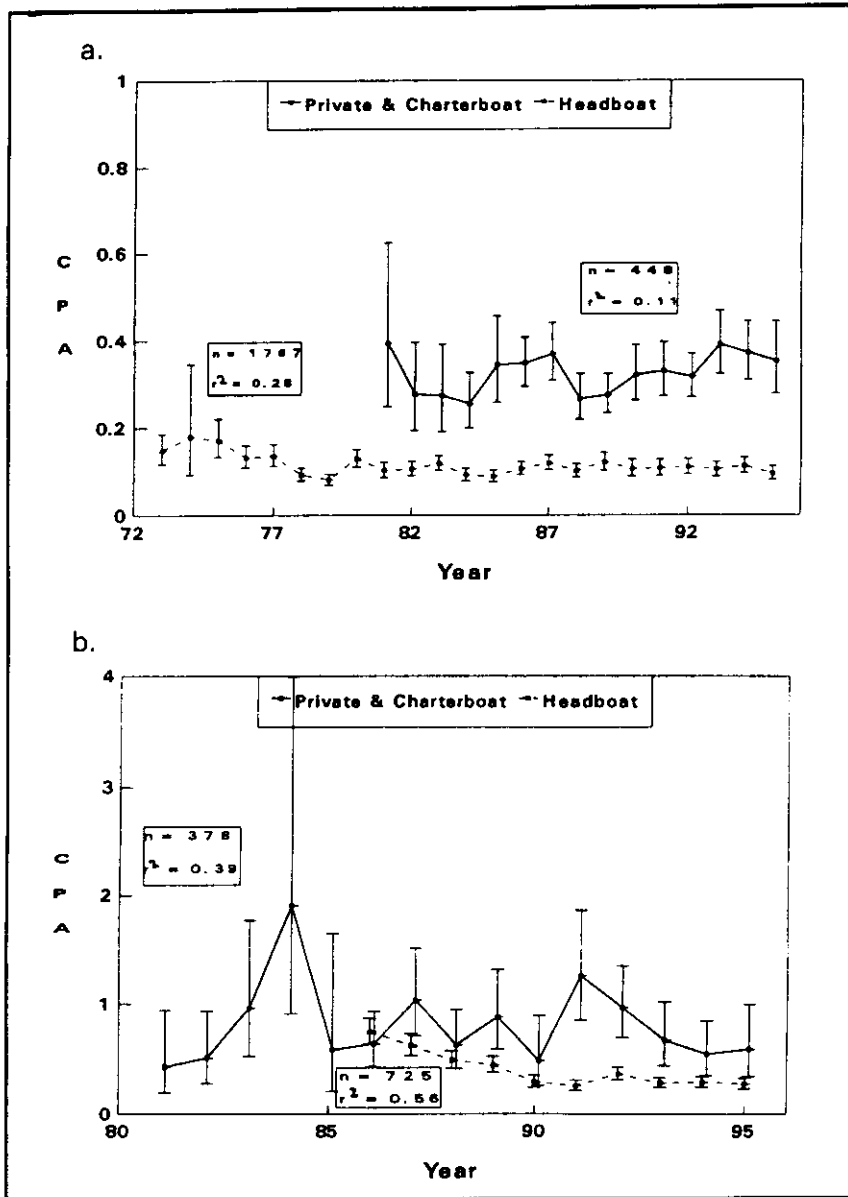


Figure 6. Standardized recreational abundance (CPA) for the a) Atlantic Ocean and b) Gulf of Mexico greater amberjack stocks.

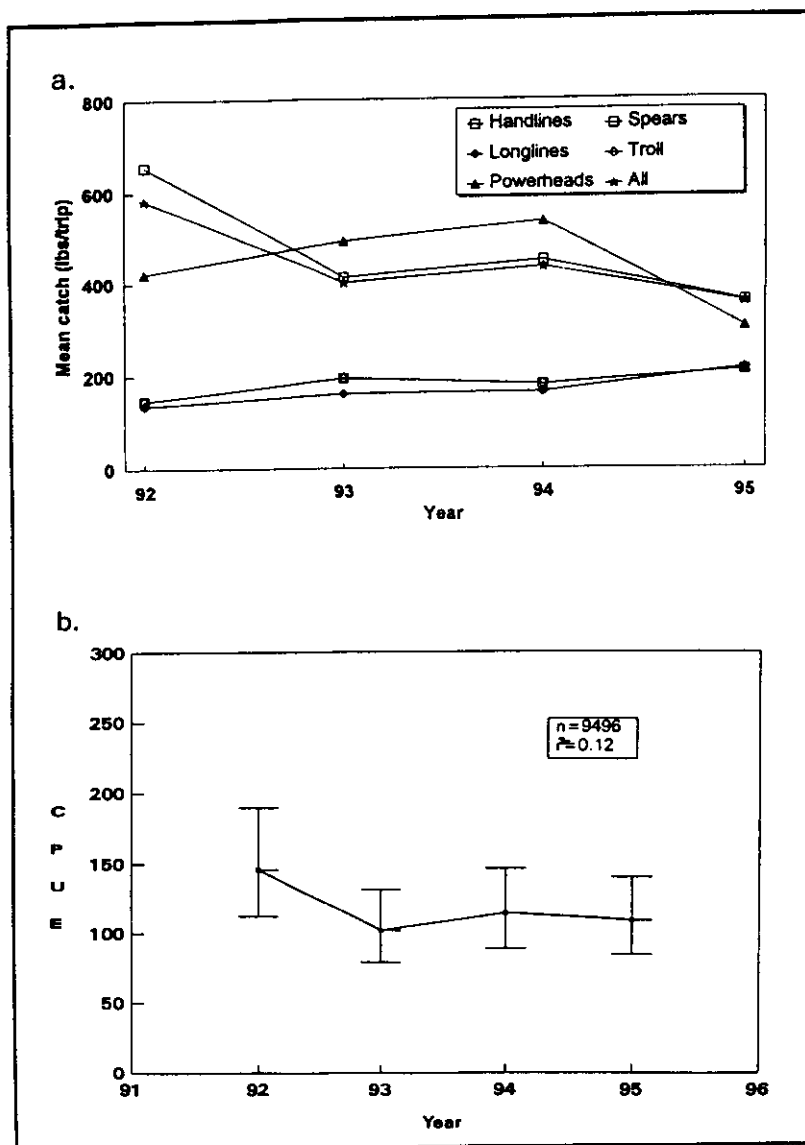


Figure 7. Commercial CPUE (lbs. per trip) from logbooks by year for the Atlantic Ocean greater amberjack stock a) unadjusted and b) standardized by GLM.

The GLM model fit to the commercial logbook data included terms for year, month, gear, and port of landing, all significant in explaining CPUE ($p < 0.05$, $df = 8,558$). The amount of the total variation explained by the GLM model however was low (9%). Results suggest commercial CPUE of the Gulf group remained stable between 1992 and 1994 and increased slightly in 1995 to about 130 pounds per trip (Figure 8b).

Recreational Bag Limits and Commercial Season Closures

The impact on future recreational catches from implementation of more restrictive bag limits suggests a two-fish bag limit would produce decreases in total annual catches for both groups. Expected reductions of 1% in the headboat fishery, 6% for charterboat anglers, and 27% for the private vessel fisheries are possible for the Atlantic stock (Table 6a). Larger catch reductions are possible for the Gulf group. Reductions of 11% for the headboat, 30% for the charterboat, and 52% for the private fisheries for the Gulf would be expected (Table 6b). The overall change in total annual recreational catches would be expected to be about 9,000 fish in the Atlantic and 30,000 fish in the Gulf.

Commercial fishery closures implemented from February through March, February through April, and February through May, would potentially reduce annual landings by 21%, 36%, and 56% by weight for the Atlantic group, respectively. Similar closure periods would result in reduced landings of 14%, 21%, and 31% for the Gulf stock, respectively. Reductions of these percentages would correspond to reductions in annual yields of about 400,000 to 1.1 million pounds for the Atlantic stock and from 200,000 to 400,000 pounds for the Gulf group depending upon the season.

DISCUSSION

The status of greater amberjack assuming two stock management units exists as adopted by fishery management councils for the stocks in the southeastern United States was evaluated. Commercial landings' data, recreational harvest estimates, samples of observed size, estimated total catch, recreational and commercial CPUE abundance trends, and impacts of more restrictive regulation changes on recreational and commercial harvest were considered.

Commercial landings showed explosive increases during the middle to late 1980s. Increases in landings in the 1980s may have been due to several factors, including increased popularity as a food fish (particularly in the smoked fish market), closure of the Gulf red drum (*Sciaenops ocellatus*) fishery in the mid 1980s, and a shift in commercial effort from other fisheries. Fishermen were displaced from several traditional fisheries; e.g., the Florida east coast king mackerel (*Scomberomous cavalla*) drift net fishery and the Florida west coast reef

Table 6. Estimated reduction (percent) in the recreational catch for the a) Atlantic Ocean and b) Gulf of Mexico greater amberjack stock (1995 data only) for several bag limit options. N equals number of interviews available.

a. Atlantic Ocean			
Bag Limit	Data Source/Fishery		
	MRFSS		NMFS
	Charter	Private	Headboat
Option			
1	18	42.9	3.8
2	5.6	26.5	1.4
3	0	18.4	0.7
4	0	10.2	0
5	0	6.1	0
N	58	16	1030

b. Gulf of Mexico			
Bag Limit	Data Source/Fishery		
	MRFSS		NMFS
	Charter	Private	Headboat
Option			
1	18	42.9	3.8
2	5.6	26.5	1.4
3	0	18.4	0.7
4	0	10.2	0
5	0	6.1	0
N	58	16	1030

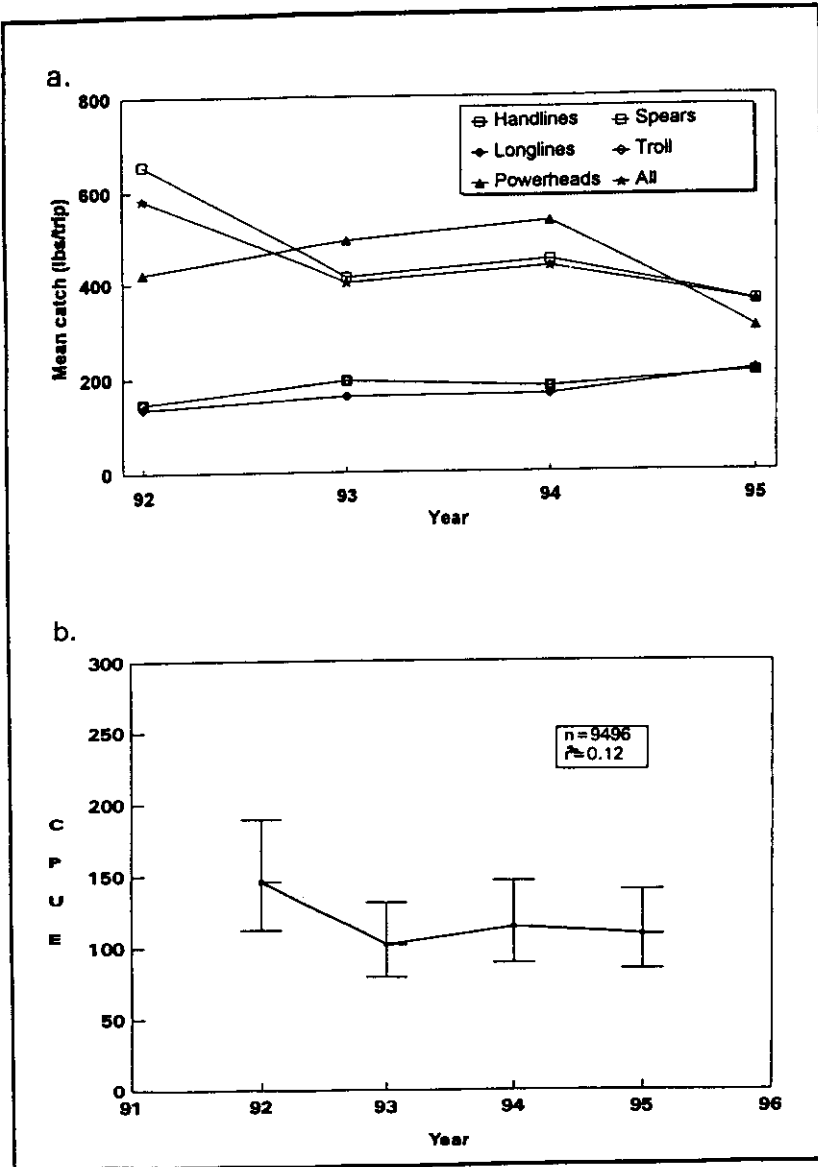


Figure 8. Commercial CPUE (lbs. per trip) from logbooks by year for the Gulf of Mexico greater amberjack stock a) unadjusted and b) standardized by GLM.

fish trap fishery during the years in which significant landings increases were observed for greater amberjack.

Some decline observed in commercial landings of the Gulf group may be explained from the introduction of minimum size limits established in 1990. Restriction of commercial sales of greater amberjack during April and May to the recreational three fish per trip limit may have also affected total landings of the Atlantic group although landings have been stable since about 1993. Under-reporting is believed to have been a significant problem until the early 1990s particularly for the Atlantic group (Ben Hartig, unpublished data). Significant quantities of landings from Florida east coast ports were shipped to markets on Florida's west coast. Cored and logged landings are also believed to have occurred in large quantities during the late 1980s. Failure to convert these landings may have introduced bias into total annual harvest data. Total landings would be underestimated for the earlier years producing a more optimistic picture of the trend in declining landings in recent years.

Recreational catches showed declines in harvest in recent years for both the Atlantic and Gulf stocks. The start of the decline and the precise level of decline is difficult to identify for either stock with certainty because of large variability in the catch estimates present in the MRFSS estimates. Long-term trends in recreational catches should be viewed with caution because estimates of catch for private angler, charterboat, and shore fisheries contain large variance in several years (1980, 1981, 1984, 1985). Uncertainty is likely due to the low number of intercepts available in the private angler and charterboat mode for the MRFSS survey. A change in the ability of fishermen and samplers to identify greater amberjacks from other *Seriola* species may have lowered the uncertainty in later years. Further reductions in recreational harvest are expected in Florida state waters as a one fish per person bag limit was implemented July 1, 1996 in Monroe county, Florida for all amberjack species. In addition, a proposed one fish per person per trip bag limit in Gulf of Mexico federal waters may produce additional declines in total recreational harvest for the Gulf group in all states making it more difficult to evaluate changes in stock condition.

Average length was variable during the early years in both the Atlantic and Gulf stocks, while in recent years an increasing trend in size is apparent in the major fisheries. Species identification problems may account for part of the variability in size during early years. Minimum size regulations introduced in 1990 for both stocks include a 71 cm fork length recreational and a 91-cm fork length commercial (71 cm core length) size limit. Increases in observed mean length in the Atlantic and Gulf group fisheries reflect these regulations and are viewed as positive changes in the fishery as many fish were captured prior to the size of first spawning during the developing years of the fishery.

A change in the targeting behavior of recreational anglers away from greater

amberjack can be hypothesized as a possible cause of the decline in catch when considering abundance trends from CPUE data for both groups. Recent increases in abundance of the Gulf red snapper (Goodyear 1996a) and red drum (Goodyear 1996b) and Atlantic and Gulf king mackerel stocks (Powers et al. 1996) may have caused anglers to shift fishing activities off amberjacks to other more preferred species. More extensive analyses of the recreational data are needed to quantify fishing effort to evaluate changes in angler preference. Annual total harvest declines were largest for the recreational fisheries for both the Atlantic and the Gulf stocks, as determined from estimates of total numbers caught. Commercial landing's data from the FDEP trip ticket data base should be used to evaluate the trend of declining commercial CPUE in the Atlantic as observed from logbooks between 1992 and 1993. These data were not available for this study to evaluate abundance trends before 1992. These recreational and commercial taken in total, suggest CPUE is currently stable for the Atlantic stock. Commercial CPUE trends and estimated annual commercial catches taken in combination with increasing observed sizes since the early 1990's also do not support a significant decline in abundance of the Gulf group.

Changes in future recreational catch trends are highly probable if proposed changes in bag limits occur. In addition, declines in commercial landings can be expected if spawning season closures are adopted. These changes, besides lowered sampling rates, will make it difficult to assess stock status. Information from virtual population analysis show declines exists in fishing effort for both stocks (McClellan and Cummings 1996, Cummings and McClellan, 1996). These analyses also provide preliminary evidence to suggest that possible declines in recruitment occurred in both groups since 1983 however, further evaluations must be done to clarify these findings. Concerns stated by Berry and Burch (1979) regarding the ". . . apparent increasing catches, and ready availability of the greater amberjack and that incomplete and adequate fisheries' statistics and information on the stock status would ultimately prevent analysts in defining the current stock condition" remain appropriate today for the greater amberjack stocks of the southeastern United States.

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