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Southeastern U.S. Deepwater Reef Fish Assemblages, Habitat Characteristics, Catches, and Life History Summaries

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Southeastern United States Deepwater Reef Fish Assemblages, Habitat Characteristics, Catches, and Life History Summaries

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ABSTRACT

There are 19 economically important reef fish species in the deepwater (100-300 m) fishery of the southeastern United States. Five species make up the majority (over 97% by weight) of the catch. In descending order of total landings for 1995, they are: tilefish, *Lopholatilus chamaeleonticeps*, snowy grouper, *Epinephelus niveatus*, blueline tilefish, *Caulolatilus microps*, warsaw grouper, *Epinephelus nigritus*, and yellowedge grouper, *E. flavolimbatus*. Life history summaries and estimates of catches from 1972 through 1995 for 14 species are described.

Introduction

The purpose of this paper is to assemble information on economically important fishes occupying deep (100–300 m) reefs along the Atlantic coast of the southeastern United States, Cape Hatteras, North Carolina, to Key West, Florida. We describe species composition, distribution, landings, preferred habitat, spawning periodicity, and associated fishes and benthos.

Reef fishes support important recreational and commercial fisheries throughout the U.S. South Atlantic, Gulf of Mexico, and Caribbean areas. Most reef fish species appear to be at maximum harvest or are overfished (Huntsman et al.[1]). Deeper reef species which occur at depths of 100 to 300 m may be especially vulnerable because of their limited geographic ranges (Fig. 1). Spawning stock biomass per recruit ratios for snowy grouper, *Epinephelus niveatus*, and warsaw grouper, *E. nigritus*, two of the most important deep reef species, were among the lowest (0.15 and 0.06) for the 19 most important reef fishes (Huntsman et al.[1]).

Less is known about the life histories of deep reef fishes than any other group supporting a major fishery. The depth and strong currents, often to 3 knots, preclude observations by SCUBA divers and make submersible observations difficult. Distance from shore of these open ocean habitats, and often inclement weather, make incidental and anecdotal observations and reports about the fish and their habitat extremely rare. Although hook and line and longline gear have been used successfully to capture some deepwater reef fishes, little is known about rare or hard to catch species. Description of the deepwater reef fish community and habitat was needed by the South Atlantic Fishery Management Council for development of a management plan for deep reef fishes (Amendment 6, Snapper Grouper Management Plan[2]).

Materials and Methods

Scientific literature, extant fishery data bases, and discussions with commercial and recreational fishermen

[1] Huntsman, G. R., J. C. Potts, R. W. Mays, R. L. Dixon, P. W. Willis, M. L. Burton, and B. W. Harvey. 1992. A stock assessment of the snapper-grouper complex in the U.S. south Atlantic based on fish caught in 1990. Report to the South Atlantic Fishery Management Council. NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort Laboratory, Beaufort, NC 28516, 97 p.

[2] Amendment 6, Regulatory Impact Review, Initial Regulatory Flexibility Analysis and Environmental Assessment and Environmental Assessment for the Snapper Grouper Fishery of the South Atlantic Region. December 1993. South Atlantic Fishery Management Council, 1 Southpark Circle, Suite 306, Charleston, SC 29407-4699.

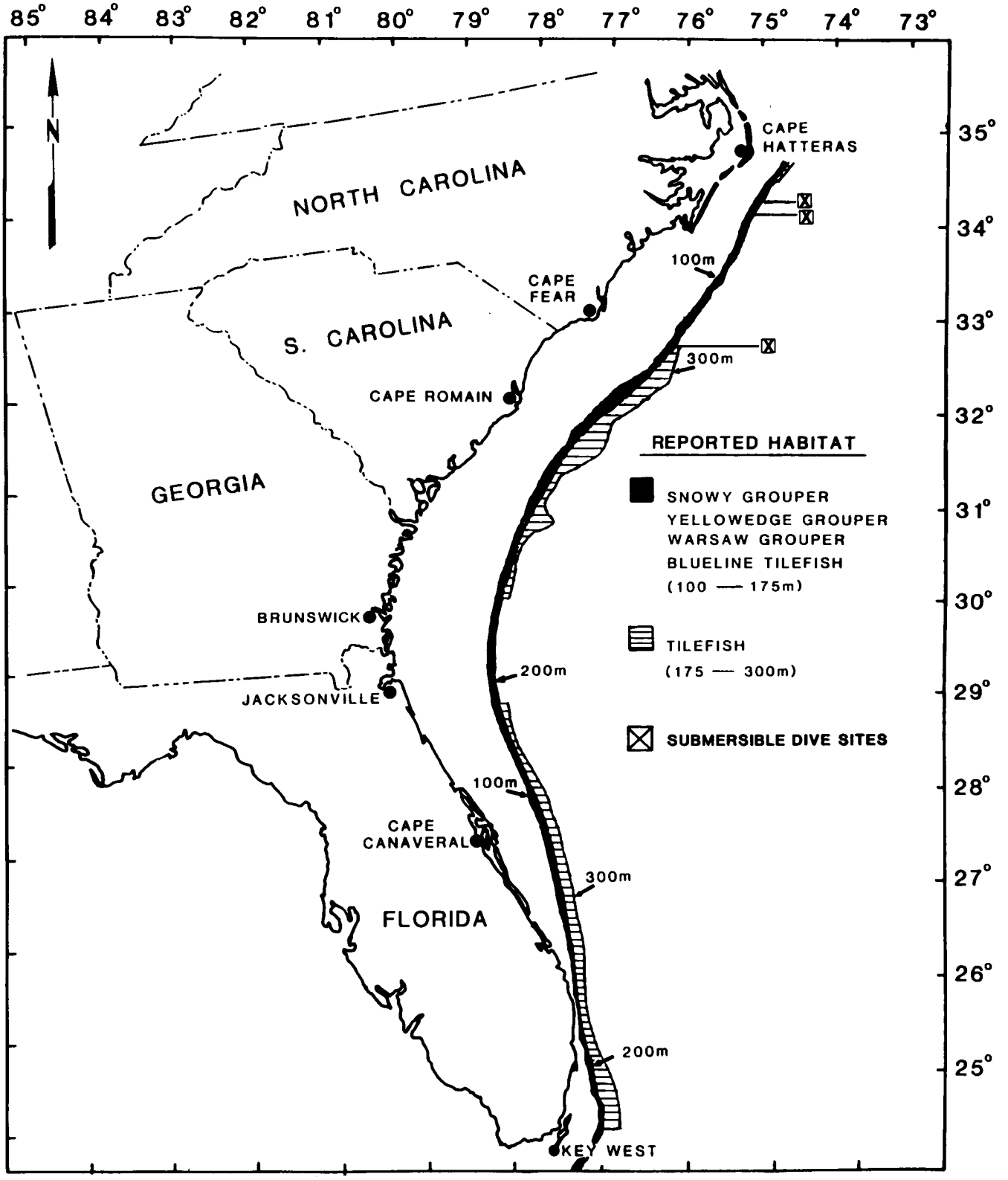

Figure 1

Deepwater reef fish habitat along the southeastern United States coast from Cape Hatteras, North Carolina, to Key West, Florida, reported by commercial and recreational fishermen. Submersible dive sites are indicated.

provided an overview of historical concentrations of deep reef fishes in the southeastern United States. The Southeast Fisheries Science Center's headboat survey[3], Marine Recreational Fisheries Statistical Survey (MRFSS)[4,5], Trip Interview Program (TIP)[6], General Canvas Landings System[6], and data gathered by observations from submersibles were used as sources of information on the biology and landings of deepwater reef fishes. Abundance of species important in the recreational and commercial fisheries was estimated from a submersible by direct visual counts of fish, measurement of distance traversed, and estimated visibility using external flood lights as described by Parker and Ross (1986). Submersible surveys were made on the Big Rock (lat. 34°11', long. 76°07'; 95 to 120 m depth) and in the Snowy Hole (lat. 34°15', long. 76°02'; 130 to 150 m depth) areas off North Carolina, and at the Charleston Lumps (lat.32°44', long. 78°06'; 185 to 220 m depth) off South Carolina (Fig. 1). Fishing areas referred to in graphs and text are the U.S. South Atlantic Bight, the area from Cape Hatteras, North Carolina, to Cape Canaveral, Florida; and southeast Florida, the area from Cape Canaveral to Key West. All fish length measurements were total length except for those of greater amberjack, *Seriola dumerili*, which were fork length. Some of the fish species included in this discussion are not obligate hard-bottom species, e.g., tilefish, *Lopholatilus chamaeleonticeps*, greater amberjack, barrelfish, *Hyperoglyphe perciformis*, oilfish, *Ruvettus pretiosus*, and escolar, *Lepidocybium flavobrunneum*, but they are often an important part of this deepwater fishery catch.

Results

Physical Habitat

Rock outcroppings occur throughout the continental shelf from Cape Hatteras to Key West (MacIntyre and Milliman, 1970; Miller and Richards, 1979; Parker et al., 1983). Generally, the outcroppings are composed of bioeroded limestone and carbonate sandstone (Newton et al., 1971) and exhibit vertical relief ranging from <0.5 to over 10 m. Ledge systems formed by rock outcrops and piles of irregularly sized boulders are common. Parker et al. (1983) determined that 24% (9,443 km^2) of the area between the 27 and 101 m isobaths from Cape Hatteras to Cape Canaveral is reef habitat. Although the bottom area between 100 and 300 m depths from Cape Hatteras to Key West is small relative to the shelf as a whole, it constitutes prime reef fish habitat according to fishermen (Fig. 1) and probably contributes significantly to the total amount of reef habitat.

Community

Overall, the deep reef fish community probably contains less than 100 species. From submersible operations off North Carolina, Parker and Ross (1986) observed 34 species of deepwater (98 to 152 m) reef fishes representing 17 families and described the behavior of species from eight families (Table 1). Gutherz et al. (1995) observed 27 species of deepwater (185 to 220 m) reef fishes from submersibles off South Carolina in 1982. There were obvious differences (probably depth related) in abundance of the most common species of fish observed from submersibles from North Carolina to South Carolina (Table 2). Tattler, *Serranus phoebe*, bigeye, *Priacanthus arenatus*, and bank butterflyfish, *Chaetodon aya*, were abundant off North Carolina (north of 34°N) but absent off South Carolina (south of 33°N), while yellowfin bass, *Anthias nicholsi*, blackbelly rosefish, *Helicolenus dactylopterus*, and longspine scorpionfish, *Pontinus longispinis*, were abundant off South Carolina but absent off North Carolina (Table 2).

Three submersible dives were conducted in May 1992 on the abundance and distribution of deepwater reef fishes important to fisheries. Observations from these dives were compared to the above surveys (Table 2). At the Big Rock or Charleston Lumps there were apparent increases in abundance (fish/ha) over time of scamp, *Mycteroperca phenax* (5 to 45), blueline tilefish, *Caulolatilus microps* (<1 to 14), and southern hake, *Urophycis floridana* (<1 to >23). Also in the Charleston Lumps area, there was an apparent decrease in snowy grouper (9 to 2). Although the recent data are sparse, they show that at least seven of nine economically important species, previously observed from submersibles, have survived intense fishing pressure at these locations.

Twenty active or retired fishermen (headboat[7] operators and commercial fishermen who employed vertical hook and line or longline gear) from Cape Hatteras to Key West described the deep reef fishery in their areas. According to fishermen, coast wide stocks (usu-

[3] Headboat Survey (1972–1993), Beaufort Laboratory, Southeast Fisheries Science Center, National Marine Fisheries Service, 101 Pivers Island Road, Beaufort, NC 28516.

[4] Given the high variance attached to these estimates, they must be used with caution.

[5] Marine Recreational Fisheries Statistical Survey (1979–1993), National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910.

[6] Trip Interview Program and General Canvas Landings System (1972–1993), Southeast Fisheries Science Center, National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, FL 33149.

[7] A headboat is a recreational fishing vessel that charges for a day's passage on a per person (i.e. per "head") basis.

ally at depths between 100 and 175 m) of yellowedge grouper, *Epinephelus flavolimbatus*, warsaw grouper, bigeye, and barrelfish were depleted before snowy grouper. Snowy grouper were most often caught between 110 and 155 m, but were sometimes taken from shallow water (<30 m) as they spawned off the Florida Keys. Tilefish usually produced monospecific catches from deeper waters, 175 to 300 m. Three areas have been unproductive for tilefish: the areas from 1) just below Cape Hatteras, North Carolina, to Cape Romain, South Carolina; 2) Bellville, Georgia, to St. Augustine, Florida; and 3) Marathon to Key West, Florida. Some fishermen believe this is because they have not yet determined when tilefish migrate through these areas, although tagging studies and submersible observations of tilefish and their burrows do not give evidence of migration (Grimes et al., 1983). There is little commercial fishing by U.S. fishermen for deepwater species between Ft. Pierce and Homestead, Florida, because the area is congested with domestic recreational and Bahamian (commercial and recreational) fishermen. Florida fishermen feared revealing "secrets" and were particularly vague about descriptions of the fishery in their area.

Table 1
Thirty-four species (representing 17 families) of deepwater (98 m to 152 m) reef fish observed from submersibles off North Carolina in 1979.

Muraenidae
Muraena retifera
Congridae
Conger sp. or *Paraconger caudilimbatus*
Ogcocephalidae
Ogcocephalus sp.
Serranidae
Diplectrum formosum
Epinephelus cruentatus
E. drummondhayi
E. morio
E. mystacinus
E. niveatus
Hemanthias vivanus
Holanthias martinicensis
Liopropoma eukrines
Serranus phoebe
Priacanthidae
Priacanthus arenatus
Pristigenys alta
Malacanthidae
Caulolatilus microps
Carangidae
Caranx bartholomaei
Seriola dumerili
S. rivoliana
Lutjanidae
Lutjanus vivanus
Rhomboplites aurorubens
Haemulidae
Haemulon plumieri
H. striatum
Sparidae
Pagrus pagrus
Sciaenidae
Equetus umbrosus
E. iwamotoi
Chaetodontidae
Chaetodon aya
C. ocellatus
C. sedentarius
Pomacanthidae
Holacanthus bermudensis
Pomacentridae
Chromis enchrysurus
Labridae
Decodon c.f. *puellaris*
Acanthuridae
Acanthurus coeruleus
Scorpaenidae
Helicolenus dactylopterus

Catch and Effort

From 1965 to the late 1970's, many north Florida fishermen and some from the Gulf of Mexico fished off South Carolina and North Carolina from June until late November. Trips usually lasted 1 to 2 weeks, but some fishermen stayed for longer periods and had their catches trucked back to Fernandina Beach and Pensacola, Florida, Pascagoula, Mississippi, or to northern markets. During these years there was a good market for snapper but not for grouper, and according to a few knowledgeable fishermen, grouper were occasionally thrown overboard to make room for the more valuable snapper.

The number of commercial and recreational fishing vessels that contributed to the recorded reef fish catch has increased considerably during the past 20 years. In 1995 there were about 2,758 vessels registered in the commercial snapper-grouper fishery from Cape Hatteras through Key West. However, only 1,324 of these actually fished. Most vessels use handlines including electric and hydraulic reels with terminal rigs of two to eight hooks. The number of full time commercial fishing vessels using handlines increased from 0 in 1972 to 730 in 1993, and the number of commercial fishing vessels using longlines increased from 1 in 1980 to 1,792 in 1993. In addition, approximately 90 headboats (usually >15 passengers) and 700 charter recreational vessels (<15 passengers) operating between Cape Hatteras and Key West occasionally fish deep reefs (Davis-Martin[8]). Headboat fishery effort data by angler day are shown in

[8] Davis-Martin, J. 1995. Regulations and Permits Branch, Regional Office, National Marine Fisheries Service, St. Petersburg, FL 33702. Personal commun.

Table 2

Comparison of past and present abundance (fish/ha) of economically important deepwater reef fish and those most commonly observed from submersibles at two stations off North Carolina and one station off South Carolina.

Species		Snowy Hole (115–155 m)		Big Rock (100–115 m)		Charleston Lumps (185–220 m)	
Common name	Scientific name	1979	1992	1979	1992	1982[1]	1992
Snowy grouper[2]	*Epinephelus niveatus*	45	22	2		9	2
Misty grouper[2]	*E. mystacinus*	4					
Speckled hind[2]	*E. drummondhayi*			4	4		
Scamp[2]	*Mycteroperca phenax*			5	45		
Yellowfin bass	*Anthias nicholsi*					P[3]	P
Red barbier	*Hemanthias vivanus*	P	P			P	P
Roughtongue bass	*Holanthias martinicensis*			P	P		
Tattler	*Serranus phoebe*	P	P	P	P		
Red snapper[2]	*Lutjanus campechanus*			5	5		
Blueline tilefish[2]	*Caulolatilus microps*			2		<1	14
Tilefish[2]	*Lopholatilus chamacleonticeps*					<1	
Blackbelly rosefish[2]	*Helicolenus dactylopterus*					P	P
Longspine scorpionfish	*Pontinus longispinis*					P	P
Southern hake	*Urophycis floridana*					<1	P
Bigeye[2]	*Priacanthus arenatus*			P	P		
Bank butterflyfish	*Chaetodon aya*			P	P		

[1] Gutherz et al., 1995.
[2] Economically important deepwater reef fish species.
[3] P = Prominent (2 dozen or more).

Figure 2. Reliable commercial fishery effort data are unavailable.

Catch data from commercial deep reef fisheries vessels often do not reveal species composition. Frequently, landings of several species are combined into aggregate categories such as "other grouper" or "tilefish." Less common species, like warsaw grouper, speckled hind, *Epinephelus drummondhayi,* or yellowedge grouper are usually not sufficiently abundant to be targeted or recorded in catches.

There are 19 economically important species in the deepwater reef fish fishery of the southeastern United States (Table 3). The data available indicate that five species make up the major portion of the catch in weight; they are, in descending order of total landings for 1995: tilefish, snowy grouper, blueline tilefish, warsaw grouper, and yellowedge grouper.

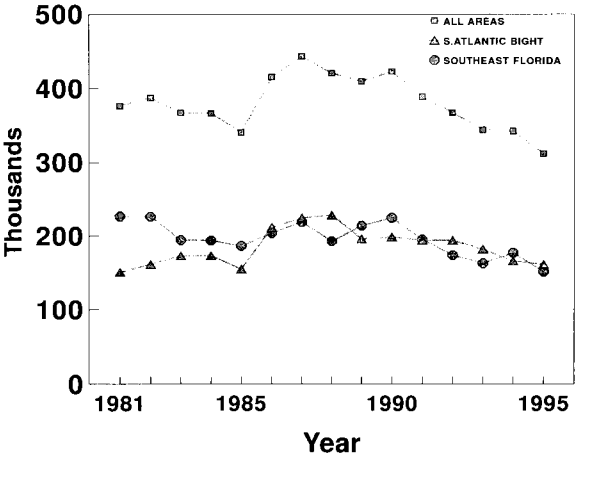

Figure 2
Headboat fishery effort by angler day.

Life Histories

Life history summaries and estimates of catches made from 1972 through 1995 follow for snowy grouper, yellowedge grouper, warsaw grouper, speckled hind, scamp, silk snapper, *Lutjanus vivanus,* blackfin snapper, *Lutjanus buccanella,* red snapper, *L. campechanus,* vermilion snapper, *Rhomboplites aurorubens,* tilefish, blueline tilefish, bigeye, red porgy, *Pagrus pagrus,* and greater amberjack. These deep reef species are important in catches from Cape Hatteras to Key West. Catch and effort data are unavailable for species not included. Headboat and commercial fisheries sample sizes and standard deviations for mean weight measurements are given in Tables 4–7.

Table 3
Economically important deepwater reef fish.

Species		Depth (m)	Age at maturity[1]	Maximum age[1]	Spawning period[1]	Catch (kg) 1995
Common name	Scientific name					
Snowy grouper	*Epinephelus niveatus*	61–262[1]	6–8	27	April–July	160,758
Yellowedge grouper	*Epinephelus flavolimbatus*	137–259[1]	5	15	April–Sept.	8,588
Warsaw grouper	*Epinephelus nigritus*	76–219[2]	9	41		20,763
Misty grouper	*Epinephelus mystacinus*	100–500[3]				
Speckled hind	*Epinephelus drummondhayi*	27–122[4]	4	25	July–Sept.	1,237[5]
Scamp	*Mycteroperca phenax*	15–122[4]	3	21	April–May	160,375[5]
Silk snapper	*Lutjanus vivanus*	61–275[6]	1			5,741
Blackfin snapper	*Lutjanus buccanella*	75–275[6]	1			491
Red snapper	*Lutjanus campechanus*	23–101[4]		16	April–Summer	1,292,104[5]
Vermilion snapper	*Rhomboplites aurorubens*	24–107[1]	3–4	10	April–Sept.	674,626[5]
Tilefish	*Lopholatilus chamaeleonticeps*	76–457[1]	5–7	33	March–Sept.	351,398
Blueline tilefish	*Caulolatilus microps*	70–236[1]	2–5	15	May–Oct.	57,826
Bigeye	*Priacanthus arenatus*	15–200[4]				5,924
Blackbelly rosefish	*Helicolenus dactylopterus*	200–650[3]				
Red porgy	*Pagrus pagrus*	27–183[1]	2–4	15	Jan–April	280,075[5]
Greater amberjack	*Seriola dumerili*	15–360[3]	3–5	10	March–July	506,153[5]
Barrelfish	*Hyperoglyphe perciformis*					2,000
Oilfish	*Ruvettus pretiosus*	200[3]				1,612
Escolar	*Lepidocybium flavobrunneum*	80–200[3]				4,904

[1] C.S. Manooch III, 1984.
[2] Manooch and Mason, 1987.
[3] Fischer, 1978.
[4] R.O. Parker Jr., personal observ.
[5] Most of the catch is from shallower waters (<100 m).
[6] Boardman and Weiler, 1980.

Table 4
Number of fish measured from headboats, 1972-96.

Species	Region	1972	1973	1974	1975	1976	1977	1978	1979
Snowy grouper	South Atlantic Bight	67	44	226	171	216	103	33	47
	Southeast Florida								
Yellowedge grouper	South Atlantic Bight	14	6	14	33	18	6	4	11
	Southeast Florida								
Warsaw grouper	South Atlantic Bight	11	3	13	18	20	5	16	3
	Southeast Florida							1	1
Speckled hind	South Atlantic Bight	141	271	183	199	109	149	114	28
	Southeast Florida							11	
Scamp	South Atlantic Bight	375	363	373	483	863	426	290	135
	Southeast Florida							12	35
Silk snapper	South Atlantic Bight	25	59	47	27	84	16	4	5
	Southeast Florida							144	68
Blackfin snapper	South Atlantic Bight	1		3	30			2	
	Southeast Florida							9	38
Red snapper	South Atlantic Bight	50	41	94	159	470	653	594	231
	Southeast Florida							3	4
Vermilion snapper	South Atlantic Bight	1,141	582	1,146	1,374	1,326	1,038	1,333	1,222
	Southeast Florida							461	169
Blueline tilefish	South Atlantic Bight	141	137	90	73	173	57	31	30
	Southeast Florida								29
Tilefish	South Atlantic Bight								
	Southeast Florida								
Bigeye	South Atlantic Bight	1		1			4	9	5
	Southeast Florida							41	23
Red porgy	South Atlantic Bight	4,199	4,663	3,593	2,304	2,506	2,142	1,539	855
	Southeast Florida							128	42
Greater amberjack	South Atlantic Bight	3	37	34	37	98	64	144	196
	Southeast Florida							18	25

continued on next page

Table 4 (continued)

Species	Region	1980	1981	1982	1983	1984	1985	1986	1987
Snowy grouper	South Atlantic Bight	51	30	22	66	34	58	72	24
	Southeast Florida		31	2	1	8	10	5	11
Yellowedge grouper	South Atlantic Bight	3		1	10	3	1		2
	Southeast Florida	1	3		1				
Warsaw grouper	South Atlantic Bight	9	19	19	14	41	10	15	8
	Southeast Florida	4	3	1	3	2	2	4	1
Speckled hind	South Atlantic Bight	28	7	27	75	94	82	72	48
	Southeast Florida	2	7	14	9	14		3	
Scamp	South Atlantic Bight	111	55	211	315	367	327	355	499
	Southeast Florida	47	54	42	119	87	106	56	22
Silk snapper	South Atlantic Bight	12	11	14	3		1	4	3
	Southeast Florida	23	58	51	65	58	70	159	68
Blackfin snapper	South Atlantic Bight		1			1			
	Southeast Florida	36	9	1	42	17	9	37	
Red snapper	South Atlantic Bight	222	601	425	921	1,154	1,082	401	296
	Southeast Florida	21	43	6	26	106	74	19	6
Vermilion snapper	South Atlantic Bight	1,096	1,162	2,612	3,026	3,977	4,457	5,081	5,391
	Southeast Florida	252	172	170	1,480	571	1,466	1,109	941
Blueline tilefish	South Atlantic Bight	28	10	18	46	26	19	29	9
	Southeast Florida	17	26			3	1	1	
Tilefish	South Atlantic Bight		1						
	Southeast Florida								
Bigeye	South Atlantic Bight	3	6		9	8	8	14	14
	Southeast Florida	23	22	43	79	47	148	133	122
Red porgy	South Atlantic Bight	1,374	1,102	2,425	2,209	2,472	1,750	1,823	2,145
	Southeast Florida	47	23	68	55	45	145	223	120
Greater amberjack	South Atlantic Bight	34	194	83	110	132	120	147	121
	Southeast Florida	69	19	15	172	97	118	96	144

Species	Region	1988	1989	1990	1991	1992	1993	1994	1995
Snowy grouper	South Atlantic Bight	44	24	5	3			14	10
	Southeast Florida	1	26	1				1	1
Yellowedge grouper	South Atlantic Bight								1
	Southeast Florida	1	2						
Warsaw grouper	South Atlantic Bight	1	2	3	1		6	7	11
	Southeast Florida		13						
Speckled hind	South Atlantic Bight	40	29	11	6	7	11	12	14
	Southeast Florida	8	1	1	1				
Scamp	South Atlantic Bight	421	328	315	383	225	319	324	362
	Southeast Florida	25	12	1	3	3	3	8	2
Silk snapper	South Atlantic Bight	23		2	1		8	4	
	Southeast Florida	16	38	34		33	27	63	32
Blackfin snapper	South Atlantic Bight								
	Southeast Florida	1	11	5	5		2		
Red snapper	South Atlantic Bight	201	331	311	86	61	182	472	129
	Southeast Florida	4	18		3		10	6	2
Vermilion snapper	South Atlantic Bight	4,237	4,117	4,751	3,866	2,330	2,893	4,920	4,565
	Southeast Florida	4,117	658	382	173	123	70	508	123
Blueline tilefish	South Atlantic Bight	7	3	1					
	Southeast Florida	1	6	5	1				
Tilefish	South Atlantic Bight		1			1			
	Southeast Florida		14	9					
Bigeye	South Atlantic Bight	24	35	40	14	10	34	35	62
	Southeast Florida	49	93	20	20	30	38	47	113
Red porgy	South Atlantic Bight	1,563	1,401	1,165	602	715	950	677	770
	Southeast Florida	39	46	41	9	7	12	30	68
Greater amberjack	South Atlantic Bight	92	102	75	64	79	110	91	111
	Southeast Florida	44	72	27	7	14	1	20	1

Table 5
Mean weight (standard deviation) from headboat fishery, 1972-95.

Species	Region	1972	1973	1974	1975	1976	1977	1978	1979
Snowy grouper	South Atlantic Bight	4.94 (3.17)	4.03 (3.36)	4.23 (2.65)	4.61 (6.58)	3.70 (3.12)	3.04 (2.40)	2.06 (1.31)	3.24 (2.11)
	Southeast Florida								
Yellowedge grouper	South Atlantic Bight	7.53 (4.96)	5.52 (0.38)	7.95 (3.15)	5.54 (2.89)	3.27 (1.03)	5.33 (5.81)	8.16 (2.23)	8.73 (4.45)
	Southeast Florida								
Warsaw grouper	South Atlantic Bight	13.50 (5.04)	21.96 (16.58)	32.66 (25.76)	50.23 (28.09)	24.08 (25.92)	21.97 (14.51)	9.38 (7.43)	7.92 (3.23)
	Southeast Florida							50.00 (0)	11.04 (0)
Speckled hind	South Atlantic Bight	4.28 (3.59)	3.59 (3.37)	3.78 (2.98)	3.60 (3.11)	4.17 (4.13)	2.69 (2.82)	2.45 (2.3)	2.77 (2.78)
	Southeast Florida				1.16 (0.64)				
Scamp	South Atlantic Bight	4.55 (1.84)	4.19 (1.70)	4.32 (1.51)	4.43 (1.93)	4.68 (1.64)	4.62 (1.99)	4.44 (2.67)	3.81 (2.13)
	Southeast Florida				1.36 (0.63)	1.15 (0.72)			
Silk snapper	South Atlantic Bight	4.93 (1.99)	4.52 (2.47)	4.81 (1.92)	4.40 (2.10)	2.11 (0.94)	1.95 (0.41)	1.94 (0.13)	3.39 (2.62)
	Southeast Florida				0.36 (0.25)			0.43 (0.21)	
Blackfin snapper	South Atlantic Bight	1.48 (0)		0.23 (0.05)	2.71 (1.46)			3.38 (0.03)	
	Southeast Florida				0.24 (0.10)				0.24 (0.05)
Red snapper	South Atlantic Bight	8.00 (2.73)	8.48 (2.15)	4.48 (3.24)	3.61 (3.07)	2.47 (2.62)	2.05 (2.16)	2.12 (2.72)	2.65 (2.85)
	Southeast Florida				2.31 (1.58)	0.64 (0.43)			
Vermilion snapper	South Atlantic Bight	0.52 (0.43)	0.80 (0.62)	0.56 (0.50)	0.62 (0.55)	0.62 (0.55)	0.45 (0.5)	0.48 (0.55)	0.46 (0.57)
	Southeast Florida							0.29 (0.17)	0.29 (0.27)
Tilefish	South Atlantic Bight								
	Southeast Florida								
Blueline tilefish	South Atlantic Bight	2.38 (1.18)	2.38 (1.21)	2.43 (1.20)	2.76 (1.44)	2.38 (0.96)	2.39 (0.96)	3.01 (1.04)	2.42 (1.17)
	Southeast Florida								0.59 (0.2)
Bigeye	South Atlantic Bight	1.00 (0)		3.31 (0)			0.72 (0.22)	0.81 (0.20)	1.09 (0.55)
	Southeast Florida							0.55 (0.13)	0.52 (0.13)
Red porgy	South Atlantic Bight	1.07 (0.40)	1.16 (0.49)	1.10 (0.51)	1.05 (0.57)	1.09 (0.56)	1.05 (0.45)	1.10 (0.61)	1.10 (0.57)
	Southeast Florida						0.50 (0.25)	0.50 (0.25)	0.61 (0.42)
Greater amberjack	South Atlantic Bight	5.89 (4.44)	7.60 (8.23)	8.19 (5.31)	10.67 (9.35)	9.05 (7.51)	5.94 (5.15)	10.74 (7.77)	4.71 (3.04)
	Southeast Florida							5.31 (6.62)	8.25 (8.16)

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Table 5 (continued)

Species	Region	1980		1981		1982		1983		1984		1985		1986		1987	
Snowy grouper	South Atlantic Bight	3.48	(2.76)	3.19	(1.96)	3.04	(2.42)	2.42	(2.32)	1.87	(1.58)	1.41	(1.24)	1.31	(1.22)	1.46	(0.86)
	Southeast Florida			1.55	(0.83)	1.92	(2.23)	7.25	(0)	1.55	(1.06)	1.34	(2.44)	0.41	(0.18)	1.57	(1.18)
Yellowedge grouper	South Atlantic Bight	5.00	(3.67)			1.75	(0)	3.30	(1.85)	3.24	(2.04)	1.50	(0)				
	Southeast Florida	1.30	(0)	0.75	(0.19)			0.62	(0)							4.15	(0.49)
Warsaw grouper	South Atlantic Bight	7.31	(3.53)	3.93	(1.40)	6.05	(3.59)	7.39	(3.88)	6.23	(3.41)	6.91	(2.65)	6.16	(3.14)	8.93	(4.92)
	Southeast Florida	8.81	(6.34)	19.37	(5.16)	7.72	(0)	0.75	(0.31)	6.35	(5.30)	3.70	(1.41)	10.00	(6.23)	3.80	(0)
Speckled hind	South Atlantic Bight	2.77	(2.41)	2.34	(1.83)	2.59	(3.68)	1.94	(2.90)	1.02	(1.00)	1.40	(2.23)	1.21	(0.99)	1.31	(1.29)
	Southeast Florida	0.35	(0.04)	0.66	(0.40)	1.07	(0.45)	1.35	(0.54)	1.24	(0.64)			0.85	(0.72)		
Scamp	South Atlantic Bight	2.76	(2.02)	3.00	(1.72)	2.89	(1.64)	2.84	(1.85)	2.75	(1.94)	2.49	(1.78)	2.21	(1.83)	1.62	(1.55)
	Southeast Florida	1.80	(0.84)	1.39	(0.99)	1.79	(0.84)	1.92	(1.27)	2.30	(1.51)	2.00	(1.31)	1.67	(1.00)	1.56	(1.06)
Silk snapper	South Atlantic Bight	1.71	(1.89)	1.28	(0.25)	1.40	(0.38)	1.20	(0.52)			0.59	(0)	0.62	(0.25)	0.84	(0.14)
	Southeast Florida	0.51	(0.39)	0.42	(0.19)	0.33	(0.19)	0.37	(0.29)	0.61	(1.31)	0.50	(0.37)	0.38	(0.16)	0.48	(0.35)
Blackfin snapper	South Atlantic Bight			0.68	(0)					1.50	(0)						
	Southeast Florida	0.24	(0.07)	0.45	(0.77)	0.60	(0)	0.24	(0.08)	0.30	(0.25)	0.29	(0.07)	0.43	(0.20)	0.24	(0.07)
Red snapper	South Atlantic Bight	2.00	(3.00)	1.59	(2.07)	2.16	(2.26)	1.23	(1.68)	1.30	(1.76)	1.18	(1.44)	1.66	(1.74)	1.38	(1.28)
	Southeast Florida	1.92	(1.17)	1.24	(0.85)	1.88	(0.39)	1.20	(1.17)	1.22	(0.68)	1.03	(0.63)	2.07	(2.26)	2.16	(1.33)
Vermilion snapper	South Atlantic Bight	0.56	(0.58)	0.36	(0.39)	0.43	(0.39)	0.39	(0.35)	0.37	(0.30)	0.33	(0.28)	0.30	(0.24)	0.28	(0.24)
	Southeast Florida	0.27	(0.14)	0.38	(0.21)	0.34	(0.17)	0.26	(0.14)	0.30	(0.30)	0.30	(0.14)	0.32	(0.15)	0.34	(0.24)
Tilefish	South Atlantic Bight			1.99	(0)												
	Southeast Florida																
Blueline tilefish	South Atlantic Bight	2.36	(1.38)	2.08	(1.13)	1.67	(0.76)	2.02	(0.82)	1.97	(1.19)	1.68	(0.89)	1.61	(0.82)	2.06	(0.60)
	Southeast Florida	0.98	(0.55)	1.92	(1.64)					1.69	(1.19)	0.43	(0)	3.51	(0)		
Bigeye	South Atlantic Bight	0.80	(0.18)	0.74	(0.26)			0.72	(0.24)	0.59	(0.21)	0.67	(0.24)	0.68	(0.19)	0.75	(0.28)
	Southeast Florida	0.61	(0.18)	0.51	(0.12)	0.49	(0.10)	0.48	(0.13)	0.51	(0.12)	0.54	(0.68)	0.48	(0.14)	0.50	(0.20)
Red porgy	South Atlantic Bight	0.98	(0.53)	0.86	(0.49)	0.73	(0.45)	0.78	(0.44)	0.77	(0.55)	0.67	(0.39)	0.64	(0.37)	0.58	(0.35)
	Southeast Florida	0.55	(0.23)	1.00	(0.44)	0.82	(0.43)	0.75	(0.28)	0.58	(0.38)	0.46	(0.24)	0.43	(0.21)	0.45	(0.20)
Greater amberjack	South Atlantic Bight	6.84	(7.94)	4.65	(2.11)	5.59	(5.76)	3.48	(5.27)	5.13	(6.93)	4.31	(5.36)	4.46	(6.09)	6.83	(5.63)
	Southeast Florida	7.63	(7.02)	3.38	(4.15)	2.37	(1.53)	3.00	(3.24)	7.36	(7.46)	3.82	(5.35)	3.89	(4.60)	3.86	(3.41)

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Table 5 (continued)

Species	Region	1988		1989		1990		1991		1992		1993		1994		1995	
Snowy grouper	South Atlantic Bight	1.49	(0.95)	1.15	(0.76)	1.05	(0.93)	1.46	(1.05)	0.36	(0)	0.56	(0.21)	0.75	(0.28)	0.84	(0.60)
	Southeast Florida	1.12	(0)	3.27	(2.29)	0.71	(0)					0.18	(0)	0.46	(0)	0.50	(0)
Yellowedge grouper	South Atlantic Bight															1.29	(0)
	Southeast Florida	1.20	(0)	3.34	(0.43)												
Warsaw grouper	South Atlantic Bight	9.92	(0)	6.69	(6.92)	3.29	(1.85)	8.50	(0)			6.23	(3.26)	6.24	(1.75)	6.99	(2.84)
	Southeast Florida			6.15	(3.77)												
Speckled hind	South Atlantic Bight	1.90	(1.94)	1.72	(1.52)	0.82	(0.70)	0.52	(0.14)	0.87	(0.15)	0.75	(0.51)	0.95	(0.63)	1.92	(2.92)
	Southeast Florida	1.21	(1.42)	0.36	(0)	0.65	(0)	0.38	(0)								
Scamp	South Atlantic Bight	1.45	(1.52)	1.40	(1.23)	1.52	(1.27)	1.54	(1.40)	2.58	(1.29)	2.70	(1.39)	2.38	(1.18)	2.30	(1.22)
	Southeast Florida	1.57	(1.20)	1.96	(0.96)	3.45	(0)	4.31	(3.63)	4.69	(3.12)	1.90	(0.20)	3.54	(1.54)	1.76	(0.26)
Silk snapper	South Atlantic Bight	0.64	(0.28)			1.22	(0.23)	2.47	(0)			0.61	(0.24)	1.31	(0.61)		
	Southeast Florida	0.51	(0.56)	0.33	(0.12)	0.36	(0.15)			0.46	(0.20)	0.51	(0.25)	0.55	(0.20)	0.66	(0.29)
Blackfin snapper	South Atlantic Bight																
	Southeast Florida	0.30	(0)	0.24	(0.16)	0.22	(0.01)	0.26	(0.14)			0.27	(0.04)				
Red snapper	South Atlantic Bight	1.61	(1.82)	1.37	(1.52)	1.45	(1.53)	2.91	(10.18)	2.75	(1.95)	2.63	(1.48)	1.48	(1.35)	3.11	(1.62)
	Southeast Florida	2.27	(2.36)	0.98	(1.69)			3.98	(0.75)			2.18	(1.39)	2.04	(0.45)	1.69	(0.27)
Vermilion snapper	South Atlantic Bight	0.29	(0.27)	0.29	(0.25)	0.23	(0.21)	0.20	(0.18)	0.34	(0.21)	0.35	(0.35)	0.33	(0.19)	0.34	(0.21)
	Southeast Florida	0.30	(0.18)	0.28	(0.75)	0.25	(0.15)	0.19	(0.12)	0.28	(0.24)	0.33	(0.23)	0.31	(0.13)	0.31	(0.18)
Tilefish	South Atlantic Bight			2.79	(0)					0.22	(0)						
	Southeast Florida			0.72	(1.08)	0.32	(0.07)										
Blueline tilefish	South Atlantic Bight	1.06	(0.93)	0.60	(0.19)	3.90	(0)										
	Southeast Florida	1.40	(0)	0.44	(0.33)	0.33	(0.8)	0.25	(0)								
Bigeye	South Atlantic Bight	0.77	(0.22)	0.80	(0.17)	0.84	(0.19)	0.71	(0.14)	0.96	(0.49)	0.91	(0.25)	0.82	(0.23)	0.88	(0.31)
	Southeast Florida	0.47	(0.12)	0.57	(0.19)	0.46	(0.11)	0.49	(0.12)	0.47	(0.12)	0.42	(0)	0.53	(0.11)	0.53	(0.18)
Red porgy	South Atlantic Bight	0.60	(0.55)	0.52	(0.28)	0.52	(0.26)	0.51	(0.25)	0.56	(0.22)	0.57	(0.22)	0.57	(0.20)	0.60	(0.22)
	Southeast Florida	0.47	(0.21)	0.34	(0.20)	0.40	(0.13)	0.78	(0.76)	0.50	(0.18)	0.53	(0.31)	0.59	(0.18)	0.38	(0.19)
Greater amberjack	South Atlantic Bight	7.29	(6.93)	5.87	(6.78)	8.85	(6.30)	7.72	(4.74)	9.42	(4.71)	9.04	(4.35)	8.68	(4.67)	7.75	(3.03)
	Southeast Florida	9.02	(5.80)	4.76	(5.85)	3.01	(4.05)	4.75	(1.32)	5.56	(5.28)	4.53	(0)	6.58	(4.49)	4.70	(0)

Table 6
Number of fish measured from commercial vessels, 1983-95.

Species	Region	1983	1984	1985	1986	1987	1988	1989
Snowy grouper	South Atlantic Bight	95	1,735	3,057	2,863	1,807	1,203	1,605
	Southeast Florida						6	
Yellowedge grouper	South Atlantic Bight		47	102	387	102	96	43
	Southeast Florida						1	
Warsaw grouper	South Atlantic Bight	3	14	17	32	19	58	15
	Southeast Florida						3	
Speckled hind	South Atlantic Bight	54	552	1,023	996	1,212	980	986
	Southeast Florida							
Scamp	South Atlantic Bight		1,275	1,722	2,269	4,049	2,885	3,462
	Southeast Florida						2	
Silk snapper	South Atlantic Bight	34	256	910	461	1,062	678	758
	Southeast Florida							
Blackfin snapper	South Atlantic Bight							
	Southeast Florida							
Red snapper	South Atlantic Bight	35	1,073	871	1,124	1,270	776	1,201
	Southeast Florida						1	
Vermilion snapper	South Atlantic Bight	391	4,921	5,996	8,621	8,022	6,215	5,625
	Southeast Florida						51	
Tilefish	South Atlantic Bight		291	109	3,433	542	807	834
	Southeast Florida				302		253	
Blueline tilefish	South Atlantic Bight	22	326	556	631	326	282	209
	Southeast Florida							
Red porgy	South Atlantic Bight	337	3,347	3,568	6,293	6,254	4,063	3,430
	Southeast Florida							
Greater amberjack	South Atlantic Bight	1	1	24	22	46	61	29
	Southeast Florida					4		

Species	Region	1990	1991	1992	1993	1994	1995
Snowy grouper	South Atlantic Bight	2,386	2,341	4,328	6,744	2,278	5,490
	Southeast Florida	8	1	267	233	112	19
Yellowedge grouper	South Atlantic Bight	107	179	744	708	128	93
	Southeast Florida			43	48	3	
Warsaw grouper	South Atlantic Bight	11	10	35	43	5	1
	Southeast Florida			5	5		
Speckled hind	South Atlantic Bight	578	478	348	243	155	15
	Southeast Florida			1			
Scamp	South Atlantic Bight	3,408	4,071	1,761	2,369	1,952	2,990
	Southeast Florida	16	1	37	40	5	
Silk snapper	South Atlantic Bight	310	118	121	170	588	723
	Southeast Florida			1	3		
Blackfin snapper	South Atlantic Bight						
	Southeast Florida						
Red snapper	South Atlantic Bight	812	927	530	1,383	1,177	1,291
	Southeast Florida	35	2	13	16	9	24
Vermilion snapper	South Atlantic Bight	6,003	10,302	5,306	8,046	7,466	9,841
	Southeast Florida	4	5	733	184	79	25
Tilefish	South Atlantic Bight	397	2,131	2,692	1,130	552	387
	Southeast Florida		40		2,613	72	578
Blueline tilefish	South Atlantic Bight	626	455	663	791	295	314
	Southeast Florida			121	61		
Red porgy	South Atlantic Bight	3,894	5,259	3,173	4,775	3,349	5,010
	Southeast Florida			70	237	17	
Greater amberjack	South Atlantic Bight	53	128	242	662	350	285
	Southeast Florida		7	3	154	87	34

Table 7
Mean weight (standard deviation) from commercial fishery, 1983-95.

Species	Region	1983	1984	1985	1986	1987	1988	1989
Snowy grouper	South Atlantic Bight	2.42 (2.09)	3.73 (3.30)	3.50 (3.02)	2.84 (2.59)	2.78 (3.02)	1.78 (1.57)	2.26 (2.25)
	Southeast Florida						1.51 (0.58)	
Yellowedge grouper	South Atlantic Bight		4.85 (3.31)	3.46 (2.74)	5.26 (3.22)	5.03 (3.21)	3.71 (2.94)	3.54 (2.55)
	Southeast Florida						6.76 (0)	
Warsaw grouper	South Atlantic Bight	77.28(25.48)	10.43 (5.87)	12.77 (8.68)	11.62 (5.27)	10.69 (5.29)	8.56(12.42)	16.58 (6.76)
	Southeast Florida						1.30 (0.13)	
Speckled hind	South Atlantic Bight	2.01 (1.78)	1.64 (2.07)	1.563 (1.52)	1.64 (1.74)	1.70 (1.45)	2.07 (2.24)	1.91 (1.71)
	Southeast Florida							
Scamp	South Atlantic Bight		3.47 (1.82)	3.14 (1.72)	3.30 (1.83)	3.12 (1.79)	2.85 (1.76)	2.48 (1.52)
	Southeast Florida						1.02 (0.40)	
Silk snapper	South Atlantic Bight	1.82 (1.53)	1.57 (1.85)	1.18 (1.27)	0.96 (0.98)	0.71 (0.66)	0.72 (0.56)	1.05 (0.96)
	Southeast Florida							
Blackfin snapper	South Atlantic Bight							
	Southeast Florida							
Red snapper	South Atlantic Bight	5.78 (3.10)	1.89 (2.01)	2.44 (1.92)	2.54 (1.92)	2.71 (2.56)	2.24 (2.19)	2.51 (1.85)
	Southeast Florida						2.35 (0)	
Vermilion snapper	South Atlantic Bight	0.94 (0.49)	0.85 (0.48)	0.82 (0.45)	0.63 (0.42)	0.56 (0.38)	0.54 (0.37)	0.62 (0.36)
	Southeast Florida						0.29 (0.07)	
Tilefish	South Atlantic Bight		11.49 (5.38)	8.86 (5.57)	6.58 (3.78)	7.35 (4.91)	4.99 (3.79)	4.67 (4.11)
	Southeast Florida				3.66 (2.64)		5.33 (3.41)	
Blueline tilefish	South Atlantic Bight	4.54 (2.43)	3.49 (2.01)	3.75 (1.81)	3.71 (1.63)	3.41 (1.78)	3.58 (1.64)	3.15 (1.78)
	Southeast Florida							
Red porgy	South Atlantic Bight	1.05 (0.49)	0.92 (0.46)	0.92 (0.45)	0.76 (0.44)	0.69 (0.38)	0.62 (0.38)	0.66 (0.39)
	Southeast Florida							
Greater amberjack	South Atlantic Bight		7.89 (0)	12.04(10.92)	17.23 (9.65)	14.26(13.02)	13.44 (9.99)	19.37 (15.21)
	Southeast Florida					1.81 (0.32)		

Species	Region	1990	1991	1992	1993	1994	1995
Snowy grouper	South Atlantic Bight	2.47 (2.15)	2.74 (2.95)	3.43 (2.73)	2.98 (2.11)	2.32 (1.98)	2.34 (1.60)
	Southeast Florida	2.67 (1.34)	2.13 4.12	(2.77)	4.08 (2.84)	1.47 (1.33)	1.09 (0.50)
Yellowedge grouper	South Atlantic Bight	3.29 (2.23)	3.84 (2.51)	3.93 (2.08)	4.41 (2.56)	3.37 (2.39)	3.39 (2.40)
	Southeast Florida			5.77 (2.93)	6.21 (3.75)	6.90 (3.71)	
Warsaw grouper	South Atlantic Bight	14.75 (7.34)	8.49 (5.04)	17.24(17.17)	24.42(30.94)	6.78 (3.24)	13.74 (0)
	Southeast Florida			12.98 (2.31)	17.78 (8.45)		
Speckled hind	South Atlantic Bight	1.76 (1.35)	1.96 (1.90)	1.97 (1.54)	3.15 (2.76)	1.85 (1.97)	1.97 (1.03)
	Southeast Florida			1.01 (0)			
Scamp	South Atlantic Bight	2.48 (1.55)	2.40 (1.49)	2.95 (1.41)	2.96 (1.38)	3.07 (1.40)	3.01 (1.38)
	Southeast Florida	2.99 (1.15)	4.08 (0)	2.82 (1.03)	3.21 (1.43)	3.51 (1.17)	
Silk snapper	South Atlantic Bight	0.87 (0.68)	0.90 (0.54)	0.74 (0.61)	0.72 (0.37)	0.72 (0.65)	0.76 (0.44)
	Southeast Florida			0.78 (0)	1.26 (0.29)		
Blackfin snapper	South Atlantic Bight						
	Southeast Florida						
Red snapper	South Atlantic Bight	2.37 (2.18)	2.48 (2.56)	4.36 (2.73)	3.55 (2.57)	3.18 (1.64)	4.04 (2.27)
	Southeast Florida	3.22 (1.32)	6.23 (3.75)	3.44 (1.75)	3.98 (2.68)	3.38 (2.80)	1.64 (0.87)
Vermilion snapper	South Atlantic Bight	0.60 (0.38)	0.61 (0.39)	0.63 (0.30)	0.70 (0.35)	0.72 (0.37)	0.65 (0.30)
	Southeast Florida	1.36 (0.10)	0.24 (0.10)	0.62 (0.19)	0.66 (0.29)	0.70 (0.26)	0.65 (0.13)
Tilefish	South Atlantic Bight	5.60 (3.95)	5.81 (4.47)	5.52 (4.12)	4.39 (4.29)	6.07 (3.71)	5.88 (3.80)
	Southeast Florida		5.34 (2.20)		4.16 (2.64)	3.09 (1.46)	3.71 (1.80)
Blueline tilefish	South Atlantic Bight	2.90 (1.63)	2.96 (1.46)	3.27 (1.40)	2.94 (1.31)	2.82 (1.27)	2.35 (1.10)
	Southeast Florida			3.29 (1.30)	3.43 (1.37)		
Red porgy	South Atlantic Bight	0.63 (0.35)	0.57 (0.35)	0.67 (0.35)	0.71 (0.32)	0.70 (0.29)	0.68 (0.30)
	Southeast Florida			0.98 (0.29)	0.93 (0.30)	0.82 (0.23)	
Greater amberjack	South Atlantic Bight	15.32(15.61)	20.11(14.41)	25.88 (8.22)	25.25 (8.74)	21.64(10.28)	27.28(10.86)
	Southeast Florida		24.12 (9.17)	23.48(19.01)	25.86 (8.07)	26.71 (6.18)	27.49 (2.33)

Snowy Grouper—The snowy grouper is a demersal serranid distributed in the western Atlantic from North Carolina and the Gulf of Mexico to Brazil. It also occurs in the eastern Pacific including the Gulf of California, Mexico, and Panama (Fischer, 1978). Juveniles (about 400 mm (TL)) have been observed off North Carolina in depths of 61 m (Parker and Ross, 1986) where bottom water temperatures fluctuate from about 15.0°C to 29.0°C. Adults occur to depths of about 180 m, and were common between 116 to 137 m off North Carolina (Huntsman and Dixon, 1976; Roe, 1976; Parker and Ross, 1986), where the habitat is irregularly sized boulders and ridges of bioeroded limestone with vertical relief up to 10 m, interspersed with sand, broken shell, and rock fragments.

Snowy grouper live at least 27 years, reaching a weight of 29 kg (Moore and Labisky, 1984). Average lengths for fish ages 1–17 years are 210, 328, 404, 462, 513, 561, 604, 648, 686, 721, 762, 797, 833, 874, 899, 924, and 958 mm (Matheson and Huntsman, 1984). They feed mostly on crabs, fishes, and cephalopods (Bielsa and Labisky, 1987; Dodrill et al., 1993). Snowy grouper are protogynous hermaphrodites, changing from females to males as they grow older. Fish first reach sexual maturity when about 4–5 years old and 450 to 500 mm long (Moore and Labisky, 1984). Spawning occurs April through July, and eggs and larvae are pelagic.

Total catch of snowy grouper peaked in 1981 around 350,000 kg and has since fluctuated between about 71,000 kg and 280,000 kg (Fig. 3). Snowy grouper are important in the commercial fishery and are the most frequently caught deep water grouper in the U.S. South Atlantic region. Commercial catches varied from 6,788 kg in 1980 to 278,330 kg in 1990 (Fig. 4). The catch in 1995 was 160,000 kg. The large catch of snowy grouper in 1990 (about 141,257 fish) was virtually all (99%) commercial. About 50% of the catch is from off the Carolinas and 50% from southeast Florida. Snowy grouper were important in the recreational fishery prior to

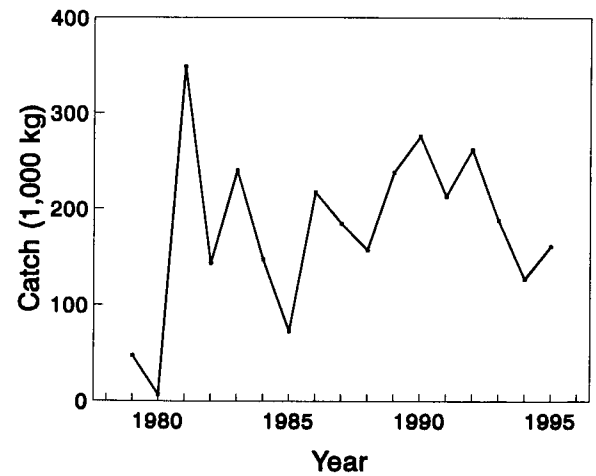

Figure 3
Snowy grouper catch (kg), all fisheries combined.

1984. The headboat catch was about 1,000 fish in the Carolinas in 1972. While fluctuating annually, catch in number was about 8,900 fish in 1983 (from Cape Hatteras to Key West), and then declined to about 395 fish in 1995 (Fig. 4). By weight, total headboat landings of about 29,148 kg in 1983 dropped to about 330 kg by 1995 (Fig. 4). Chartered and private recreational vessel (MRFSS) landings were highly variable and ranged from 247,532 kg in 1981 to about 397 kg in 1992.

Mean weight of headboat-caught snowy grouper in the South Atlantic Bight declined from 4.9 kg in 1972 to only 0.8 kg in 1995 (Fig. 5). The only data from the commercial fishery prior to 1983 are from South Carolina where mean weight dropped from 5.4 kg in 1977 to 5.0 kg in 1982 (Huntsman and Willis, 1989). Mean weight of commercially caught snowy grouper for the South Atlantic Bight declined from 3.7 kg in 1984 to 2.3 kg in 1995.

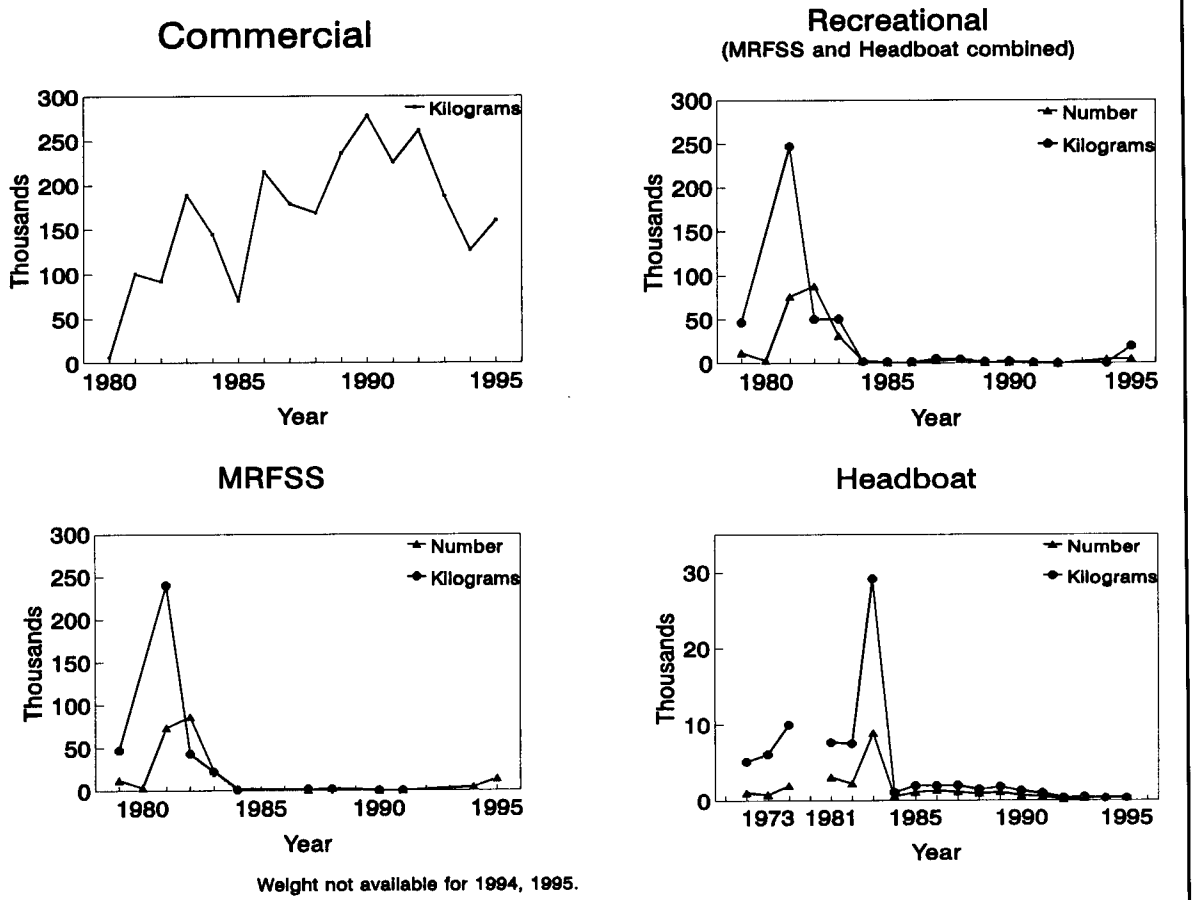

Figure 4

Snowy grouper catch (kg) from commercial and recreational (MRFSS and headboat) fisheries. (Because headboat data are considered more reliable than MRFSS data, the two are also shown separately in this and other figures.)

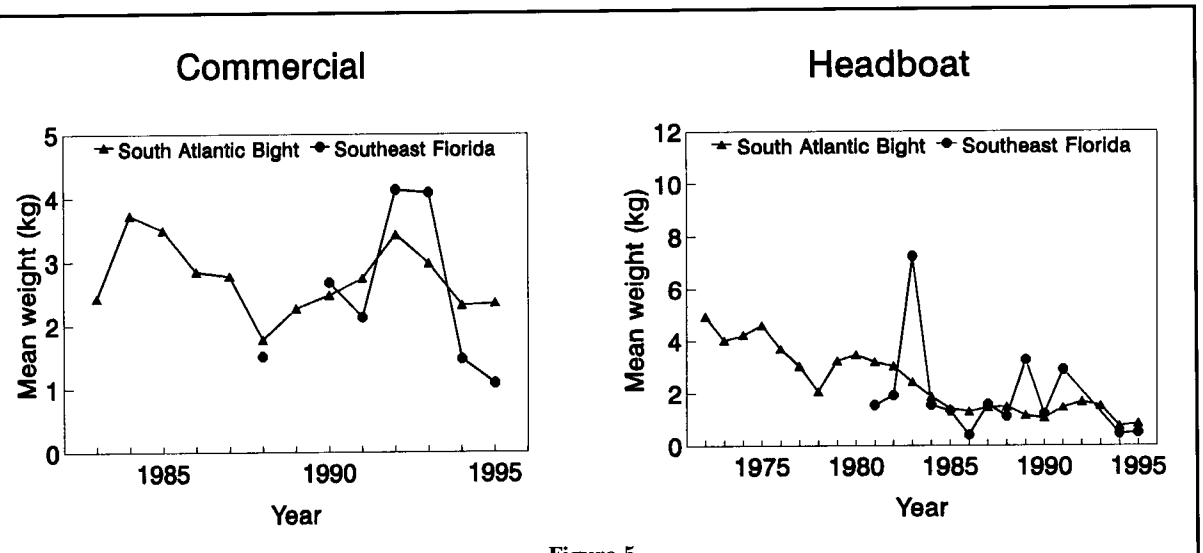

Figure 5

Snowy grouper mean weight (kg) from commercial and headboat fisheries.

Yellowedge Grouper—The yellowedge grouper is a large (to 18 kg) grouper that inhabits hard bottom and rocky outcroppings in depths of 190 to 220 m (Low and Ulrich[9]). It ranges from offshore North Carolina along the continental shelf break to Brazil and the Gulf of Mexico. It is much more abundant in the western Gulf of Mexico than in the Atlantic (Chester et al., 1984).

Yellowedge grouper live at least 15 years and grow to 1,110 mm. Like their close relative, snowy grouper, yellowedge grouper are believed to be protogynous hermaphrodites. Sex reversal may take place over a wide range of sizes, but has usually occurred by the time a fish reaches 850 mm (Keener, 1984). Yellowedge grouper normally mature between ages 5 and 6 (450 to 469 mm). Spawning occurs from April to October with a September peak, and eggs and larvae are pelagic. Adults feed on bottom dwelling animals, including squid, octopus, crabs, eels, lizardfish, seahorses, scorpionfish, and searobins (Manooch, 1984).

Total catch of yellowedge grouper peaked just under 20,000 kg in 1983 and has fluctuated between 6,300 kg and 15,000 kg from 1986 through 1995 (Fig. 6). Although usually not specifically targeted, yellowedge grouper are occasionally caught by fishermen seeking snowy grouper. Catches from most trips are small. The largest reported annual commercial catch, 17,765 kg, occurred in 1983 (Fig. 7). Catches fluctuated from 15,104 kg in 1986 to 6,218 kg in 1994. Reported landings in 1995 were 8,475 kg. Recreational landings from headboats have been insignificant, ranging from 1,300 kg in 1981 to about 100 kg in 1995 (Fig. 7). Mean weight of commercially caught yellowedge grouper in the South Atlantic Bight in 1984 was 5.2 kg (Fig. 8); however, by 1995 it had declined to about 3.4 kg. Mean weight sample sizes of yellowedge grouper caught from headboats in the South Atlantic Bight have been <3 since 1985 (Table 4).

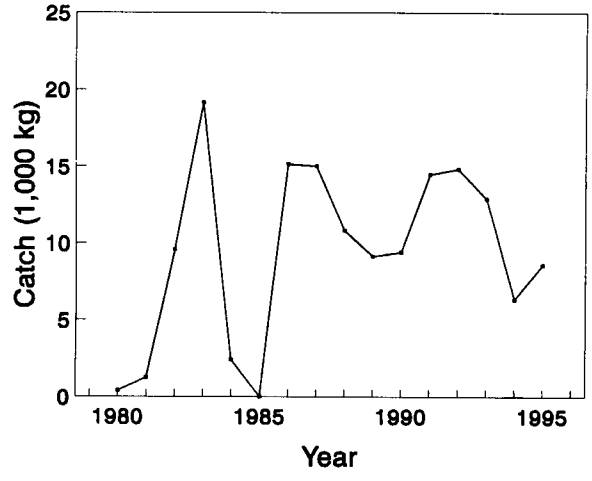

Figure 6
Yellowedge grouper catch (kg), all fisheries combined.

[9] Low, R. A., Jr., and G. F. Ulrich. 1983. Deep-water demersal finfish resources and fisheries off South Carolina. South Carolina Marine Resources Center, Charleston, SC 29412. Tech. Rep. 57.

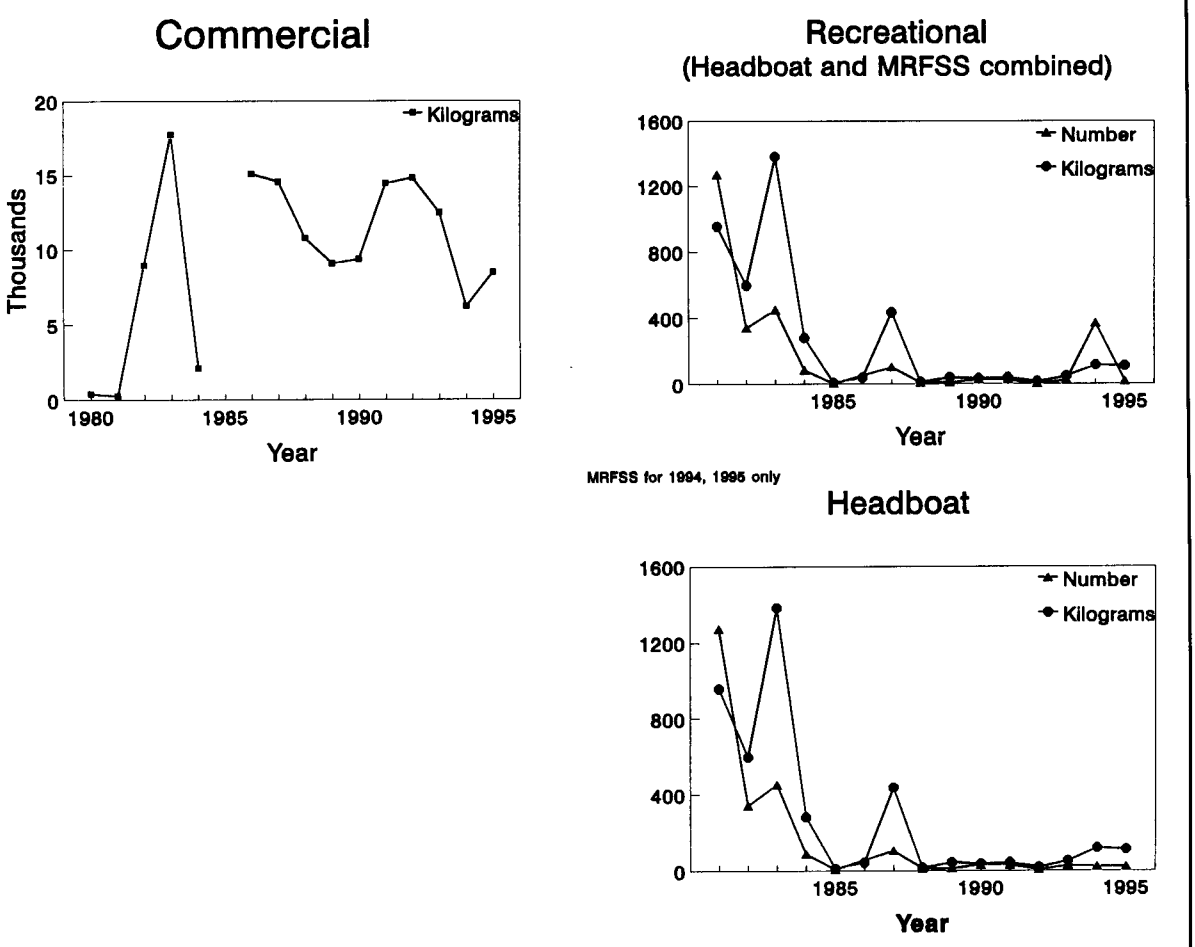

Figure 7
Yellowedge grouper catch (kg) from commercial and recreational fisheries.

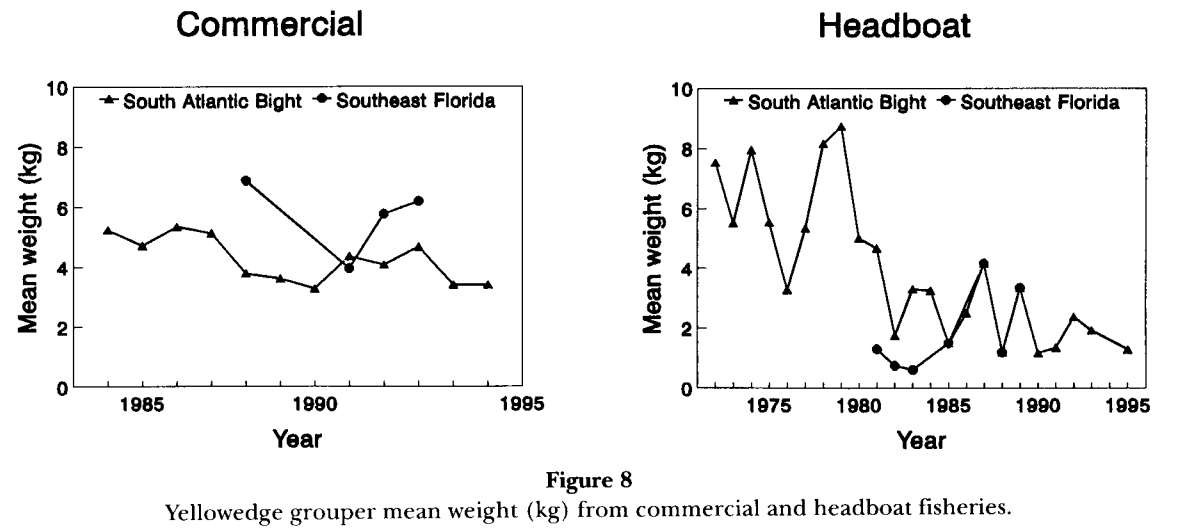

Figure 8
Yellowedge grouper mean weight (kg) from commercial and headboat fisheries.

Warsaw Grouper—The warsaw grouper is a large serranid distributed from North Carolina to the Florida Keys, and Gulf of Mexico to the northern coast of South America. It inhabits irregular bottoms including steep cliffs, notches, and rocky ledges of the continental shelf break in depths of 76 to 219 m (Manooch and Mason, 1987).

Little is known about the reproduction of warsaw grouper but eggs and larvae are thought to be pelagic. Warsaw grouper live at least 41 years and reach lengths of over 2,300 mm and weights of at least 190 kg. Average lengths for fish ages 1, 5, 10, 15, 20, and 24 years are 330, 914, 1,194, 1,295, 1,397, and 1,473 mm (Manooch and Mason, 1987). Fishes and crustaceans are major foods (Manooch, 1984).

Warsaw grouper are an occasional trophy for sport fishermen, but contribute less than 1% to the commercial landings of groupers in the Southeast. The total catch of warsaw grouper has declined from 536,201 kg in 1985 to 10,204 kg in 1993 (Fig. 9). Commercial and headboat catches trended downward to the present, from 34,005 kg in 1973 and 7,732 kg in 1981 to 1,393 kg and 2,046 kg in 1995 respectively (Fig. 10). Annual charter and private recreational vessel landings are highly variable and ranged from 6,545 kg in 1982 to 528,812 kg in 1985 (Fig. 10).

Mean weight for warsaw grouper from headboats has declined from about 50 kg in the 1970's to 7 kg in 1995 (Fig. 11). Although sample sizes were small (usually less than 10 fish), commercial data generally showed increasing mean weight per fish in recent years (Fig. 11). In 1990, in the South Atlantic Bight, 11 commercially caught fish had a mean weight of 14.8 kg. More recently, 43 fish measured in 1993 averaged 24.4 kg in the South Atlantic Bight while five southeast Florida fish averaged 17.8 kg.

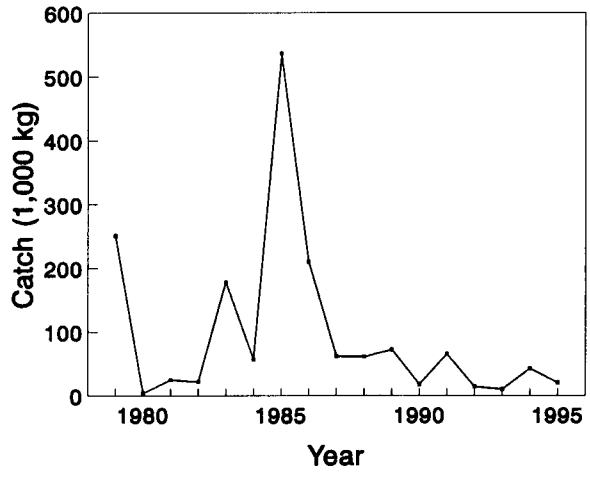

Figure 9
Warsaw grouper catch (kg), all fisheries combined.

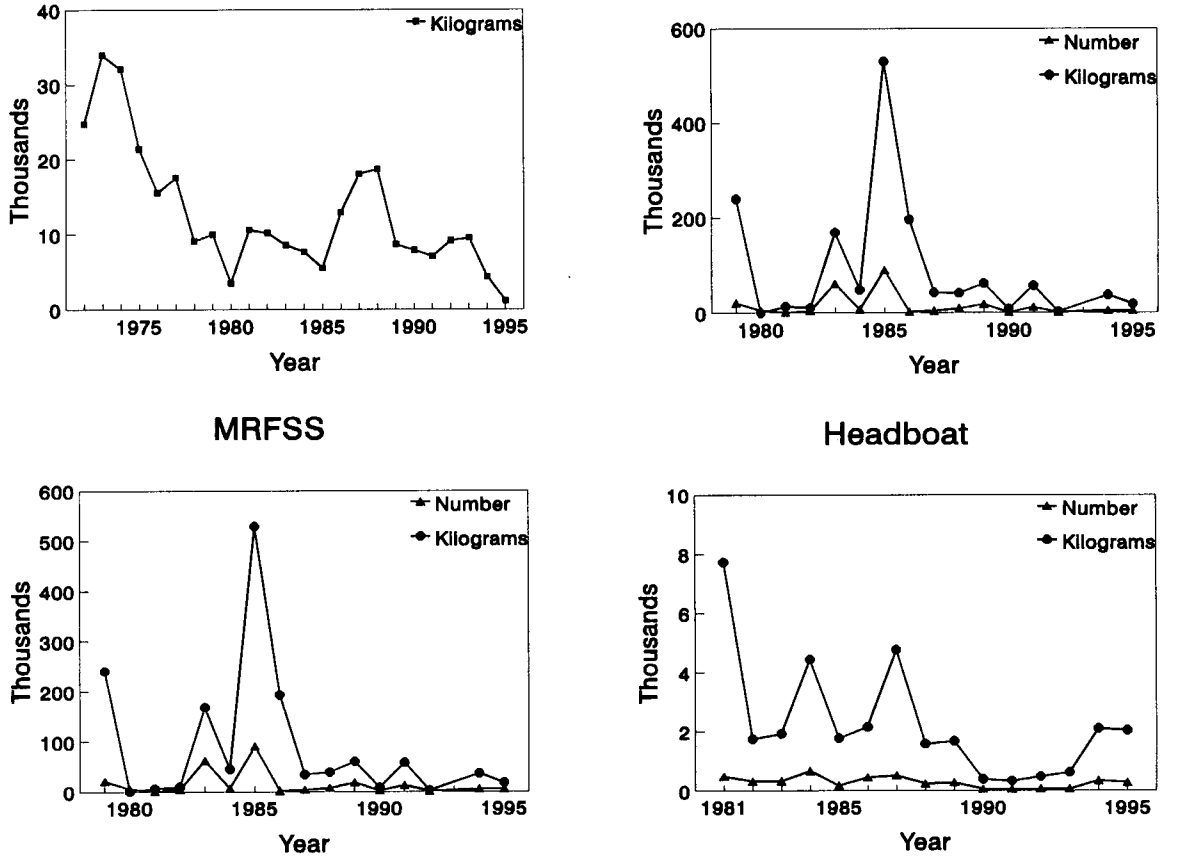

Figure 10
Warsaw grouper catch (kg) from commercial and recreational fisheries.

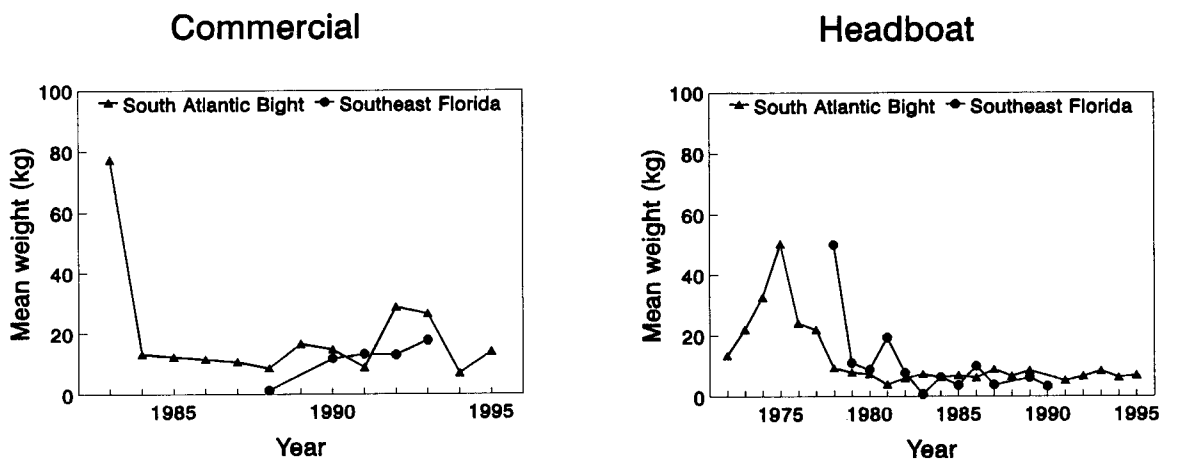

Figure 11
Warsaw grouper mean weight (kg) from commercial and headboat fisheries.

Speckled Hind—The speckled hind ranges from Bermuda and North Carolina to Florida, and throughout the Gulf of Mexico (Smith, 1971; Hoese and Moore, 1977). It inhabits high and low profile hard bottom in depths ranging from 27 to 122 m (Huntsman and Dixon, 1976; Parker, personal observ.).

Preliminary investigation indicates that speckled hind are protogynous hermaphrodites (Matheson, 1981). Most of the larger, older fish are males. Sexual maturity is reached in about 5 years (500 mm).

Speckled hind live more than 15 years and can weigh over 20 kg. Average total lengths for fish from North Carolina and South Carolina ages 1–15 years are 186, 317, 408, 475, 528, 572, 613, 645, 678, 709, 739, 774, 804, 839, and 861 mm (Matheson and Huntsman, 1984). Speckled hind generally engulf their prey whole. Their diet includes fishes, shrimp, crabs, squid, and octopus (Bullock and Smith, 1991).

Recent total catch of speckled hind has decreased from 19,594 kg in 1986 to 1,237 kg in 1995 (Fig. 12). The total headboat and commercial catch was probably greatest in 1973 when the headboat catch in North Carolina alone was almost 30,000 kg (Huntsman and Willis, 1989). North Carolina anglers caught about 8,600 speckled hind in 1973, and averaged about 3,100 fish per year through the late 1970's (Huntsman and Willis, 1989). From 1981 through 1988 the headboat catch in the South Atlantic Bight ranged from about 1,000 to 5,000 kg but dropped to 226 kg by 1994 (Fig. 13). Numbers of fish ranged from 2,735 in 1985 to 175 in 1995. Data are sporadically available for the charter and private boat sectors of the recreational fishery. In 1991, 6,532 speckled hind weighting 4,313 kg were landed by charter and private boats combined. In 1995, 1,994 fish were landed.

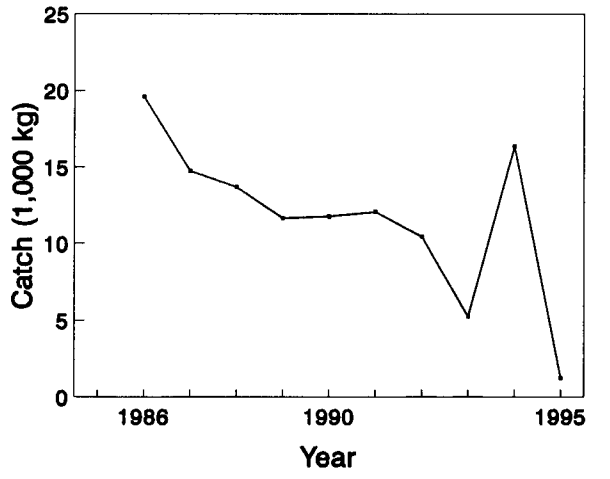

Figure 12
Speckled hind catch (kg), all fisheries combined.

Based on headboat samples, mean weights for speckled hind have declined as much as any species studied (Fig. 14). Speckled hind grow to 30 kg but averaged about 4 kg in headboat catches from the South Atlantic Bight before 1977 and <1 kg from 1990 to 1994. Mean weight of commercially caught speckled hind is about 2 kg.

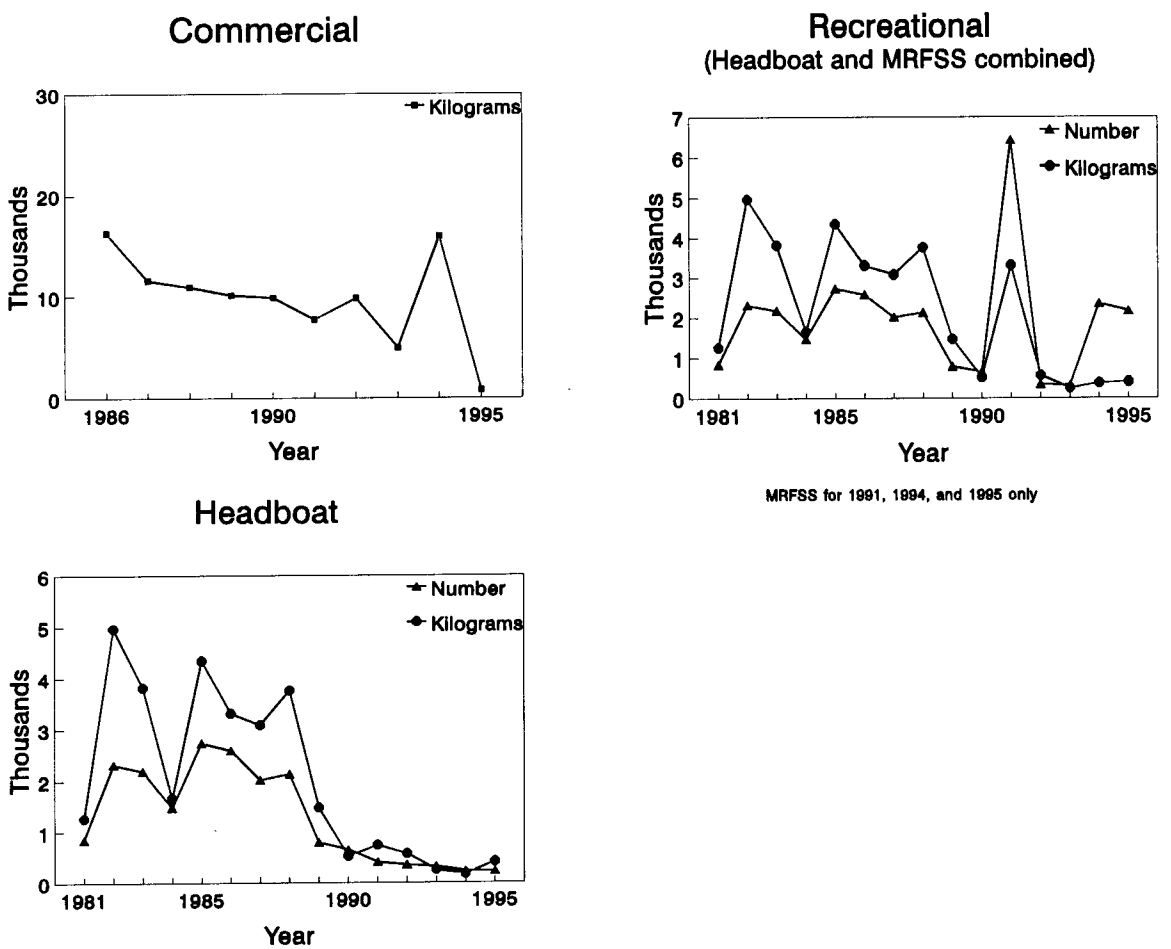

Figure 13
Speckled hind catch (kg) from commercial and recreational fisheries.

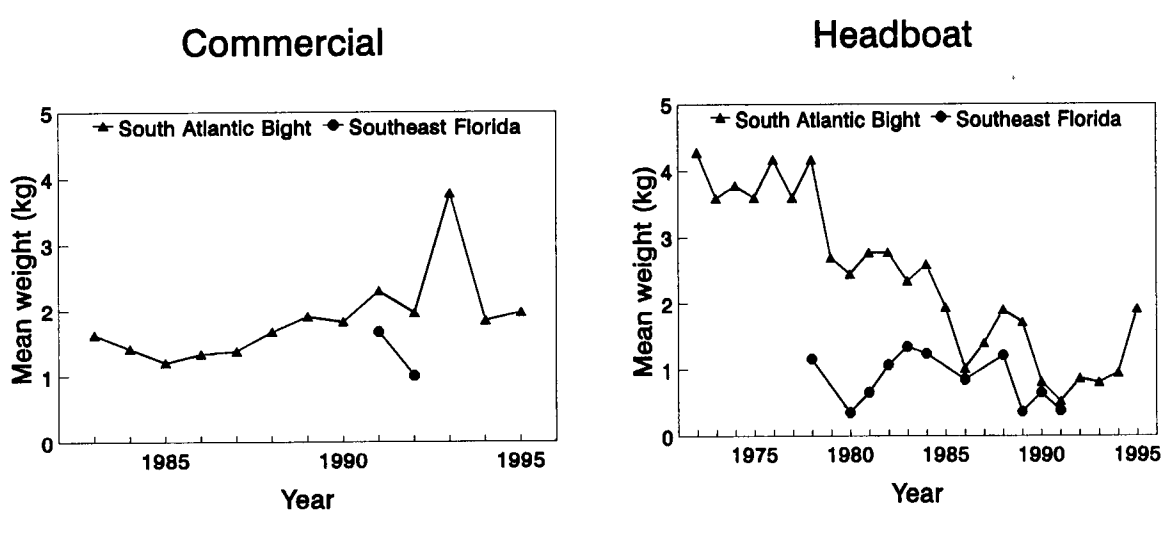

Figure 14
Speckled hind mean weight (kg) from commercial and headboat fisheries.

Scamp—The scamp inhabits continental shelf waters from North Carolina to Florida and throughout the Gulf of Mexico. The species has been observed over low to high profile rock outcroppings encrusted with soft corals, sponges, hydroids, and bryozoa in waters 20 to 100 m deep (Parker and Ross, 1986).

Scamp spawn from April through August with a peak in May and June (Matheson et al., 1986). They live at least 21 years and grow to 894 mm. Average total lengths (and weights) for fish ages 1, 2, 3, 4, 5, 10, 15, 20, and 21 years are 216 mm (0.15 kg), 333 mm (0.54 kg), 414 mm (1.0 kg), 470 mm (1.4 kg), 516 mm (1.9 kg), 663 mm (3.9 kg), 770 mm (6.9 kg), 884 mm (8.9 kg), and 894 mm (9.3 kg). Scamp feed mostly on fishes, such as round scad, *Decapterus punctatus*, tomtate, *Haemulon aurolineatum*, and vermilion snapper (Matheson et al., 1986).

Since 1980, the total catch of scamp has fluctuated from 54,260 kg in 1980 to 331,493 kg in 1982. The 1995 total catch was 160,375 kg (Fig. 15). In the recreational fishery, North Carolina and South Carolina headboats (approximately 35 vessels) consistently account for more than 90% of the annual headboat catch. Georgia and northeast Florida headboats (approximately 20 vessels) account for <10% of the catch of this species (Huntsman et al.[1]). Headboat catches have varied in number, from 3,581 fish in 1981 to 23,628 fish in 1991, while landed weights during the same years ranged from 13,485 kg (1981) to 78,233 kg (1991) (Fig. 16). Catches from charter and private recreational vessels ranged from 2,900 kg (1981) to 220,000 kg (1982) (Fig. 16). The identified commercial catch increased from 17,372 kg in 1980 to 221,192 kg in 1990, dropped to 30,014 kg in 1992, and then increased to 152,462 kg in 1994 (Fig. 16).

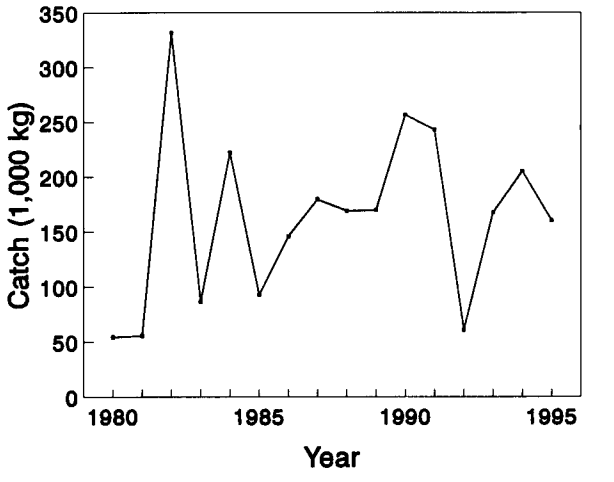

Figure 15
Scamp catch (kg), all fisheries combined.

The mean weight of fish caught from headboats in the South Atlantic Bight dropped from 4.6 kg in 1972 to 1.4 kg by 1989, then increased to 2.7 kg in 1993, but dropped to 2.3 in 1995 (Fig. 17)[10]. Mean weights from the commercial fishery were about 3 kg from 1984 through 1995.

[10] Size limit regulations were implemented in January 1992 (shown by an arrow (with size in parentheses) in figures) by Amendment 4 to the Snapper-Grouper Management Plan of the South Atlantic Fishery Management Council.

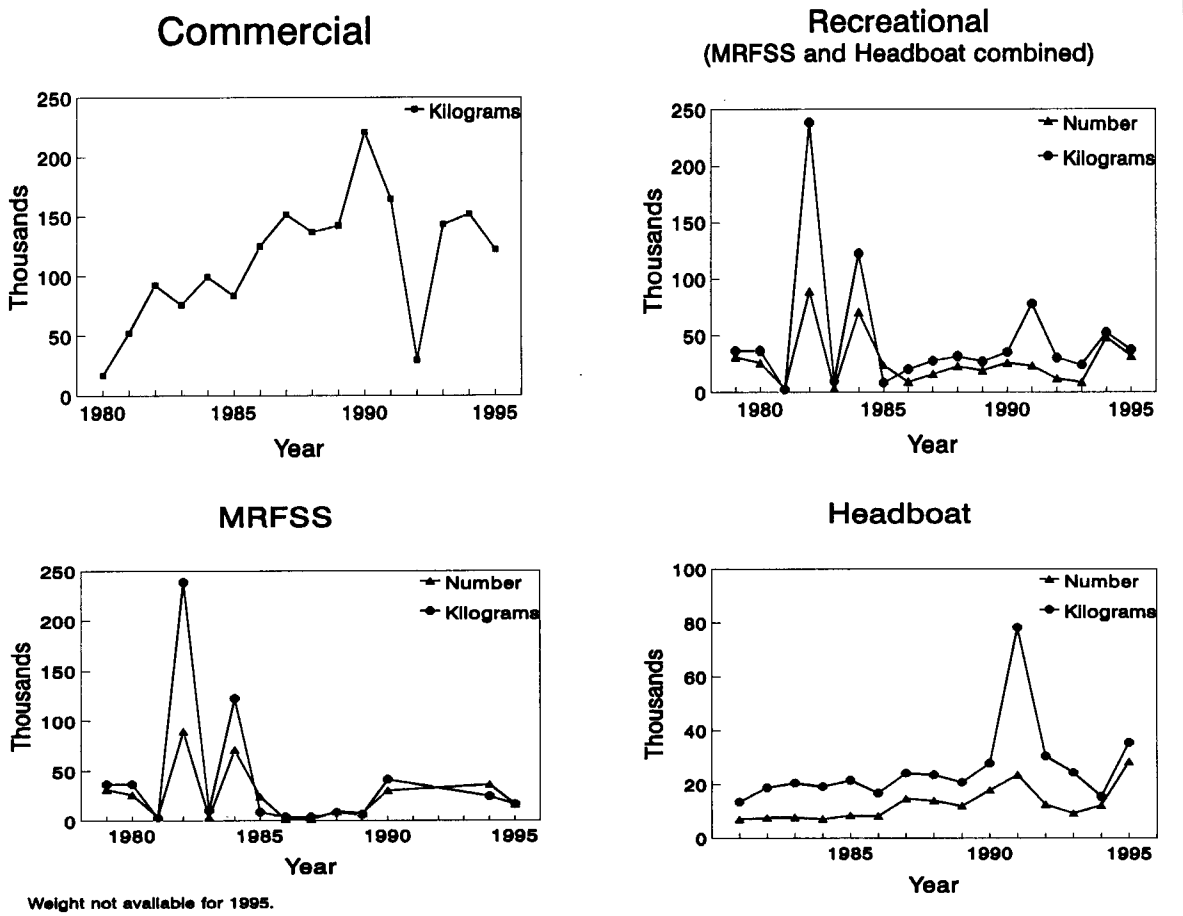

Figure 16
Scamp catch (kg) from commercial and recreational fisheries.

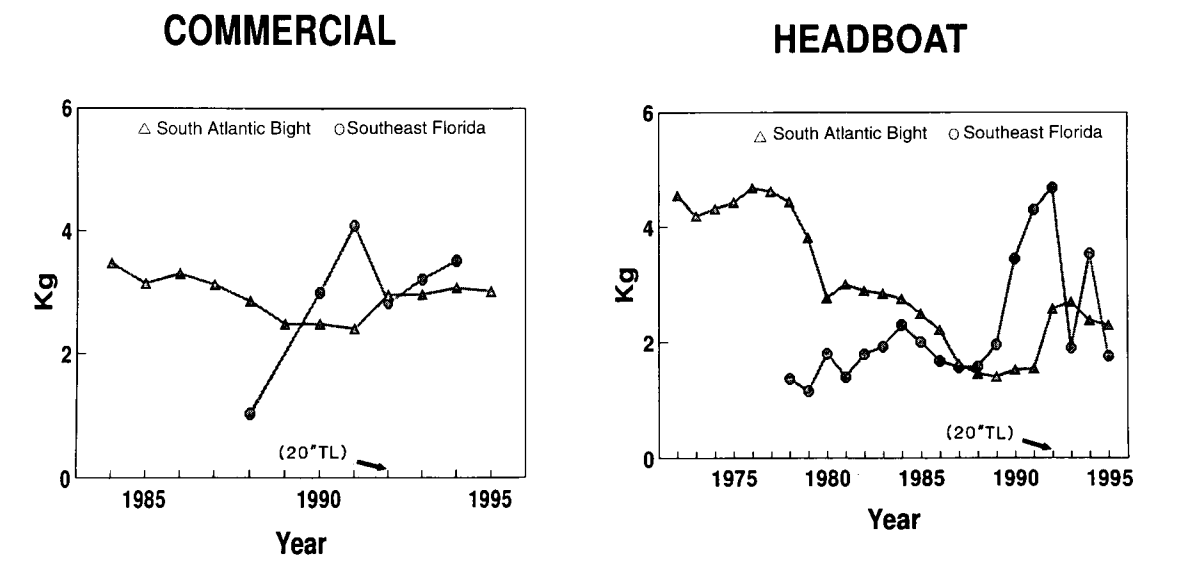

Figure 17
Scamp mean weight (kg) from commercial and headboat fisheries.

Silk Snapper—The silk snapper ranges from Cape Hatteras to Brazil and in the northern Gulf of Mexico along the continental shelf edge, 64 to 242 m in depth (Böhlke and Chaplin, 1993). This shelf edge habitat consists of algal limestone cliffs and ledges interspersed with shell hash and sandstone (Grimes, 1976). Young adult and juvenile fish occupy shallower depths than adult fish, to as shallow as 12 m where preferred bottom type occurs (Nagelkerken, 1981). Fish and crustaceans make up the majority of the diet.

Silk snapper reach sexual maturity by 500 to 555 mm and grow to 750 mm. Thought to travel in loose schools, silk snapper aggregate year round for spawning with apparent peaks in July through September and October through December. Female fish outnumber males (Boardman and Weiler, 1980).

The total catch of silk snapper declined from 17,548 kg in 1983 to 2,426 kg in 1992 (Fig. 18). The 1995 total catch was 5,741 kg. Commercial databases reveal widely varied silk snapper catches, from 117 kg in 1980 to

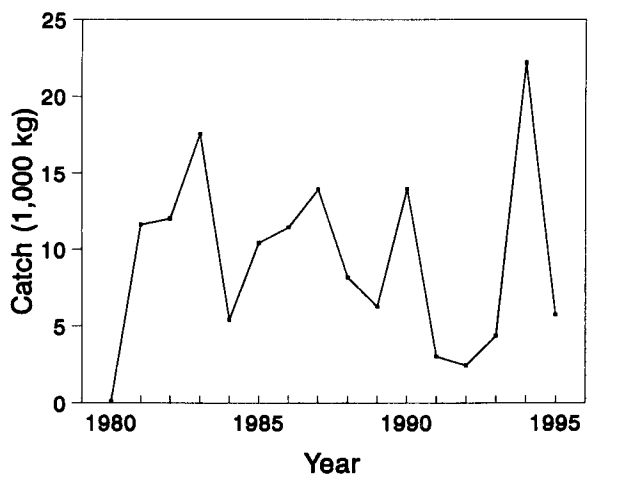

Figure 18
Silk snapper catch (kg), all fisheries combined.

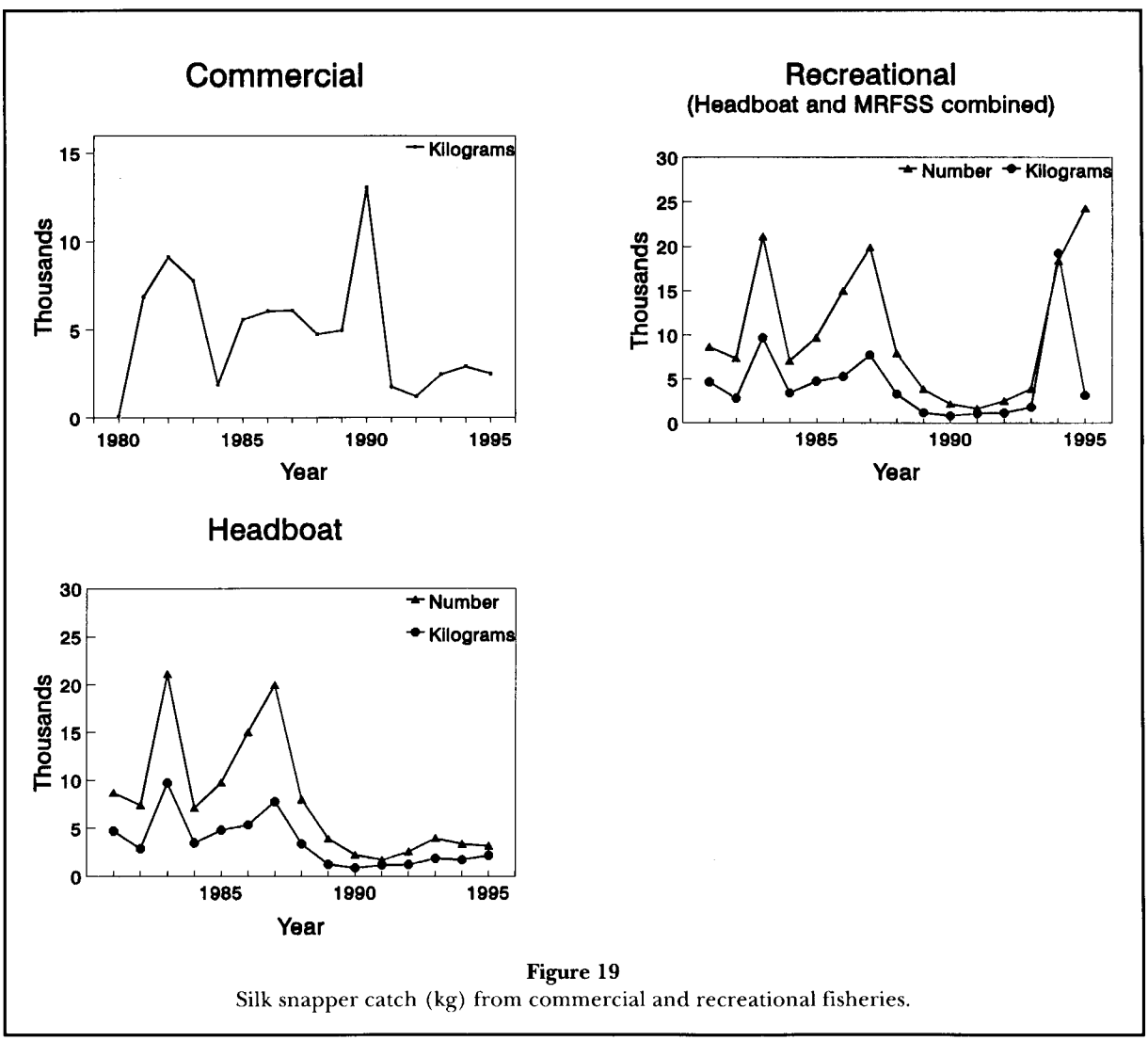

Figure 19
Silk snapper catch (kg) from commercial and recreational fisheries.

about 13,070 kg in 1990 (Fig. 19). The 1995 catch was 2,540 kg. Although the recreational (headboat) catch comprises a smaller segment of the silk snapper take, the catch has been significant, with a high of 9,736 kg in 1983 (Fig. 19). The mean weight of silk snapper in the South Atlantic Bight headboat fishery dropped from 4.9 kg in 1972 to 2.0 kg by 1977 (Fig. 20). Since 1977, sample sizes have been too small (except for 1988, 0.6 kg) to be meaningful (Table 4). Commercial fishery mean weight in the South Atlantic Bight dropped from 1.8 kg in 1983 to 0.7 kg in 1987 and has varied from 0.7 kg to 1.0 kg since then (Fig. 20)[10].

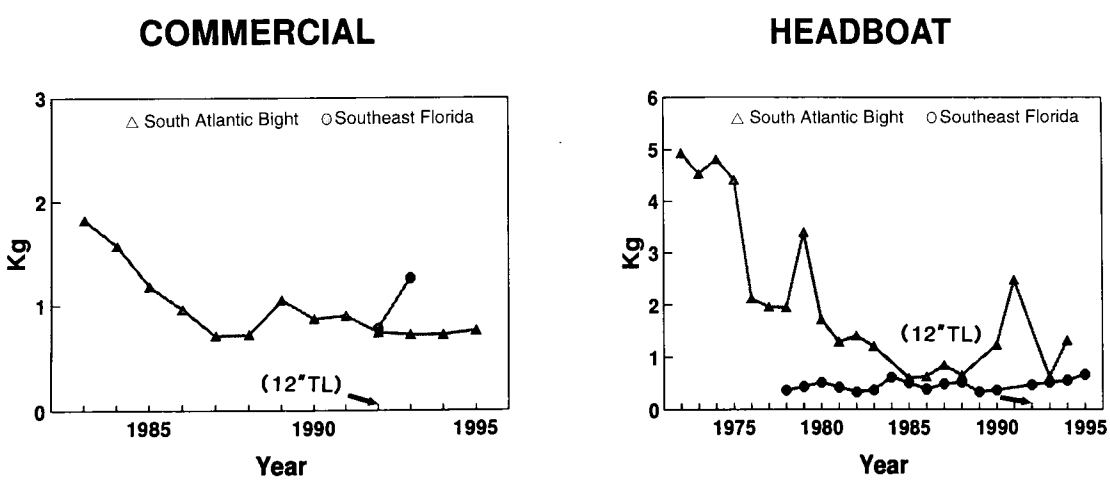

Figure 20
Silk snapper mean weight (kg) from commercial and headboat fisheries.

Blackfin Snapper—The blackfin snapper occupies shelf edge habitat from Cape Hatteras to the Caribbean Antilles, and in the Gulf of Mexico (Böhlke and Chaplin, 1993). While juveniles and subadults sometimes inhabit hard bottom at shallow depths (12 to 40 m), adult fish usually occur from 40 to 300 m (Nagelkerken, 1981). Male fish grow larger (to 740 mm) than females but are less common (Boardman and Weiler, 1980). Adult fish more commonly reach 500 mm on a diet of fish and crustaceans (Nagelkerken, 1981).

Blackfin snapper have never been reported in significant numbers. The total catch of blackfin snapper since 1981 fluctuated from 2,137 kg in 1991 to 26 kg in 1994 (Fig. 21). The 1995 total catch was 491 kg. The largest documented annual catch from headboats was 2,130 kg in 1991 (Fig. 22). Commercial landings varied from 353 kg in 1982 to 5 kg in 1990. Blackfin snapper are frequently misidentified as red snapper in the commercial catch, and landings are consequently underestimated.

Mean weight from the headboat fishery in southeast Florida has been around 0.2 kg to 0.4 kg from 1978 through 1989 (Fig. 23); since then sample sizes have been too small (<6) to be meaningful (Table 4).

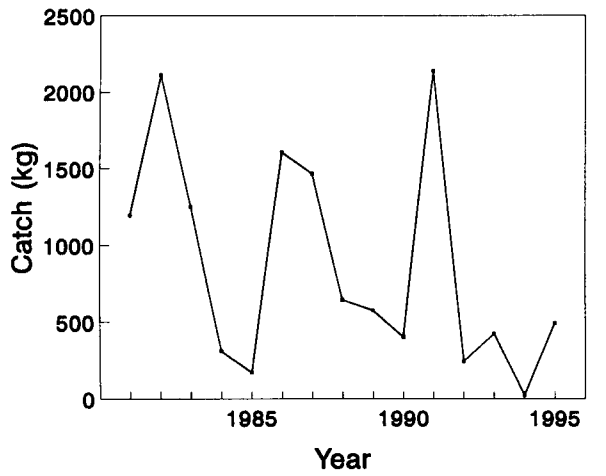

Figure 21
Blackfin snapper catch (kg), all fisheries combined.

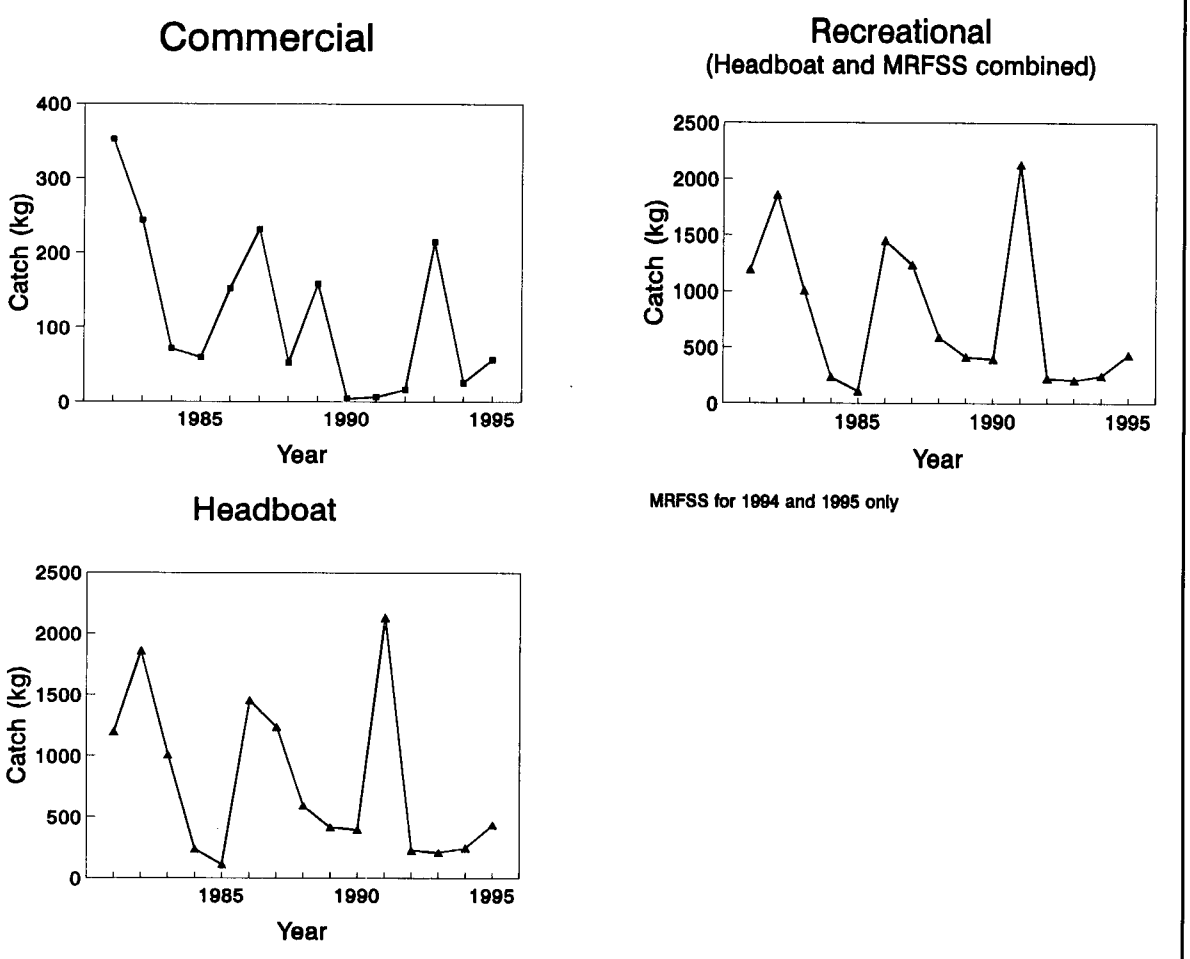

Figure 22
Blackfin snapper catch (kg) from commercial and recreational fisheries.

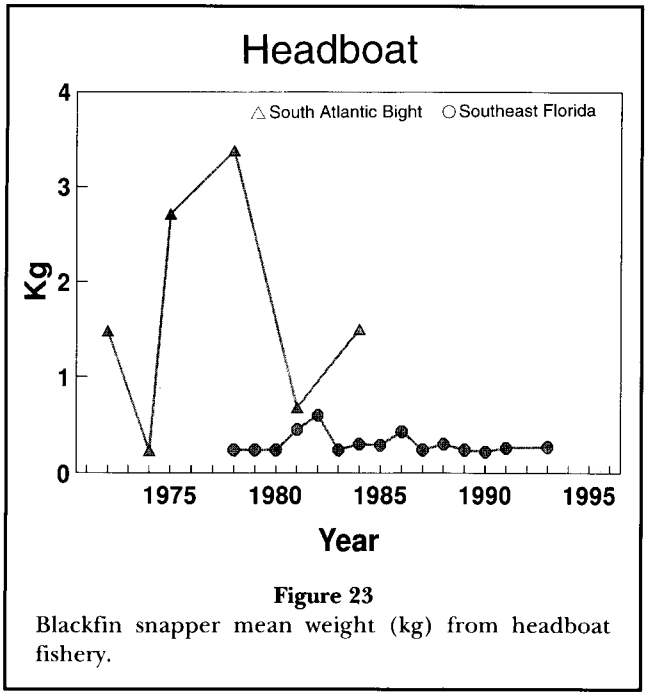

Figure 23
Blackfin snapper mean weight (kg) from headboat fishery.

Red Snapper—The red snapper ranges from Cape Hatteras to Florida and throughout the Gulf of Mexico. It is found over rocky bottom at depths from 10 to 190 m and feeds on fishes and invertebrates, including shrimp, cephalopods, and worms (Fischer, 1978).

Red snapper mature after 3 years (Bradley and Bryan, 1975) and spawn throughout the warmer months. Eggs and larvae are pelagic. The red snapper lives at least 16 years and grows to 1,025 mm. Average total lengths for fish aged 1, 2, 3, 4, 5, 10, and 15 are 224, 379, 453, 536, 577, 845, and 1,025 mm (Nelson and Manooch, 1982).

Most red snapper landed in the region are caught off north Florida and the Carolinas. Since 1980, the total catch of red snapper has fluctuated between 918,538 kg in 1985 to 57,792 in 1992 (Fig. 24). The 1993 total catch was 117,322 kg. The 1994 and 1995 peaks are due to MRFSS data and are unreliable (see footnote 4). Early estimates (1972) of the red snapper catch from headboats come from North Carolina where 2,187 fish weighing 18,576 kg were landed (Huntsman and Willis, 1989). By 1984, the combined headboat catch from both North Carolina and South Carolina had decreased to 2,581 fish weighing 5,196 kg. During the same year the entire U.S. southeast Atlantic headboat fishery yielded 31,146 fish weighing 36,930 kg (Fig. 25). A general downward trend resulted in a headboat catch of only 8,826 fish weighing 26,070 kg in 1995.

The charter and private recreational vessel catch estimates for 1979 through 1995 ranged from 51,000 kg in 1990 to 1,233,264 kg in 1994 (Fig. 25)[4]. Commercial landings of red snapper have decreased from about 300,000 kg in the 1970's to less than 100,000 kg in 1987 (Fig. 25). The 1995 catch was 80,000 kg.

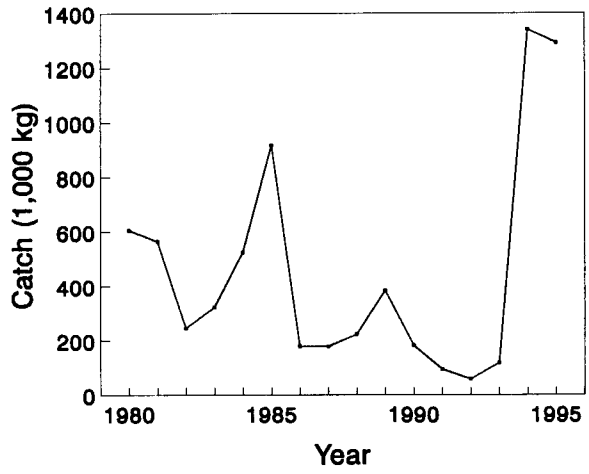

Figure 24
Red snapper catch (kg), all fisheries combined.

A 508 mm size limit instituted in January 1992 appears to have affected catches and mean weights. The mean weight of red snapper in the headboat fishery in the South Atlantic Bight declined from 8.5 kg in 1973 to 1.5 kg in 1990 (Fig. 26). From 1991 through 1995, the mean weight was about 2.5 kg. Commercially caught red snapper in the South Atlantic Bight increased from 1.9 kg in 1984 to 4.0 kg in 1995 (Fig. 26).

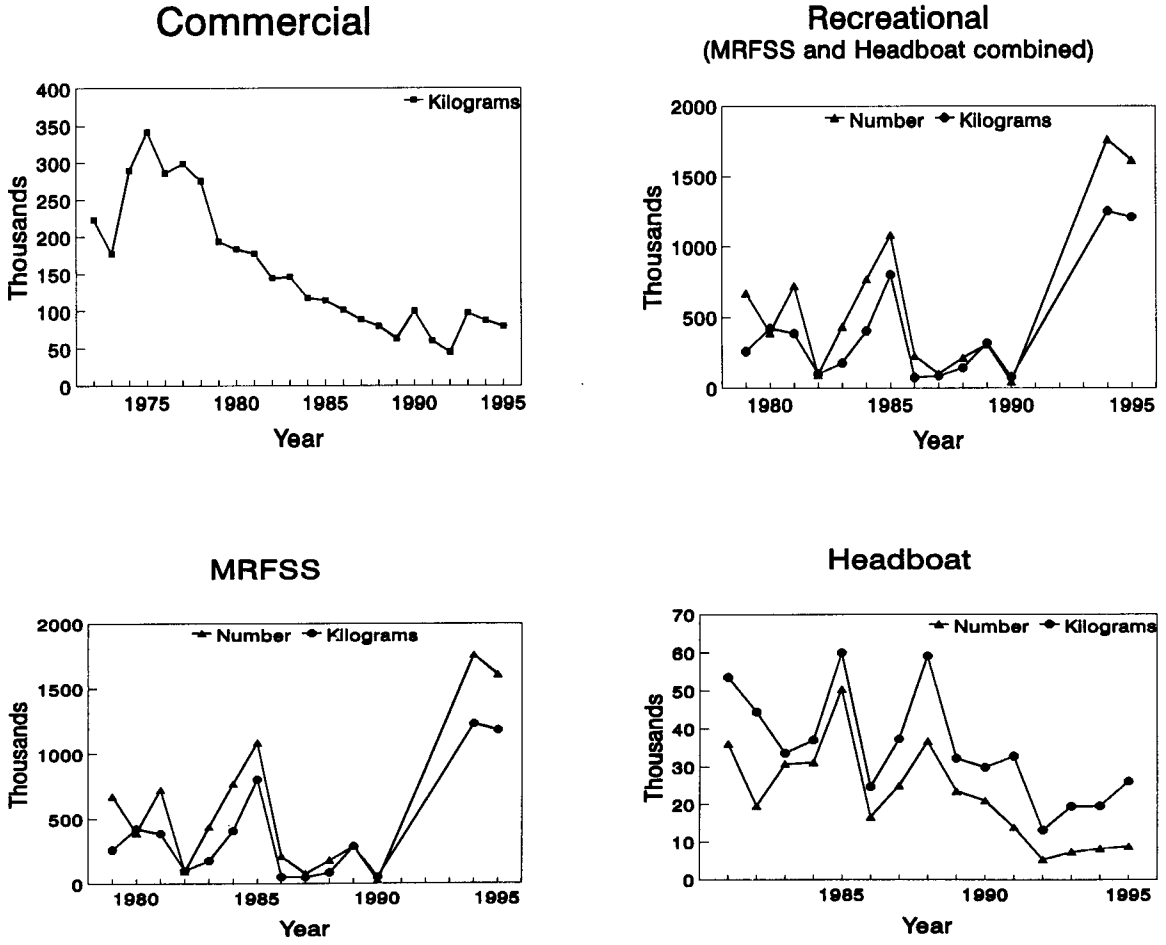

Figure 25
Red snapper catch (kg) from commercial and recreational fisheries.

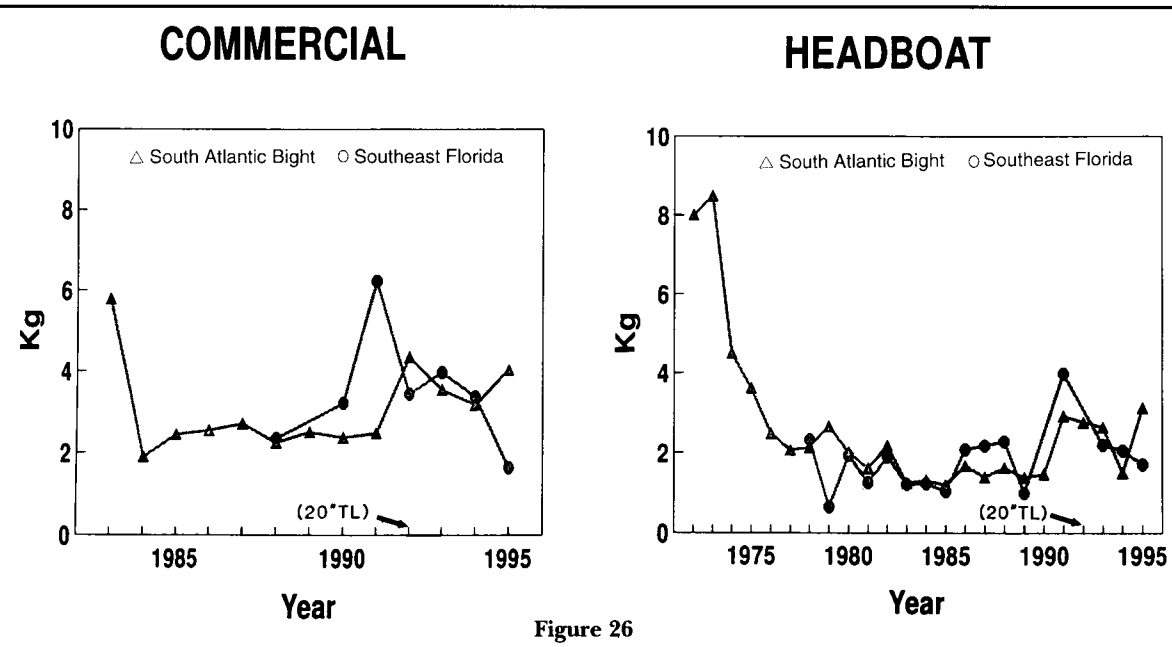

Figure 26
Red snapper mean weight (kg) from commercial and headboat fisheries.

Vermilion Snapper—The vermilion snapper occurs over rough bottom from Bermuda and North Carolina to Brazil, including the West Indies (Bohlke and Chaplin, 1993). Their diet consists mostly of small pelagic crustacea (ostracods, copepods, stomatopods, amphipods, shrimp, and crabs), cephalopods, pelagic gastropods, and small fish (Dixon, 1975; Grimes, 1979).

Vermilion snapper mature in 3–4 years, and spawn April through September off North Carolina (Grimes, 1976) and year-round off Puerto Rico (Boardman and Weiler, 1980). Ovaries contain 100,000 to 1.8 million eggs (Grimes, 1976). Eggs and larvae are pelagic. Vermilion snapper live at least 10 years and grow to 618 mm (Grimes, 1978).

Since the peak in 1982 of 1,263,808 kg, the total catch of vermilion snapper fluctuated to a low of 323,395 kg in 1993 (Fig. 27). The 1995 total catch was 674,626 kg. The headboat catch varied from 104,320 kg in 1981 to 275,691 kg in 1991 (Fig. 28). The 1995 headboat catch was 123,314 kg. Catches from charter and private recreational vessels ranged from 831,876 kg in 1982 to 5,496 kg in 1986, then increased to 201,686 kg in 1995 (Fig. 28). Commercial landings of vermilion snapper increased from 34,703 kg in 1972 (off the Carolinas) to 596,021 kg in 1990 and then declined to 206,730 kg in 1993 (Fig. 28). The 1995 commercial catch was 359,626 kg.

The mean weight of vermilion snapper caught from headboats in the South Atlantic Bight decreased from 0.8 kg in 1973, to 0.2 kg by 1991. Since size limits were implemented in 1992, the mean weight from headboats has averaged about 0.3 kg (Fig. 29). Mean weight for commercially caught fish throughout the region has remained about 0.6 kg since 1986.

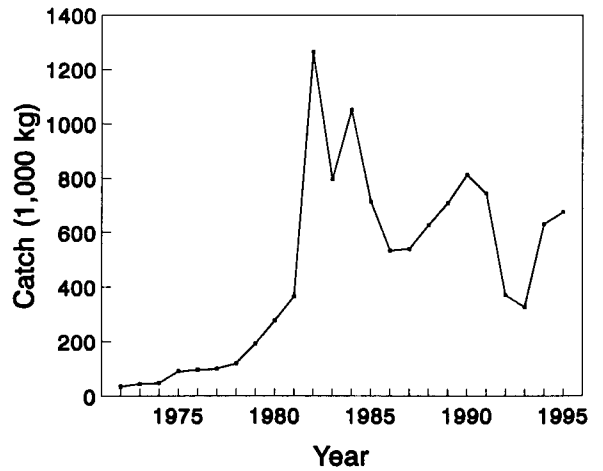

Figure 27
Vermilion snapper catch (kg), all fisheries combined.

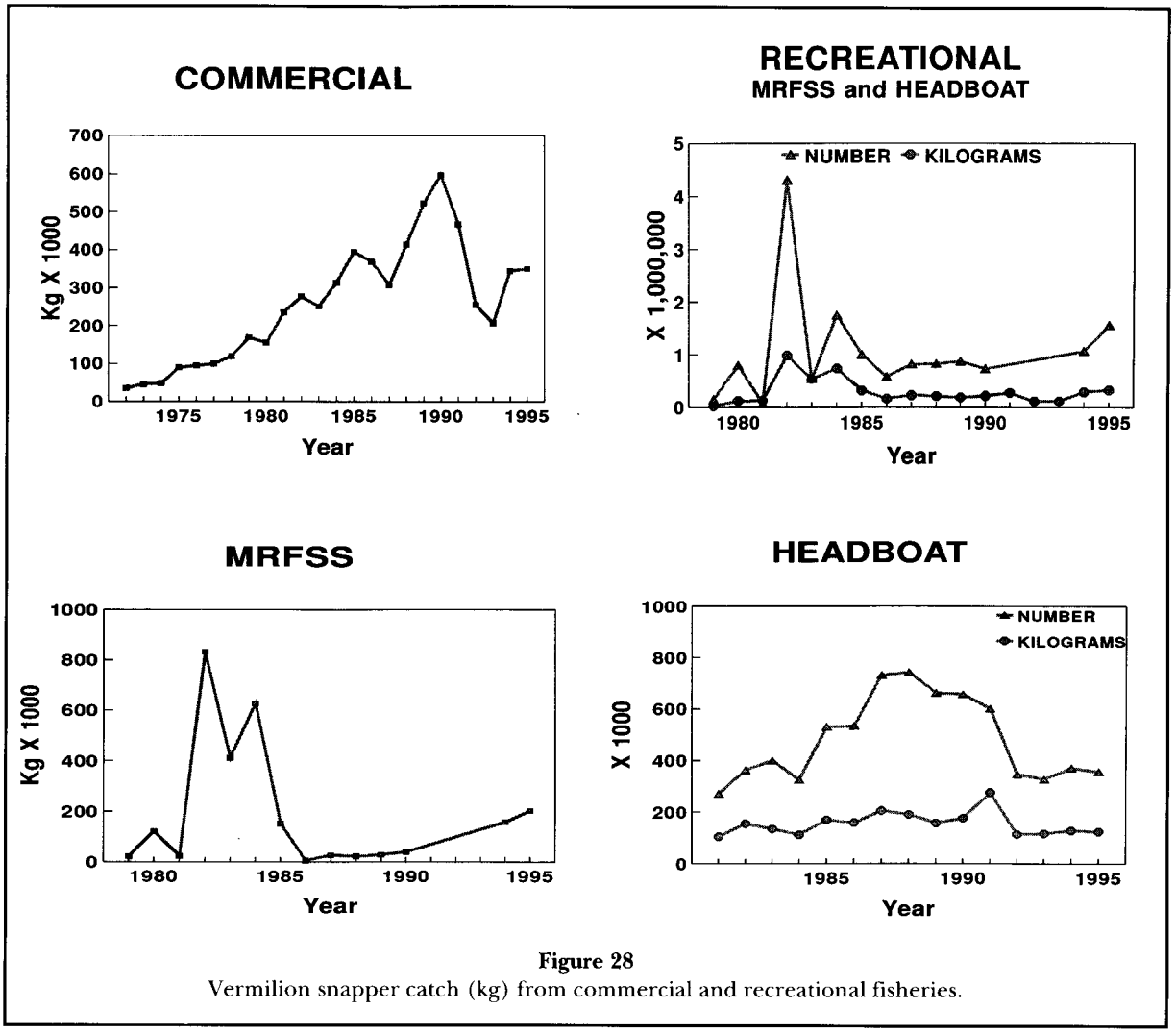

Figure 28
Vermilion snapper catch (kg) from commercial and recreational fisheries.

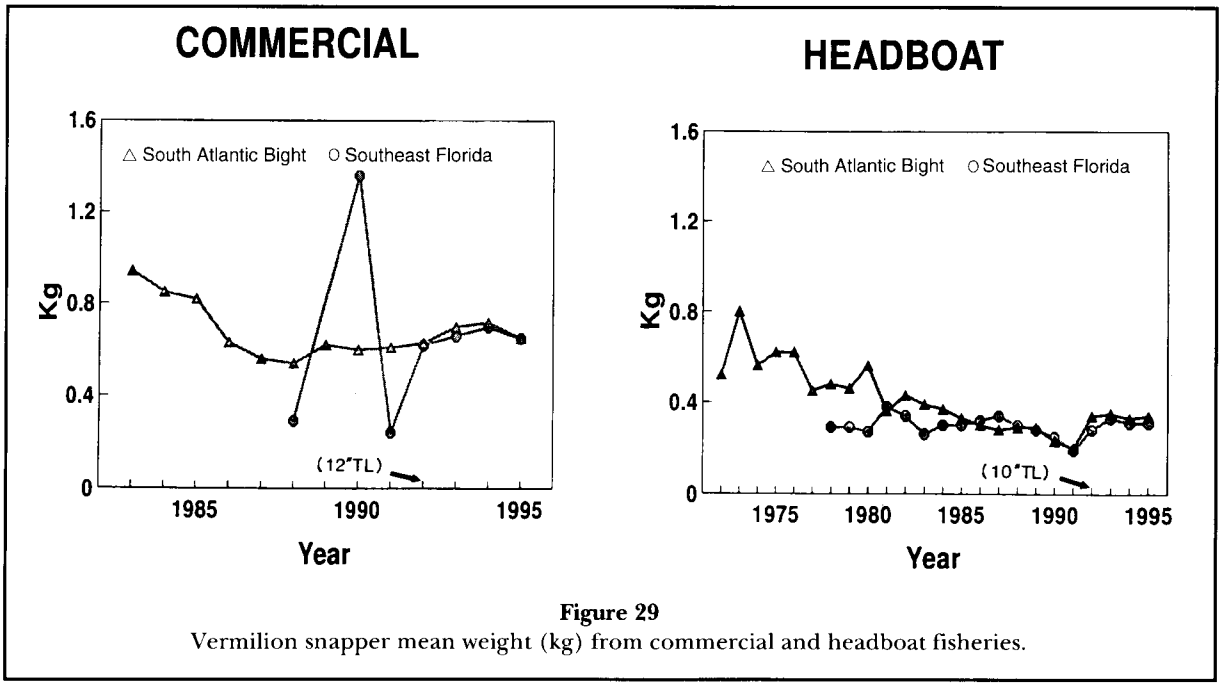

Figure 29
Vermilion snapper mean weight (kg) from commercial and headboat fisheries.

Tilefish—The tilefish is a demersal malacanthid species that inhabits the outer continental shelf and upper continental slope along the entire east coast of the United States and the Gulf of Mexico south to Venezuela. It is a bottom dweller, living in burrows in clay substrate at depths from 76 to 457 m (Freeman and Turner[11]) in water temperatures from 9°C to 14°C (Grimes et al., 1986).

Fifty percent of males mature by age 5 (450 mm) while 50% of females mature by age 6 (500 mm) (Erickson and Grossman, 1986). Females spawn 1 to 10 million eggs, and spawn fractionally from March to November (Grimes et al., 1988).

Tilefish live at least 33 years and mean sizes for fish ages 5, 10, 15, 20, 25, and 30 are 471, 554, 689, 790, 883, and 852 mm (Harris and Grossman, 1985). Adult tilefish feed on fish, crabs, shrimp, squid, worms, sea cucumbers, anemones, tunicates, and sea urchins (Freeman and Turner[11]).

Total weight of tilefish dropped from 1,709,970 kg in 1982 to 170,613 kg in 1987. The 1995 total catch was 351,398 kg (Fig. 30). Commercial catches of tilefish from Cape Hatteras to Key West grew steadily from 1972 to 1980, from 5,766 to 165,252 kg respectively (Fig. 31). Effort and landings exploded in the following 3 year period, resulting in huge catches (1,709,962 kg in 1982), but by 1983 (959,601 kg) the fishery began to decline. From 1985 through 1995, catches have fluctuated around 420,000 kg per year. Commercial mean weight in the South Atlantic Bight decreased from 11.5 kg in 1984 to about 5.0 kg in 1995 (Fig. 32). About 50 commercial vessels concentrated on tilefish from 1988 through 1992. Recently, there has been no significant recreational catch of tilefish (about 1,000 fish annually from 1986 through 1992).

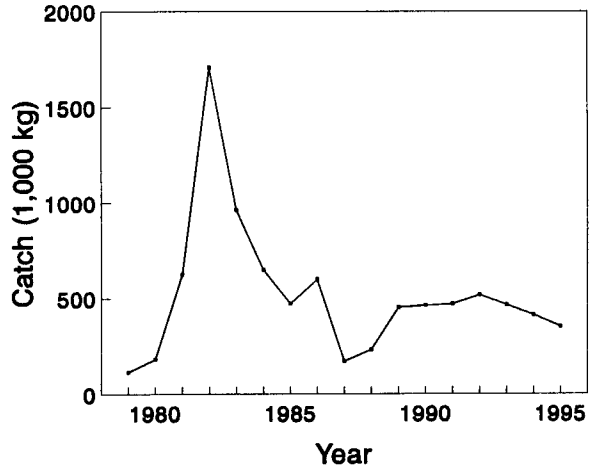

Figure 30
Tilefish catch (kg), all fisheries combined.

[11] Freeman, B. L., and S. C. Turner. 1977. Biological and fisheries data on tilefish, *Lopholatilus chamaeleonticeps*, Goode and Bean. Sandy Hook Laboratory, Northeast Fisheries Center, National Marine Fisheries Service, Highlands, NJ 07732. Tech. Ser. Rep. 5, 41 p.

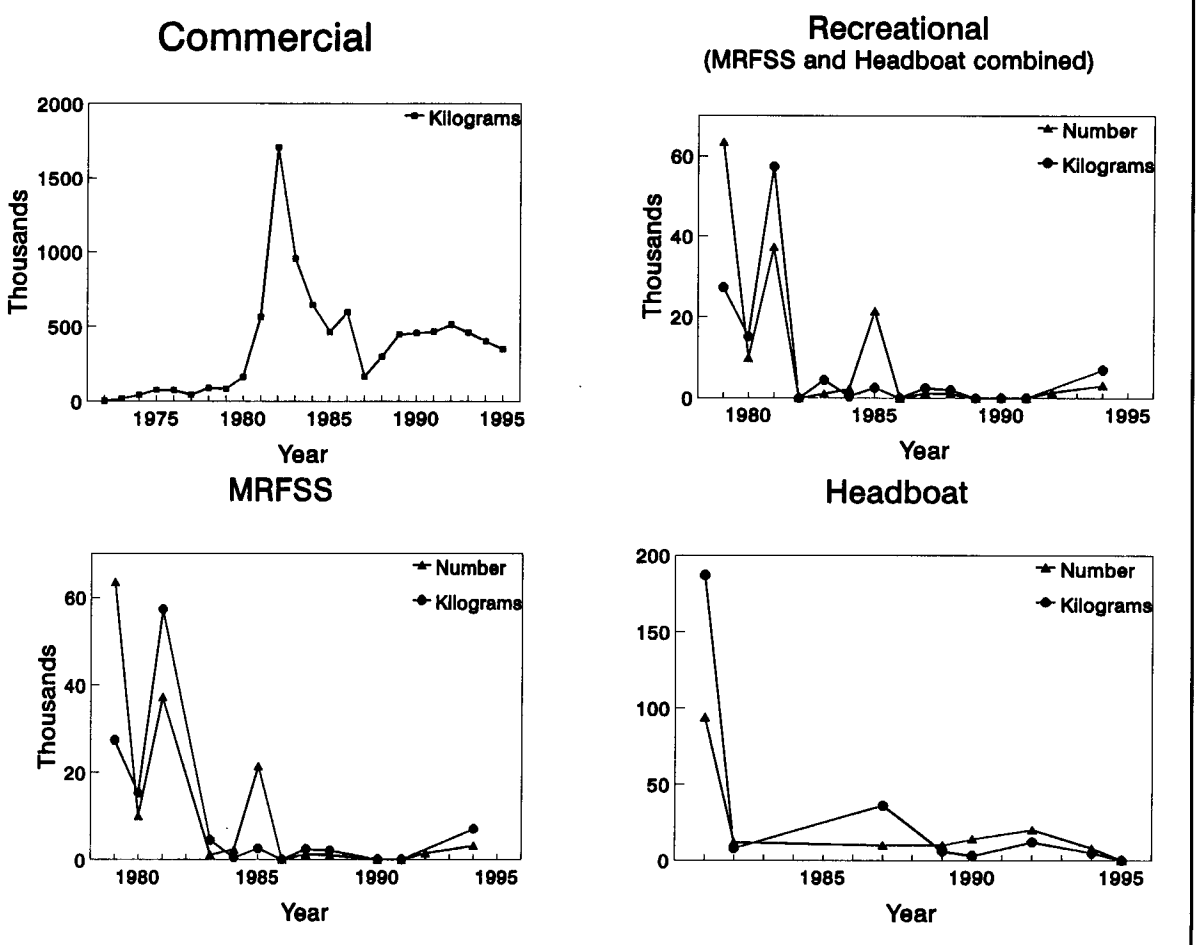

Figure 31
Tilefish catch (kg) from commercial and recreational fisheries.

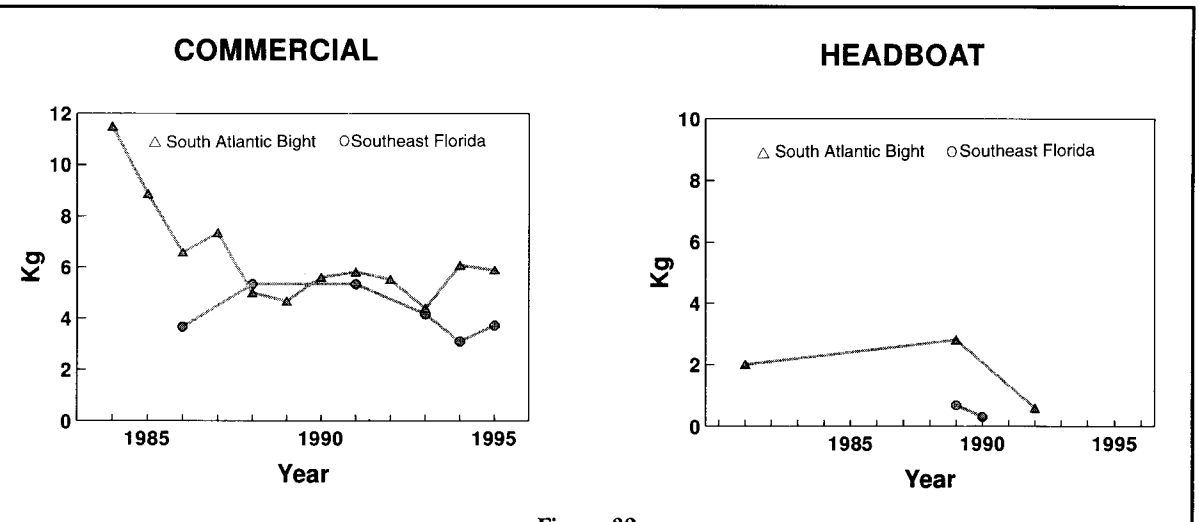

Figure 32
Tilefish mean weight (kg) from commercial and headboat fisheries.

Blueline Tilefish—The blueline tilefish occurs from Cape Charles, Virginia, to the Campeche Banks, Mexico, in water depths between 68 and 236 m, but is found principally south of Cape Hatteras (Dooley, 1978). The species frequents irregular bottom comprised of troughs and terraces inter-mingled with sand, mud, or shell hash bottom along the continental shelf break. This habitat is commonly shared with some of the deepwater snappers and groupers, especially snowy grouper. Blueline tilefish have been observed hovering near and entering burrows under rocks (Parker and Ross, 1986). Water temperatures typically range from 15°C to 23°C (Ross, 1978). These tilefish are epibenthic browsers, often feeding upon crabs, shrimps, snails, worms, sea urchins, and fish (Ross, 1982; Bielsa and Labisky, 1987).

Long lived and slow growing, blueline tilefish may attain 820 mm in 17 years (Ross, 1978; Ross and Huntsman, 1982; Labisky et al., 1983). They commonly reach 150 mm by the end of year one. Labisky et al. (1983) reported average lengths for fish ages 1–15 of 165, 279, 358, 414, 464, 505, 544, 576, 607, 632, 655, 676, 693, 709, and 726 mm respectively.

Some females mature at age 1, all are mature by age 6. Large females spawn up to 4 million pelagic eggs between April and September, with peak spawning in May and September (Ross and Merriner, 1982). Early researchers believed that blueline tilefish might be protogynous hermaphrodites; however, a recent study indicates normal sexual dimorphism (Labisky et al., 1983).

The fishery was important to both commercial and recreational snapper-grouper fishermen but recently only the commercial fishermen made significant catches. The total catch peaked in 1983 at 536,170 kg then fell to 3,219 kg by 1986 (Fig. 33). The 1995 total catch was 57,826 kg. The NMFS commercial database shows increased catches beginning in the late 1970's, climbing to 55,427 kg in 1978 (Fig. 34). The 1979 catch dropped to 24,778 kg, but in 1980 the "boom" years began with a catch of 93,969 kg. The catch escalated to 530,090 kg in 1983. By 1986, however, catches plummeted to 2,231 kg. Catches since 1990 have been around 60,000 kg. Headboat catches peaked at 6,952 kg in 1980 and again at 6,080 kg in 1983, but have remained less than 500 kg since 1989 (Fig. 34). The 1995 peak is from MRFSS data

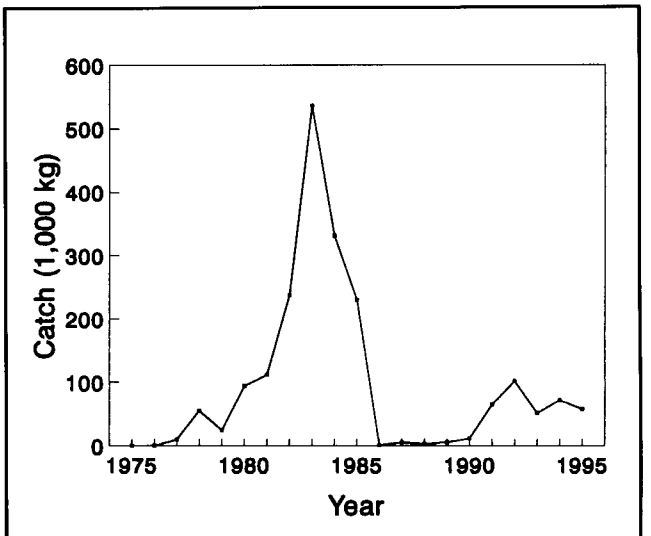

Figure 33
Blueline tilefish catch (kg), all fisheries combined.

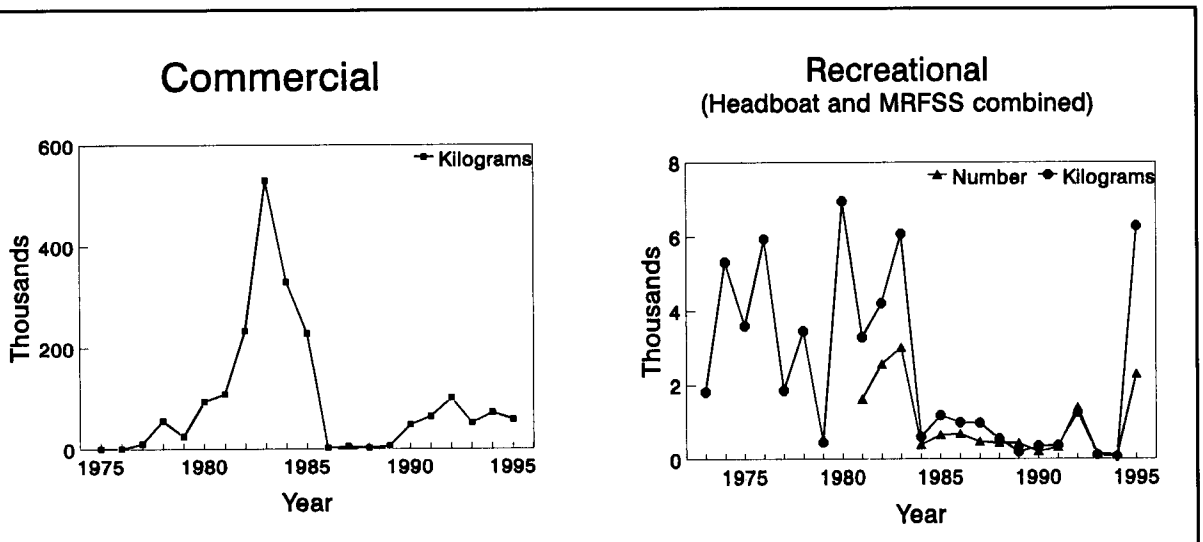

Figure 34
Blueline tilefish catch (kg) from commercial and recreational fisheries.

that must be in error. Much of the decrease may be attributable to diversion of headboat effort from blueline tilefish habitat to shallower water as the catch-per-unit-effort of blueline tilefish, snowy grouper, and speckled hind diminished. Mean weight of fish caught by headboats declined from 2.4 kg in 1972 to <1.0 kg by 1990 (Fig. 35). Commercial mean weight decreased from about 4.0 kg in the mid-1980's to 2.4 kg in 1995 (Fig. 35).

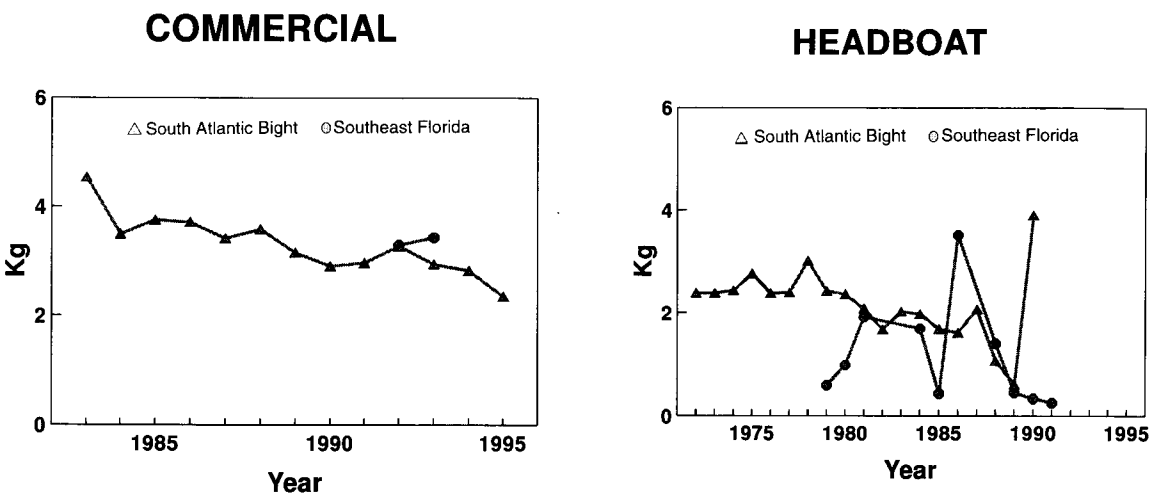

Figure 35
Blueline tilefish mean weight (kg) from commercial and headboat fisheries.

Bigeye—The bigeye occurs from New England and Bermuda to Argentina (Böhlke and Chaplin, 1993). Found to depths of 200 m over rough, hard bottom near crevices or burrows (Parker, personal observ.), mostly nocturnal bigeye feed on zooplankton, polychaete worms, crustaceans, and small fishes (Randall, 1968) and grow to about 400 mm.

Though not specifically targeted, bigeye frequently occur in the headboat catch. Annual catches varied between 1,811 kg in 1984 and 7,762 kg in 1987 (Fig. 36). Bigeye are taken commercially but the catch has not been reported by species. The 1992 and 1993 commercial vessel logbook reports revealed a catch of about 1,000 kg and 1,982 kg respectively (Harris et al.[12]).

Mean weights of bigeye caught from headboats have fluctuated between 0.5 kg and 0.7 kg from 1977 through 1995 (Fig. 37). Commercial mean weights were not available.

[12] Harris, K. C., G. N. Johnson, C. W. Krouse, and A. J. Chester. 1993, 1994. The 1993 and 1994 south Atlantic snapper-grouper logbook programs. Beaufort Laboratory, Southeast Fisheries Science Center, National Marine Fisheries Service, Beaufort, NC 28516.

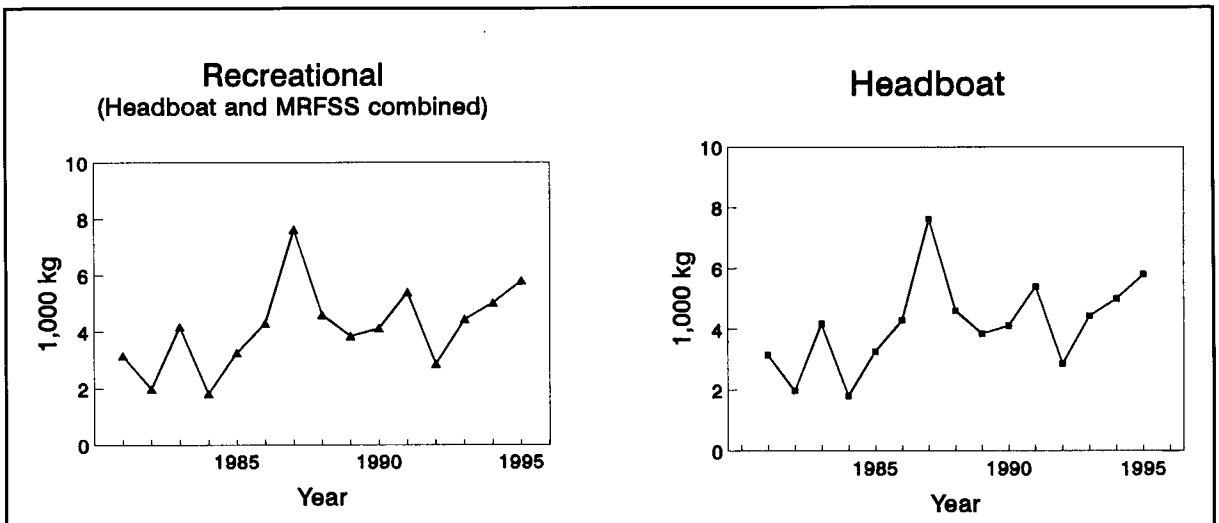

Figure 36
Bigeye catch (kg) from recreational fisheries.

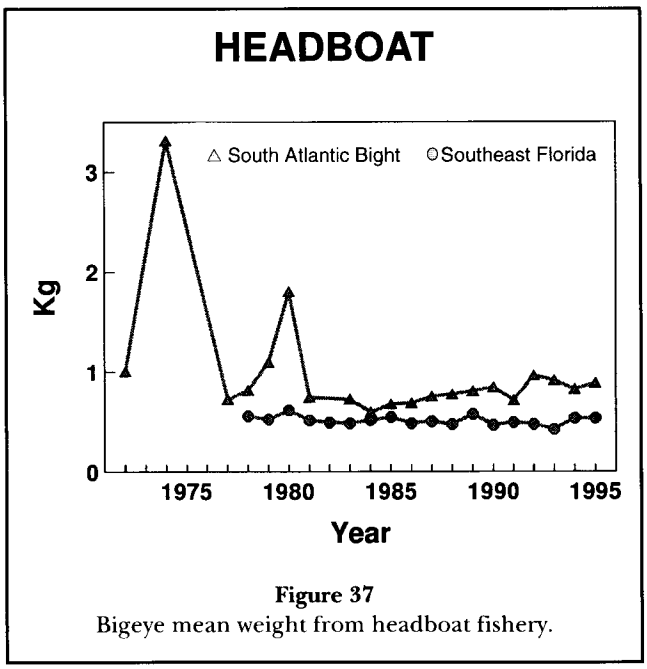

Figure 37
Bigeye mean weight from headboat fishery.

Red Porgy—In the western Atlantic the red porgy occurs from North Carolina to Argentina over rough bottom at depths from 18 to 280 m (Murray and Hjort, 1912), but has not been reported from the Caribbean (Manooch and Huntsman, 1977). Red porgy are protogynous hermaphrodites; most fish longer than 457 mm are males. Females mature in 2-4 years and may spawn 47,000–500,000 eggs. Spawning occurs from January through April and eggs and larvae are pelagic (Manooch, 1975). Red porgy live up to 15 years. Average lengths for ages 1–12 years are 238, 290, 341, 382, 419, 451, 483, 505, 527, 543, 558, and 604 mm. The red porgy feeds on crabs, snails, worms, sea urchins, and occasionally small fishes such as round scad and tomtate (Manooch, 1977).

The total catch of red porgy decreased from 1,056,565 kg in 1982 to 148,746 kg by 1994 (Fig. 38). The 1995 catch increased to 280,075 kg. Charter and private recreational vessel survey data for the period 1980–90 show a large variation in annual landings, from 1,056,565 kg

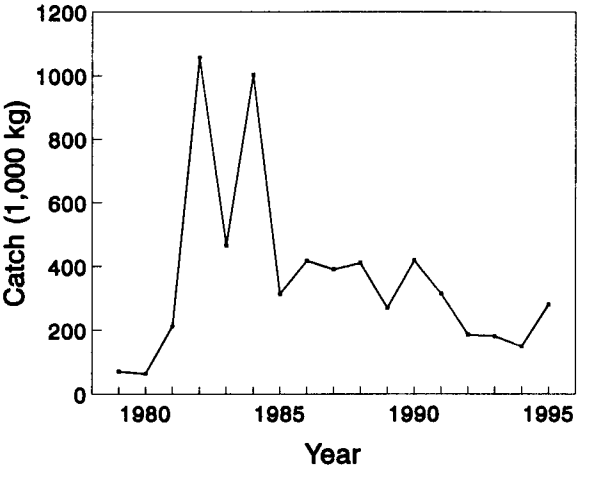

Figure 38
Red porgy catch (kg), all fisheries combined.

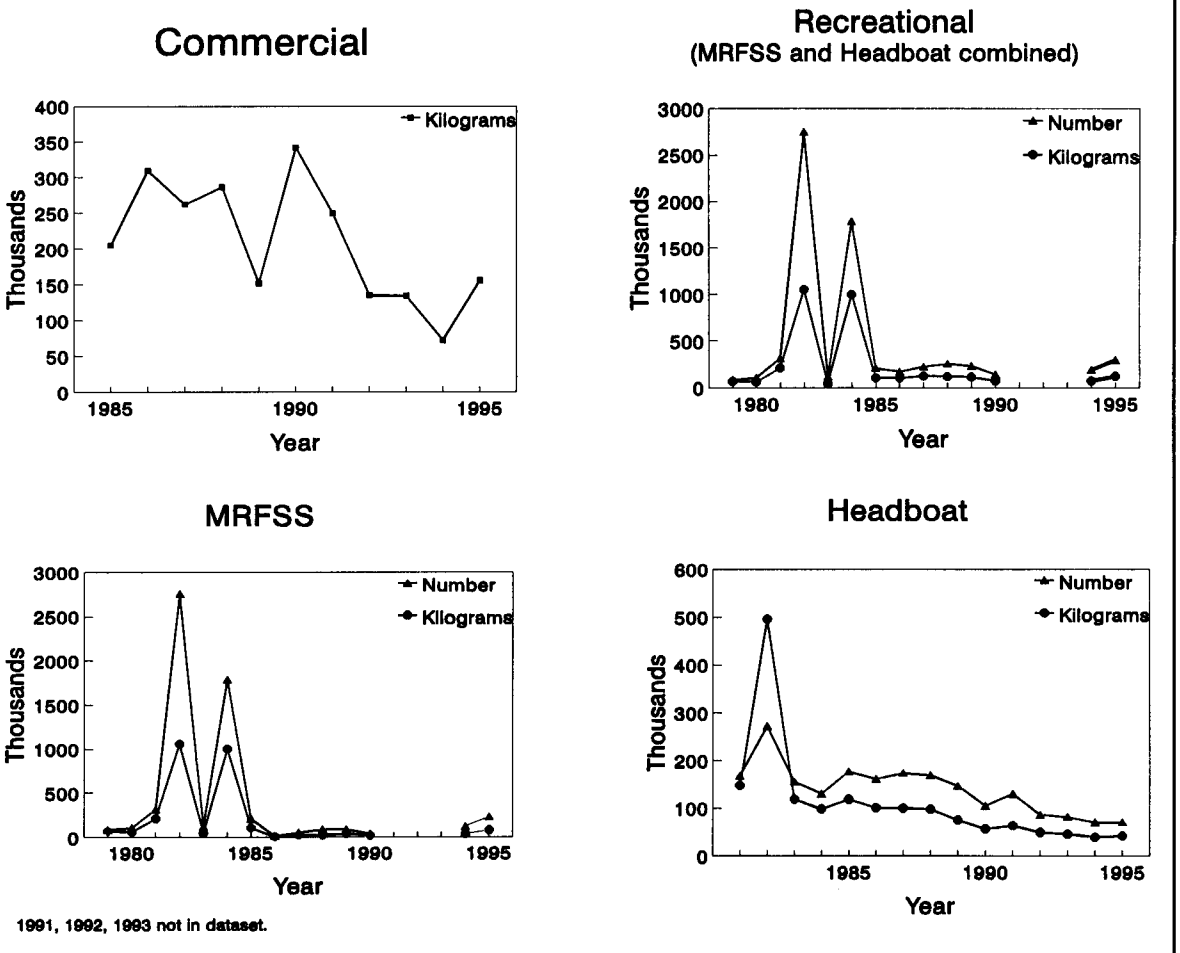

Figure 39
Red porgy catch (kg) from commercial and recreational fisheries.

in 1982 to 5,821 kg in 1986 (Fig. 39). Commercial catches of red porgy have declined from a high of 342,351 kg in 1990 to 72,680 kg in 1994 (Fig. 39). The 1995 commercial catch was 156,458 kg. Headboat landings also declined, from a high of 495,924 kg in 1982 to <100,000 kg from 1988–95 (Fig. 39). Mean weights from headboats in the South Atlantic Bight have dropped from >1 kg prior to 1980 to about 0.5 kg from 1989 through 1995 (Fig. 40)[10]. The commercial mean weight dropped from 1.1 kg in 1983 to 0.7 kg from 1987–95.

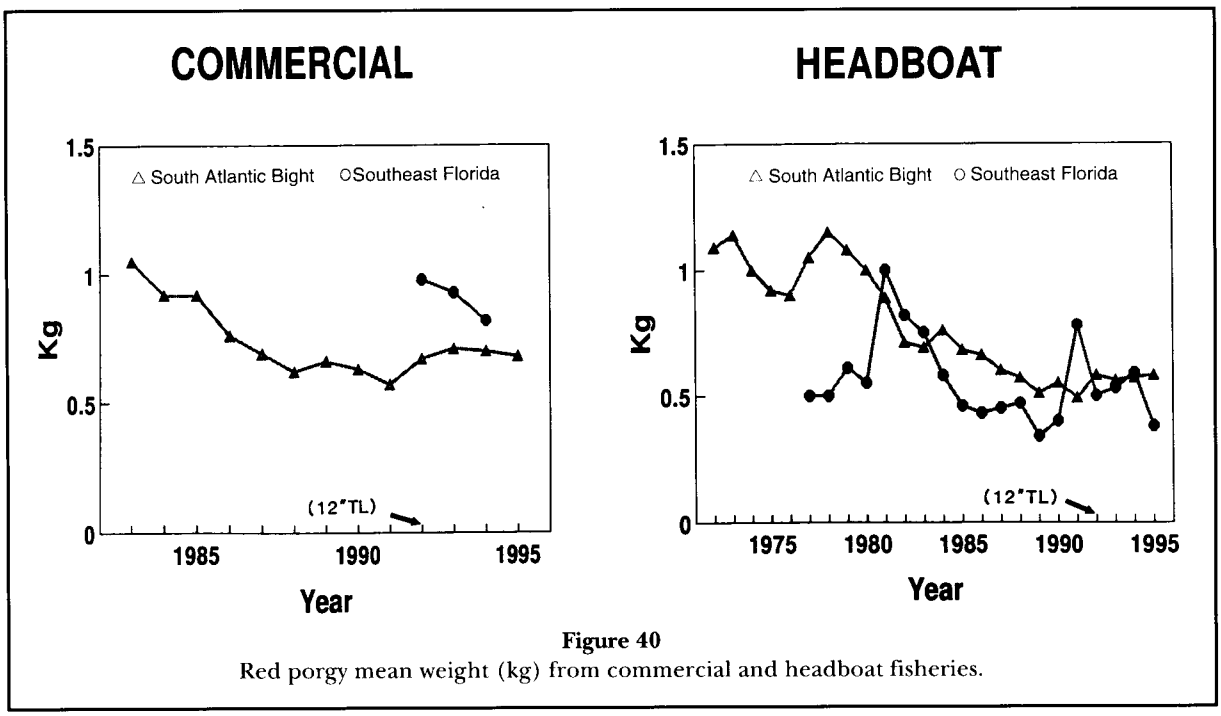

Figure 40
Red porgy mean weight (kg) from commercial and headboat fisheries.

Greater Amberjack—The greater amberjack occurs in the western Atlantic from Nova Scotia and Bermuda to Brazil, including the West Indies and Gulf of Mexico (Fischer, 1978). Greater amberjack probably spawn year-round but are reproductively most active from March through June (Burch, 1979). Spawning concentrations occur in southeast Florida and the Keys. The relatively new (since 1985) commercial fishery, especially that conducted by divers with spearguns, focuses on these aggregations. Greater amberjack have been aged to 17 years; they reach a weight of at least 30.5 kg and a length (FL) of 1,552 mm (Manooch and Potts, 1997). Average lengths for ages 1–10 years are 407, 643, 908, 1,000, 1,094, 1,169, 1,218, 1,333, 1,397, and 1,435 mm (Burch, 1979). Amberjacks are voracious feeders; major foods are fishes, cephalopods, and crustaceans (Manooch and Haimovici, 1983).

Total catch of greater amberjack fluctuated from 245,439 kg in 1979 to 1,797,776 kg in 1980 (Fig. 41). The 1995 total catch was 506,153 kg. Although com-

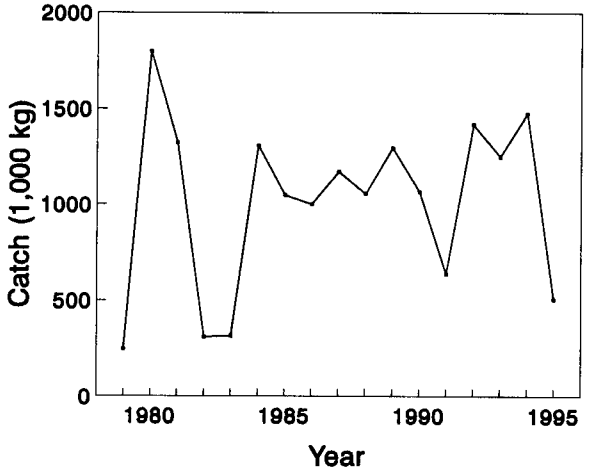

Figure 41
Greater amberjack catch (kg), all fisheries combined.

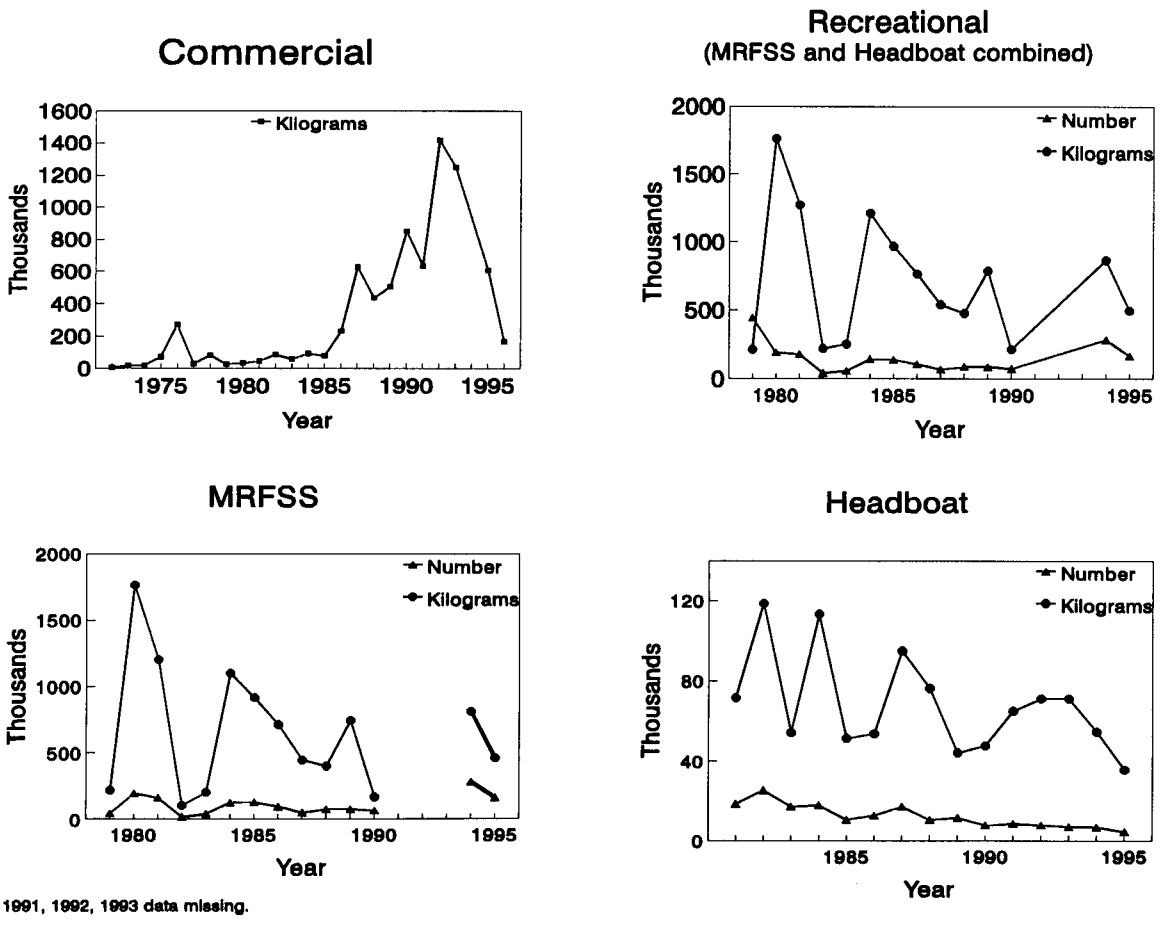

Figure 42
Greater amberjack catch (kg) from commercial and recreational fisheries.

mon, amberjack have not been commercially exploited historically. Commercial landings remained around 50,000 kg per year until about 1986 (Fig. 42). A new market for amberjack in 1985 increased landings to 627,865 kg by 1987. Landings continued to increase, exceeding 1.2 million kg in 1992 and 1993, then declined to 505,153 kg by 1995. Headboat landings decreased from a high of 118,594 kg in 1982 to 35,785 kg in 1995 (Fig. 42). Estimates of recreational catch, exclusive of that made from headboats, fluctuated widely, ranging from 0.1–1.8 million kg (Fig. 42). Mean weight of fish from the commercial fishery in the South Atlantic Bight increased steadily from 7.9 kg in 1984 to 27.3 kg in 1995 (Fig. 43)[10]. Mean weight from headboats varied from 10.7 kg in 1975 to 3.5 kg in 1983. The 1995 mean weight from headboats in the South Atlantic Bight was 7.8 kg.

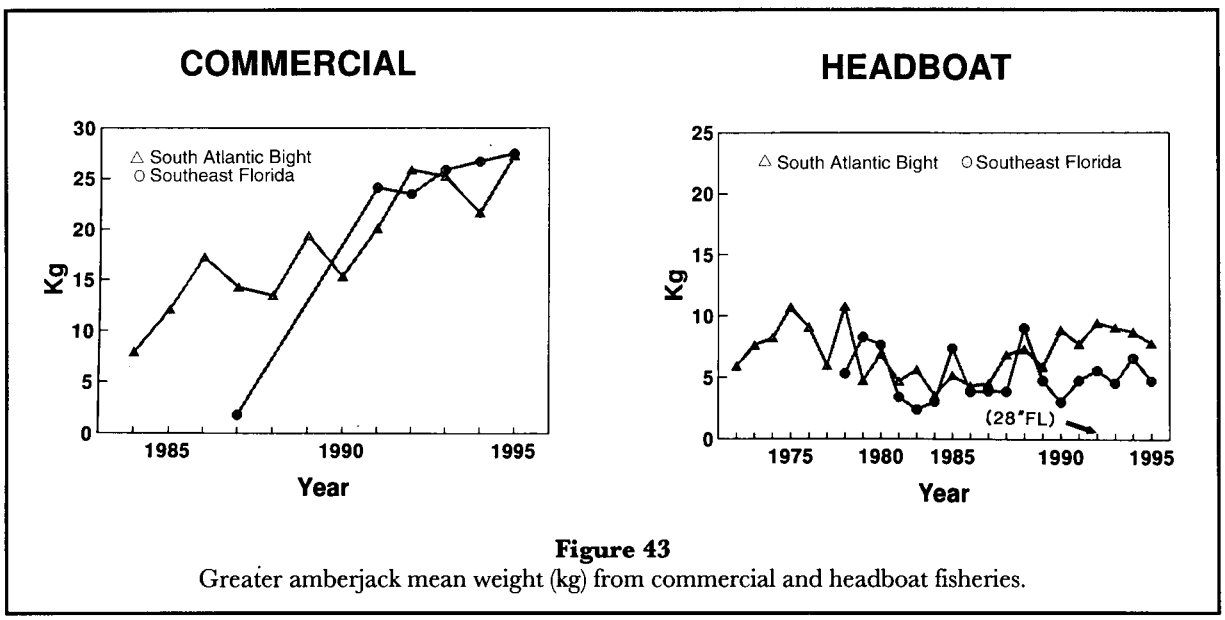

Figure 43
Greater amberjack mean weight (kg) from commercial and headboat fisheries.

Conclusions

Our goal was to put together existing knowledge of the deepwater reef fish fishery and habitat characteristics along the U.S. south Atlantic coast. We found that there are 19 economically important species, five of these comprising 97% of the catch (by weight). They are, in descending order of total landings for 1995: tilefish, snowy grouper, blueline tilefish, warsaw grouper, and yellowedge grouper. Although headboat effort has remained relatively constant from 1981–95 (Fig. 2) and commercial effort has most likely increased during the same period (see numbers of commercial vessels in Catch and Effort section), total landings decreased for 10 of the 14 species with catch data: yellowedge grouper, warsaw grouper, speckled hind, silk snapper, blackfin snapper, red snapper, vermilion snapper, tilefish, blueline tilefish, and red porgy. Mean weight data from headboats (1972–95) showed a decrease in 12 of the 14 species. Only bigeye, an incidental catch, and greater amberjack, a recently (1991) directed fishery with size limits initiated in 1992, have maintained average weight. The mean weight for commercial tilefish decreased, but remained about the same for snowy grouper, yellowedge grouper, and speckled hind. Other commercial fishery mean weight data were from sample sizes that generally were too small to be meaningful (Table 4). Federal size limits implemented in 1992 initially appeared to have a positive affect on scamp, silk snapper, red snapper, and vermilion snapper in the South Atlantic Bight. The same size limits were proclaimed by the State of North Carolina in 1991 and this probably accounts for the increase in average sizes that year for scamp, red snapper, and vermilion snapper (Figs. 17, 26, and 29).

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