Offshore Headboat Fishing in North Carolina and South Carolina

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ABSTRACT—Headboats operating on the outer Continental Shelf of North Carolina and South Carolina made a recreational catch of 489,570 fish weighing 1,313,247 pounds with 49,989 angler days of effort in 1972 and a catch of 513,174 fish weighing 1,595,228 pounds with 59,815 angler days in 1973. Mean catch-per-angler day was approximately 26 pounds. Species caught represent a community of tropical, deepwater fish typical of Caribbean Banks. Fishes most commonly taken included red porgy, Pagrus sedecim, *black sea bass,* Centropristis striata, *vermilion snapper,* Rhomboplites aurorubens, *white grunt,* Haemulon plumieri, *and mixed groupers,* Epinephelus *sp. and* Mycteroperca *sp. Red, silk, and blackfin snappers,* Lutjanus campechanus, L. vivanus, *and* L. buccanella, *were highly prized by the fishers but were caught infrequently.*

A productive and interesting recreational fishery for bottomfishes is conducted from headboats along the coasts of North Carolina and South Carolina[1]. Despite the northerly latitude of this fishery, it produces large catches of fishes usually associated with Caribbean and Bahama reefs and banks: groupers (*Epinephelus* and *Mycteroperca*), snappers (*Lutjanus* and *Rhomboplites*), porgies (*Calamus* and *Pagrus*), and grunts (*Haemulon*). Even though this fishery was obviously popular and the catches large, no knowledge of it existed, other than in the minds of fishers and headboat operators, until our study began in January 1972.

In this paper I wish to: 1) briefly describe the geography and oceanography pertinent to the fishery; 2) review the history of scientific research and fishery development in the study area; 3) describe the vessels, gear, and techniques used in the fishery; 4) document the catches and expenditure of effort in the fishery for the 1972 and 1973 fishing seasons; and 5) review factors affecting the future of the headboat fishery.

[1]Headboats are those where anglers pay for a day's fishing on a per person (thus per "head") basis.

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GEOGRAPHY AND PHYSICAL ENVIRONMENT OF THE FISHERY

Headboats, operating out of ports from Hatteras, N.C., to Charleston, S.C., fish the outer Continental Shelf from Cape Hatteras, N.C., to Savannah, Ga. (Table 1) (Fig. 1). The fishing area is divided into three large bays and an unnamed region south of Cape Romain. Raleigh Bay lies between Cape Hatteras and Cape Lookout, Onslow Bay between Cape Lookout and Cape Fear, and Long Bay between Cape Fear and Cape Romain (Fig. 1). The presence of tropical fishes this far north depends on two features of the physical

Table 1.—Headboats of North and South Carolina, 1972 and 1973.

Location	Headboat	Fishing area	Operated in 1972	Operated in 1973
North Carolina				
Hatteras	*Shady Lady*	Offshore	—	X
Morehead City	*Capt. Stacy*	Offshore	X	X
"	*Capt. Stacy III*	Offshore	X	X
"	*Deep Blue*	Offshore	X	X
"	*Carolina Princess*	Inshore	X	X
Sneads Ferry	*Pirate*	Inshore	X	X
Topsail Island	*Buddy Pirate*	Inshore	X	X
Topsail Beach	*Buccaneer*	Inshore	X	X
Carolina Beach	*Stew Bird II*	Inshore	X	X
"	*Carl Winner Queen*	Inshore	X	—
"	*Cheerio II*	Inshore	X	X
"	*Flying Squirrel*	Inshore	X	—
"	*Pirate-Too*	Inshore	X	—
"	*Capt. Winner IV*	Offshore	—	X
Wrightsville Beach	*Capt. Skippy Winner*	Offshore	X	X
Southport	*Skipper*	Inshore	X	X
South Carolina				
Little River	*Capt. Juel I*	Offshore	X	X
"	*Hurricane*	Inshore	X	X
"	*Gulf Queen*	Offshore	X	—
"	*Bonita*	Inshore	—	X
Murrells Inlet	*Flying Fisher I*	Inshore	X	X
"	*Flying Fisher II*	Inshore	X	X
"	*Capt. Alex*	Offshore	X	X
"	*Rocket*	Inshore	X	—
"	*Tom-A-Gator*	Inshore	X	—
"	*Carolina Princess*	Offshore	X	X
"	*Capt. Bill*	Offshore	—	X
Charleston	*Gulf Stream II*	Offshore	X	X
"	*Mustang II*	Inshore	X	X
"	*Comanche*	Inshore	X	X
"	*J. J.*	Inshore	X	X

environment: the rugged bottom topography and the warming influence of the nearby Gulf Stream.

The outer Continental Shelf, that zone from 15 fathoms seaward to the Continental Slope, furnishes two types of habitat attractive to reef fishes. The most spectacular of these two habitats is the shelf break zone (Struhsaker, 1969) where the ocean floor slopes abruptly from the Continental Shelf to the Continental Slope. The shelf break, which usually lies between 30 and 100 fathoms, is a rugged area of jagged peaks, precipitous cliffs, and rocky ledges. The other type of habitat, less spectacular but equally productive, includes numerous rocky outcroppings and coral patches of low profile (Huntsman and Macintyre, 1971) that are scattered over the flat bottom shoreward of the shelf break area.

Water temperature on the outer shelf is strongly influenced by the Gulf Stream and is sufficiently high to allow year-round occupancy by tropical and subtropical fishes. For instance, bottom water temperature along the 50 fathom curve is near 57°F the year-round, and as far north as the center of Raleigh Bay bottom temperatures may remain near 68°F during winter (Stefansson and Atkinson, 1967).

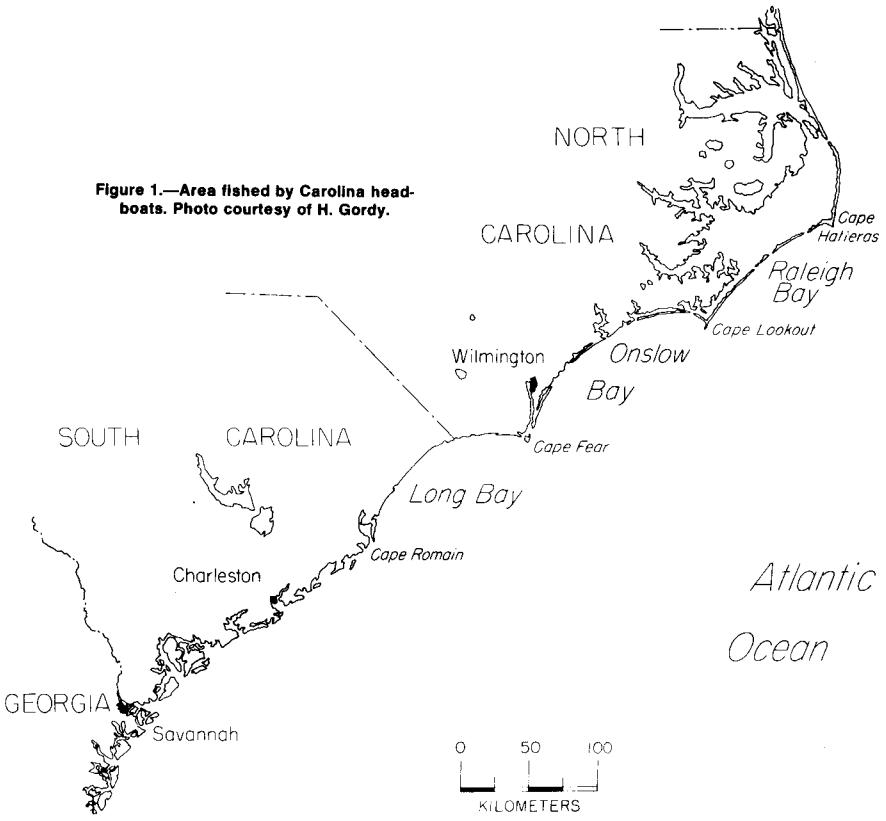


Figure 1.—Area fished by Carolina headboats. Photo courtesy of H. Gordy.

HISTORY OF FISHERY RESEARCH AND FISHERY DEVELOPMENT ON THE OUTER CAROLINA SHELF

Fishery Research

Neither scientists nor fishers displayed much interest in the fishes of the outer shelf until the last two decades. The RV *Fish Hawk* cruises in 1902 and 1913 were searches for sea bass fishing grounds on Onslow Bay coral patches and did not investigate deeper water (Smith, 1905; Radcliffe, 1914). An RV *Albatross III* cruise in May and June 1949, featuring roller trawling from 10 to 150 fathoms in Raleigh, Onslow, and Long bays (Buller, 1951), captured a few red grouper (*Epinephelus morio*) and red porgy (*Pagrus sedecim*) but failed to provide substantive information on shelf break fish stocks. Cruises by the MV *Combat*, MV *Silver Bay*, and RV *Oregon* (Bullis and Thompson, 1965) included trawling at or near the shelf break of Raleigh, Onslow, and Long bays. Work of the RV *Silver Bay* was significant because it allowed Struhsaker (1969) to describe fish habitats off the southeast coast and furnished the best collections of fishes ever made in that area. The cruises of the MV *Silver Bay* have provided the best available description of the stocks of demersal fishes on the shelf break even though sampling was diffuse. Bad weather, rough bottom, and a greater interest in shallower waters precluded more than a few trawl or hand-line stations and some observations of fish concentrations with sonic instruments.

Recently the marine fishery agencies of North Carolina and South Carolina have conducted explorations of the outer shelf. Bearden and McKenzie (1971), using handlines and traps in 1970 and 1971, located concentrations of porgies, groupers, and snappers off South Carolina. Most sampling occurred south of Cape Romain. In 1969, the RV *Dan Moore* of North Carolina occupied 93 roller trawl stations in Raleigh and Onslow bays at depths from 10 to 60 fathoms (North Carolina, RV *Dan Moore* Cruise 020). A few catches of snowy grouper (*Epinephelus niveatus*) were made southeast of Cape Fear but trawling was often precluded by rough bottom at the shelf break.

In summary, every fishery study of the outer Continental Shelf of North Carolina and South Carolina has been primarily oriented to the discovery of commercial concentrations of demersal fishes, and has usually avoided bottom not fishable with commercial trawling gear. There has not been an intensive, multigear, research program oriented primarily toward describing the fish communities of the outer Shelf.

Fishery Development

While scientists were slow to study fishes of the outer shelf, it was not until the late 1950's that fishers began to recognize the importance of the potential fishery. In 1956 and 1957 two handline fishers, Lloyd Reed and John Chivas, made the 40-50 mile run to the shelf break from Morehead City, N.C. Fishing from a 38-foot boat, they accounted for most of the 300,000 pounds of groupers and snappers landed in North Carolina in 1957 (Power, 1959). In the winter of 1957-58 water temperatures in outer Raleigh, Onslow, and Long bays were the lowest recorded during the entire 20-yr period from 1948 to 1968 (McLain, Mayo, and Owen[2]). A large

[2]McLain, D. R., F. V. Mayo, and M. J. Owen. Monthly maps of sea surface temperature anomalies in the northwest Atlantic Ocean and Gulf of Mexico, 1948-67. Unpublished manuscript. Pacific Environmental Group, National Marine Fisheries Service, NOAA, c/o Fleet Numerical Weather Central, Naval Post Graduate School, Monterey, CA 93940.

mortality of red snapper, the only species with high market value, occurred and the commercial fishery ended.

In the mid-1960's a sport fishery conducted primarily by headboats began to develop. About 25 headboats now operate over the outer shelf from Cape Hatteras to Charleston (Table 1). Charter and private boats engage in recreational bottom fishing over the outer shelf at times, but their fishing effort appears comparatively small.

Traditional wooden hulled headboat at Morehead City, N.C. Photo courtesy of H. Gordy.

An aluminum hulled catamaran headboat at Carolina Beach, N.C. This type of vessel affords more comfort and angling space than conventional headboats, but the initial cost is great.

Fishery Equipment and Methods

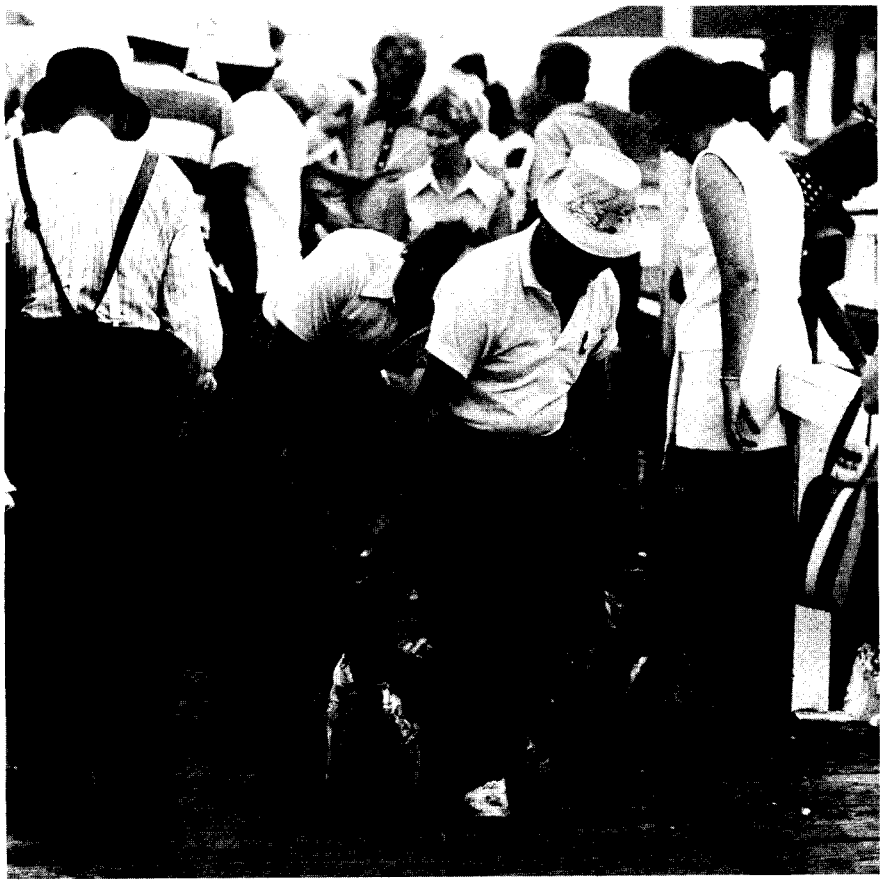
Headboats fall into two major classes according to the habitat they fish: 1) those that fish the inshore rocks and coral patches from 15 to 25 fathoms (inshore boats), and 2) those that fish the shelf break zone and the extreme outer shelf from 25 to 80 fathoms (offshore boats).

All vessels must have a large passenger capacity and be able to attain high speed. Capacity varies between 30 and 75 anglers. Offshore vessels are often constructed along the lines of the fast, powerful crew boats used in the oil industry and usually are powered by two V-12 diesel engines. Some vessels may attain speeds of 25 knots, although 15 knots is probably average. Inshore boats average from 10 to 15 knots. Since the success of a trip depends on the ability of the captain to find fish, most boats are equipped with sensitive depth recorders to detect fish schools and loran to enable the relocation of productive areas. Vessels are usually crewed by a captain and two or three mates.

Tackle is sturdy enough to resist the abuse of heavy fish, constant use, and inexperienced anglers. Solid 5- to 6-foot fiberglass rods, with the rod blank extending through the butt, are preferred. Reels are size 6/0 to 9/0, either manual or electric, and line is 80- to 120-pound test monofilament. The bottom rigs are usually made of 80-pound test monofilament and two 6/0 to 8/0 hooks connected with three-way brass swivels that help prevent twisting of the rig and aid in freeing tangles. During fishing aboard our own research vessel, we found that a two-hook bottom rig of 250-pound test monofilament fastened with crimped sleeves will hold almost any fish other than sharks (Fig. 2). It will not kink, and yet will allow sharks to cut themselves loose and save us the trouble of fighting and landing them. Crimped sleeves fasten securely and are faster and easier to use than knots. Another bottom rig, which is especially effective for scamp, has a single hook and slip sinker on the line above the swivel joining the line and leader (Fig. 3). Depending on the current and the depth fished, 6- to 28-ounce lead sinkers are used. Sinkers weighing up to 50 ounces may be used effectively with an electric reel. Heavy sinkers improve the presentation of bait during rough seas or when swift currents sweep lighter sinkers from the bottom.

A typical fishing day begins at daybreak and lasts from 12 to 16 hours. After a 2 to 4 hour trip to the fishing ground and a brief search either for fish or bottom topography likely to produce fish, anglers spend 4 to 6 hours fishing, and then return to port.

Fishing occurs at depths of 10-80 fathoms. Captains, in general, dislike fishing at depths greater than 35 fathoms because tangling is frequent and strong currents often prevent lines from reaching the bottom. Depending on conditions, captains may either drift or anchor. In water deeper than 30 fathoms anchoring is not practical. According to some headboat captains, anchoring produces the best catches of groupers and drifting allows the best catches of porgies and grunts.



A successful headboat angler debarks with an "average" catch which includes gray tilefish and vermilion snapper. Photo courtesy of H. Gordy.

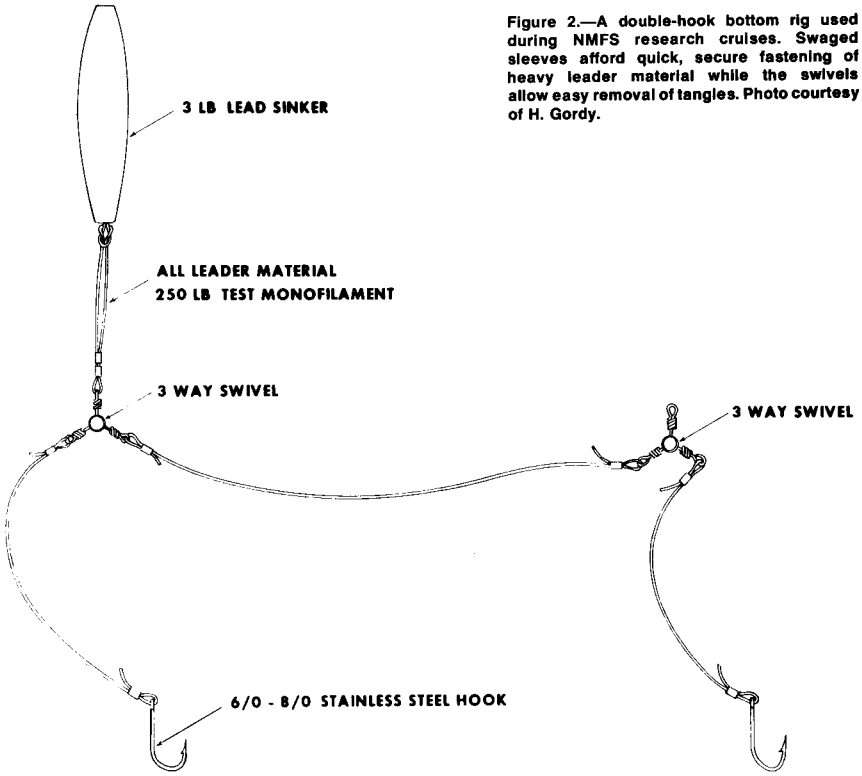


Figure 2.—A double-hook bottom rig used during NMFS research cruises. Swaged sleeves afford quick, secure fastening of heavy leader material while the swivels allow easy removal of tangles. Photo courtesy of H. Gordy.

CATCHES, EFFORT, AND ANGLING QUALITY

Survey Methods

Because there was no existing system of record keeping on headboats, we were forced to initiate our own system of collecting catch and effort data. To be successful, our system had to reflect four constraints: 1) the catch was intact and available for examination for only a few hours between the end of fishing and dispersion of anglers upon docking; 2) landings were made at irregular intervals at many widely scattered points; 3) the fishes, in general, were not sold so no records of transfer were available; and 4) we could not hire enough employees to meet all vessels. These constraints dictated that catch records be recorded by a crew member during the return to port. In addition, the crew member reported the number of anglers aboard and the location fished.

Because the daily catch records were

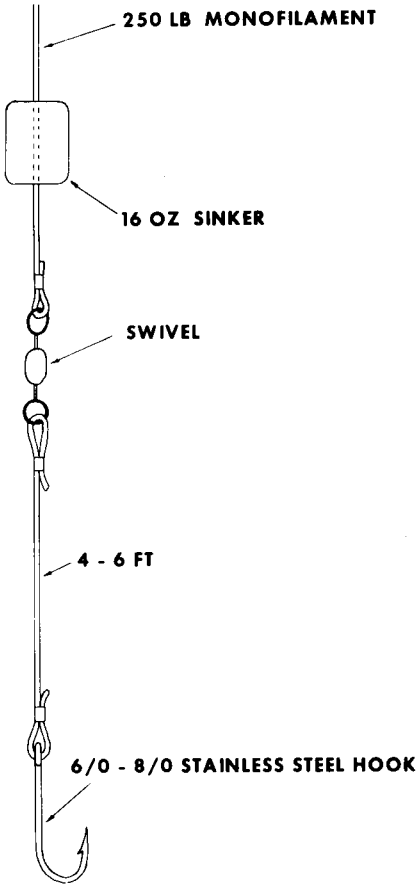


Figure 3.—This bottom rig, which features a sliding sinker and only a single hook, is very effective for taking scamp. Photo courtesy of H. Gordy.

essential to our research, we paid the crews a small fee. With this incentive we achieved 50 percent coverage by catch records of all headboat trips for June, July, and August 1972 and 1973. Catch record coverage was less in spring and fall when fishing was more sporadic and when many mates worked only part time. National Marine Fisheries Service (NMFS) personnel worked at dockside measuring and weighing fish, collecting stomachs and gonads for studies of food habits and reproductive cycles, and collecting scales and otoliths for age determination.

Total numbers of fish caught were obtained from the daily catch sheets kept by vessel personnel. When catch records were missing for some days within a month, we adjusted catches upward by multiplying the observed catch per angler day of each species by the total angler days for the month. This adjustment was performed separately for each boat. Total angler days were taken from vessel booking records. Multiplying the average weight, obtained through dockside sampling, of each species by the total numbers caught of that species furnished an estimate of catch weights. Calculation of confidence intervals is theoretically possible for each of our catch estimates, but the procedures used to compensate for missing data made such calculations difficult.

To facilitate the estimation and presentation of catch values we divided the fishing area from Cape Hatteras through South Carolina into four districts: Cape Hatteras, Cape Lookout, Cape Fear, and Cape Romain. Cape Hatteras vessels fish in the northern part of Raleigh Bay; Cape Lookout vessels in the southern part of Raleigh Bay and the northern half of Onslow Bay; Cape Fear vessels in southern Onslow Bay and the northern third of Long Bay; Cape Romain vessels in southern Long Bay and south to Savannah. Within each of the four districts we designated inshore and offshore subdistricts. We divided the fishing season into five time-units: March-May, June, July, August, and September-November. There is little fishing from December through February. The catches are presented by year, district, subdistrict, and time unit.

Working at dockside, NMFS employees sample catches of headboat anglers. Photo courtesy of H. Gordy.

Catches

Our sampling yielded both qualitative and quantitative information about the catches. Not only did sampling provide a list of species caught (Tables 2, 3), but also estimates of catch of each principal species or species group in both numbers and pounds (Tables 4, 5).

Table 2.—Species commonly taken by the Carolina headboat fishery.

Common name	Scientific name	Usual size taken (lb)	Depth (fathoms)	Remarks
Sea basses	Serranidae			
Rock hind	*Epinephelus adscensionis*	2-5	15-30	
Speckled hind	*E. drummondhayi*	4-12	25-55	
Yellowedge grouper	*E. flavolimbatus*	8-16	35-80	
Red hind	*E. guttatus*	2-5	15-30	
Red grouper	*E. morio*	10-20	20-35	
Warsaw grouper	*E. nigritus*	23-40	30-60	
Snowy grouper	*E. niveatus*	6-12	30-60	
Gag	*Mycteroperca microlepis*	3-6 inshore 12-40 offshore	15-55	
Scamp	*M. phenax*	15-20	20-55	Mid-Onslow Bay southward
Black seabass	*Centropristis striata*	0.5-2.0	7-30	
Porgies	Sparidae			
Red porgy	*Pagrus sedecim*	1.75-2.5 inshore 2.5-5.0 offshore	10-55	
Knobbed porgy	*Calamus nodosus*	3-5	10-30	Most common off South Carolina
Whitebone porgy	*C. leucosteus*	1-3	10-25	
Spottail pinfish	*Diplodus holbrooki*	1-2	10-20	
Longspine porgy	*Stenotomus caprinus*	0.5-1.5	20-55	
Snappers	Lutjanidae			
Red snapper	*Lutjanus campechanus*	18-22	20-55	
Silk snapper	*L. vivanus*	18-22	25-55	
Vermilion snapper	*Rhomboplites aurorubens*	0.5-1.5 inshore 1.6 offshore	15-55	
Grunts	Pomadasyidae			
White grunt	*Hameulon plumieri*	1-2	10-25	
Tomtate	*H. aurolineatum*	0.25-0.75	10-25	
Tilefishes	Branchiostegidae			
Gray tilefish	*Caulolatilus microps*	6-10	30-70	
Jacks	Carangidae			
Almaco jack	*Seriola rivoliana*	15-30	25-100	
Greater amberjack	*S. dumerili*	15-50	25-100	
Triggerfishes	Balistidae			
Gray triggerfish	*Balistes capriscus*	2-7	10-30	

Table 3.—Some fishes of the outer Continental Shelf of North Carolina taken by National Marine Fisheries Service sampling or occasionally by headboats.

Common name	Scientific name	Depth (fathoms)
	Carcharhinidae	
Silky shark	*Carcharinus falciformis*	15-70
	Sphyrnidae	
Scalloped hammerhead	*Sphyrna lewini*	45-50
	Rhinobatidae	
Atlantic guitarfish	*Rhinobatos lentiginosus*	39-78
	Ragidae	
Unidentified skate	*Raja* sp.	39-78
	Dasyatidae	
Unidentified stingray	*Dasyatis* sp.	39-78
	Muraenidae	
Blackedge moray	*Gymnothorax nigromarginatus*	15-60
Reticulate moray	*Muraena retifera*	47
	Congridae	
Conger eel	*Conger oceanicus*	40-55
Margintail conger	*Paraconger* cf. *P. caudilimbatus*	33
	Ophichthidae	
Palespotted eel	*Ophichthus ocellatus*	15-57
	Engraulidae	
Unidentified anchovy	*Anchoa* sp.	15-20
	Synodontidae	
Inshore lizardfish	*Synodus foetens*	13
Red lizardfish	*S. synodus*	37-58
Snakefish	*Trachinocephalus myops*	15-40
	Ogcocephalidae	
Pancake batfish	*Halieutichthys aculeatus*	39-78
Roughback batfish	*Ogcocephalus parvus*	39-78
Unidentified batfish	*Ogcocephalus* sp.	39-78
	Ophidiidae	
Striped cusk-eel	*Rissola marginata*	15-20
	Holocentridae	
Squirrelfish	*Holocentrus ascensionis*	28
Longspine squirrelfish	*Holocentrus* cf. *H. rufus*	28
	Fistulariidae	
Red cornetfish	*Fistularia villosa*	50
	Syngnathidae	
Lined seahorse	*Hippocampus erectus*	15-60
Unidentified pipefish	*Syngnathus* sp.	15-60
	Serranidae	
Bank sea bass	*Centropristis ocyurus*	15-60
Sand perch	*Diplectrum formosum*	15-50
Marbled grouper	*Dermatolepis inermis*	
Yellowfin grouper	*Mycteroperca venenosa*	
Roughtongue bass	*Ocyanthias martinicensis*	39-78
Creole-fish	*Paranthias furcifer*	
	Priacanthidae	
Bigeye	*Priacanthus arenatus*	
Short bigeye	*Pristigenys alta*	18-23
	Apogonidae	
Twospot cardinalfish	*Apogon pseudomaculatus*	18
	Branchiostegidae	
Atlantic golden-eyed tilefish	*Caulolatilus chrysops*	40-70
Sand tilefish	*Malacanthus plumieri*	28-50
	Rachycentridae	
Cobia	*Rachycentron canadum*	28
	Carangidae	
Round scad	*Decapterus punctatus*	15-18
	Lutjanidae	
Blackfin snapper	*Lutjanus buccanella*	30-50
Wenchman	*Pristipomoides aquilonaris*	
Yellowtail snapper	*Ocyurus chrysurus*	
	Sciaenidae	
Jacknife-fish	*Equetus lanceolatus*	18
Cubbyu	*E. umbrosus*	37-60
	Mullidae	
Spotted goatfish	*Pseudupeneus maculatus*	18
	Chaetodontidae	
Spotfin butterflyfish	*Chaetodon ocellatus*	18
Blue angelfish	*Holacanthus bermudensis*	18
	Pomacentridae	
Yellowtail reeffish	*Chromis* cf. *C. enchrysurus*	18
Dusky damselfish	*Pomacentrus* cf. *P. Fuscus*	40-50
	Labridae	
Yellowhead wrasse	*Halichoeres* cf. *Hgarnoti*	40-50
Pearly razorfish	*Hemipteronotus novacula*	30-50
	Sphyraenidae	
Great barracuda	*Sphyraena barracuda*	28
	Uranoscopidae	
Southern stargazer	*Astroscopus* cf. *A. y-graecum*	39-78
	Scorpaenidae	
Spinythroat scorpionfish	*Pontinus nematophthalmus*	39-78
Barbfish	*Scorpaena brasiliensis*	18-70
Deepreef scorpionfish	*Scorpaenodes tredecimspinosus*	18
	Triglidae	
Northern searobin	*Prionotus carolinus*	13-20
	Bothidae	
Eyed flounder	*Bothus ocellatus*	23
Summer flounder	*Paralichthys dentatus*	28
Dusky flounder	*Syacium papillosum*	15-23
	Balistidae	
Orange filefish	*Aluterus schoepfi*	18
Fringed filefish	*Monacanthus ciliatus*	23
Planehead filefish	*M. hispidus*	23
	Tetraodontidae	
Marbled puffer	*Sphoeroides dorsalis*	23
Bandtail puffer	*S. spengleri*	18

Qualitative Description of the Catch

Our lists of fishes (Tables 2, 3) not only provide information about the catch, but when considered with observations of fishing areas, allow an insight into the zoogeography of marine organisms. Most species caught were tropical deep-water fishes. Shallow-water tropical species such as the yellowtail snapper and Nassau grouper were extremely rare. Briggs (1974) summarized the numerous attempts to characterize the fauna of the South Atlantic region and to delimit the northern distribution of tropical fauna. Examination of this summary indicates that most, if not all, previous authors seem to have missed an essential point: that two faunas, one temperate and one tropical, exist side by side on the South Atlantic Shelf. The tropical fauna extends northward in a narrowing band along the Gulf Stream over the outer Continental Shelf to about Cape Hatteras. The shoreward portion of the shelf and the estuaries are inhabited by a typically temperate fauna (Smith, 1905). While previous discussions indicating overlapping faunal regions might lead one to believe that the Carolina Shelf shelters a complex mixture of temperate and tropical forms, actually the two faunal groups maintain their integrity to a great extent and exist side by side within separate thermal regimes.

Quantitative Description of the Catch

Total catches, exclusive of sea bass, were 489,570 fish weighing 1,313,247 pounds in 1972 and 513,174 fish weighing 1,595,228 pounds in 1973. We estimated the sea bass catch in 1973 to be

Table 4.—Season catches by Carolina headboats—1972[1].

Species		Cape Lookout, N.C.				Cape Fear, N.C.				Cape Romain				Total					
		Inshore	%	Offshore	%	Inshore	%	Offshore	%	Inshore	%	Offshore	%	Inshore	%	Offshore	%	Total	%
Porgies	No.	10,431	33	31,055	56	44,459	32	5,087	37	4,605	8	120,321	62	59,495	26	156,463	59	215,958	44
	Wt.[2]	21,052	29	94,878	33	80,688	35	11,399	23	10,135	14	300,706	50	111,875	30	406,983	43	518,858	40
Grunts	No.	11,752	37	664	1	54,739	40	3,273	24	23,566	41	42,144	22	90,057	40	46,081	18	136,138	28
	Wt.	19,646	27	1,498	1	88,159	39	7,252	15	36,148	51	75,510	13	143,953	39	84,260	9	228,213	17
Vermilion snapper	No.	5,828	19	11,126	20	22,966	17	1,245	9	29,108	50	10,571	5	57,902	26	22,942	9	80,844	17
	Wt.	9,371	13	33,735	12	21,916	10	1,795	4	23,219	33	17,054	3	54,506	15	52,584	6	107,090	8
Groupers *Epinephelus*	No.	859	3	2,323	4	537	—	1,154	8	9	—	2,908	1	1,405	—	6,385	2	7,790	2
	Wt.	11,236	15	28,395	10	4,573	2	11,564	23	34	—	36,168	6	15,843	4	76,127	8	91,970	7
Groupers *Mycteroperca*	No.	402	1	5,223	9	623	—	1,991	15	118	—	10,764	6	1,143	—	17,978	7	19,121	4
	Wt.	1,997	3	96,654	33	4,771	2	15,803	32	528	1	118,345	20	7,296	2	230,802	25	238,098	18
Red snapper	No.	155	—	816	1	218	—	33	—	16	—	949	—	389	—	1,798	1	2,187	—
	Wt.	2,553	4	14,801	5	4,352	2	291	—	118	—	18,754	3	7,023	2	33,846	4	40,869	3
Others	No.	1,955	6	4,330	8	13,696	10	804	6	317	1	6,430	3	15,968	7	11,564	4	27,532	6
	Wt.	6,963	10	20,941	7	24,412	11	1,815	5	760	1	33,259	6	32,135	9	56,015	6	88,150	7
Total no.		31,382		55,537		137,238		13,587		57,739		194,087	74	226,359		263,211		489,570	
Total wt.		72,818		290,902		228,871		49,919		70,942		599,796	64	372,631		940,617		1,313,248	

[1]No vessels operated in the Cape Hatteras District in 1972.
[2]All weights are in pounds.

Table 5.—Season catches by Carolina headboats—1973.

Species		Cape Hatteras, N.C.		Cape Lookout, N.C.				Cape Fear, N.C.				Cape Romain			
		Offshore	%	Inshore	%	Offshore	%	Inshore	%	Offshore	%	Offshore	%	Total	%
Porgies	No.	2,727	28.6	18,900	33.9	25,272	43.5	51,834	46.7	56,257	78.5	142,764	68.9	297,754	58.0
	Wt.[1]	9,060.1	21.1	34,020.0	31.8	78,121.4	22.8	94,204.2	26.2	173,690.2	65.5	356,576.8	55.1	745.672.7	46.4
Grunts	No.	562	5.9	19,064	34.2	1,208	2.1	40,681	36.7	8,389	11.7	9,520	4.6	79,424	15.5
	Wt.	1,240.0	2.9	32,408.8	30.3	3,176.1	0.1	64,149.2	31.4	19,220.3	7.2	22,658	3.5	142.852.4	8.9
Vermilion snapper	No.	2,498	26.2	14,718	26.4	18,241	31.4	15,641	14.1	512	0.7	32,030	15.5	83,640	16.3
	Wt.	7,450.8	17.4	19,672.8	18.4	60,056.7	17.5	24,091.2	11.8	1,721.7	0.6	43,844.7	6.8	156,837.9	9.7
Groupers *Mycteroperca*	No.	34	0.4	1,048	1.8	6,217	10.7	1,415	1.2	2,475	3.5	6,373	3.1	17,562	3.4
	Wt.	834.7	1.9	8,677.7	8.1	127,449.8	37.2	12,944.9	6.3	27,432.7	10.3	85,547.8	13.2	262,887.6	16.3
Groupers *Epinephelus*	No.	544	5.7	228	0.4	2,099	3.6	206	0.2	1,321	1.8	6,218	3.0	10,616	2.1
	Wt.	5,381.3	12.5	1,451.0	1.4	26,803.3	7.8	1,975.4	1.0	11,167.4	4.2	52,692.7	8.1	99,471.1	6.2
Red snapper	No.	100	1.1	9	0.01	1,886	3.2	101	0.1	271	0.4	1,615	0.8	3,982	0.8
	Wt.	1,452.8	3.6	135.2	0.1	27,023.4	7.9	830.3	0.4	3,018.6	1.1	27,762.5	4.3	60,222.8	3.7
Others	No.	3,054	32.1	1,801	3.2	3,146	5.4	1,038	0.9	2,431	3.4	8,726	4.2	20,196	3.9
	Wt.	17,413.3	40.6	10,682.2	10.0	20,217.0	5.9	5,896.4	2.9	15,592.6	10.9	57,483.2	8.9	127,284.7	8.7
Total no.		9,519		55,768		58,069		110,916		71,656		207,246		513,174	
Total wt.		42,833.0		107,047.7		342,847.7		204,091.6		251,843.5		646,565.9		1,595,229.4	

[1]All weights are in pounds.

211,000 pounds in North Carolina and believe an equal or greater amount was landed in South Carolina.

We did not estimate the sea bass catch in 1972 because when we began this study we were primarily interested in the tropical offshore species—grunts, snappers, groupers, and porgies—and, therefore, did not ask mates to keep records of sea bass catches. It was evident after one season, however, that the sea bass was an important member of the ecosystem at the shoreward limit of distribution of the more tropical fishes, and that the angling success on inshore boats could not be adequately represented without including sea bass.

Red porgy, vermilion snapper, white grunt, and groupers were the most numerous fishes caught other than black sea bass.

Notes on Principal Fishes Caught

It is beyond the scope of this paper to completely describe each species or species group listed in Tables 4 and 5, but some salient comments on each of the principal fishes should be of value in understanding the fishery. The following species are discussed in descending order of importance as indicated by their total weight landed.

The red porgy, also called silver snapper, provided the largest catch in number and weight in both years and is clearly one of the most important recreational fishes of our southeast Atlantic Coast. In the Carolinas alone, approximately 216,000 porgies weighing 519,000 pounds were taken in 1972 and 298,000 weighing 746,000 pounds were taken in 1973. Red porgies are also taken off Georgia, the east coast of Florida, and in the eastern Gulf of Mexico.

The black sea bass, taken almost entirely by inshore boats, was probably the second most important species caught by weight.

Dockside sampling includes weighing and measuring fish and collecting scales that will reveal the age of fish sampled. Photo courtesy of H. Gordy.

Groupers are large bass-like fishes that include the scamp, gag, hinds, and others. The species composition varied over the range of the study. Scamp occurred only irregularly north of central Onslow Bay, but were extremely important to vessels fishing south of there. Gag were important throughout the fishery but were more abundant in the southern districts. Snowy and yellowedge groupers seemed abundant in deep water (60-80 fathoms) throughout our study area but appeared mostly in catches of northern boats, which more often fished deep areas. The speckled hind, a large fish that has been taken to 45 pounds in South Carolina and 38 pounds in North Carolina, was common throughout the area and, with the gag, appeared to have the most northern distribution. Warsaw groupers attained prodigious weights but were only caught occasionally. The records for Warsaw grouper are 245 pounds in North Carolina and 310 pounds in South Carolina. Several 100-pound Warsaw grouper are caught each year.

Vermilion snapper, often erroneously called red snapper aboard headboats, and grunts, principally white grunt, shared ranking as the fourth and fifth most productive species and were more numerous in the catch than groupers. Of the two, more pounds of grunts were caught in 1972; more pounds of vermilion snapper were taken in 1973. Vermilion snapper, caught from both offshore and inshore boats, were usually larger offshore. In 1972, those taken offshore averaged 2.9 pounds versus 1.1 pounds for those taken inshore.

Grunts were extremely important to inshore boats but also commonly occurred in the catches of offshore boats in South Carolina and southern North Carolina, where the fishing subdistricts seem less distinct than in the north. White grunt were often found with scamp grouper on rocks in 18 to 25 fathoms southward from mid-Onslow Bay, and with sea bass, porgies, and vermilion snapper northward.

Red snapper, yelloweye or silk snapper, and blackfin snapper, all commonly known as red snapper, were not abundant even though headboats advertise "red snapper fishing." Only 2,178 were taken in 1972 and 3,982 in 1973. They are, however, usually large, averaging over 18 pounds per fish in 1972 and 1973. Because of their large size, relative scarcity, and fine tasting flesh, fishers prize them highly.

Our category of "other fishes" includes greater amberjack, almaco jack, gray tilefish, and gray triggerfish. Available from 10 to over 100 fathoms, both jacks are large fierce fighters, the greater amberjack commonly attaining a weight of 50 pounds and the almaco, 25 pounds. Although the flesh is good tasting, few people eat it, possibly because 75 percent or more amberjacks carry heavy infestations of larval tapeworms in the flesh.

Gray tilefish, a relatively recent addition to headboat catches, are regularly taken from water deeper than 35 fathoms. Although of equally good flavor, they do not attain the size of the common tilefish, *Lopholatilus chamaelonticeps*, a popular sport fish of the northeast coast that appears to be a colder water species. In the southeast it might occur farther offshore than the gray tilefish.

Gray triggerfish, which anglers formerly viewed with disfavor but now accept with more enthusiasm, are common from 10 to 30 fathoms. Although good fighters, they are clever at stealing bait and are difficult to hook. Their flesh is white, sweet, very firm, and makes excellent chowder.

Effort

The amount and distribution of fishing effort changed from 1972 to 1973. Angling effort was 49,989 angler days in 1972 and 59,815 angler days in 1973 (Tables 6, 7)[3]. Major increases in effort occurred within the Cape Romain and Cape Hatteras offshore subdistricts. The operation of a headboat at Hatteras for the first time since the study began allowed accrual of effort there in 1973. Cape Romain offshore vessels carried more anglers in 1973 than in 1972 because of exceptionally good fall weather and also because anglers were apparently more abundant in 1973.

Distribution of effort changed not only because of vessels operating in new territory, as at Hatteras, but also because of changes in competition between vessels at a port. For instance, in the Cape Fear district, the addition of a new offshore vessel radically changed the distribution of effort between inshore and offshore vessels. The new

[3]An angler day represents the participation of one rod and reel angler in the headboat fishery for one full day (12 to 16 hours, including travel to and from the fishing ground).

Table 6.—Catch and effort by Carolina headboats during the 1972 fishing season[1].

Time	Cape Lookout, N. C.		Cape Fear, N.C.		Cape Romain		All areas combined	
	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore
Spring								
Angler days	754	1,192	1,536	110	352	736	2,642	2,038
Fish/day	3.3	6.7	14.9	6.4	14.5	14.0	11.6	9.3
Wt/day[2]	10.87	30.92	22.94	26.36	15.16	49.74	18.46	37.47
Wt/fish	3.2	4.6	1.5	4.1	1.0	3.5	1.6	4.0
June								
Angler days	767	1,757	3,162	379	1,137	3,186	5,066	5,322
Fish/day	4.6	5.3	10.6	7.8	12.8	15.7	10.2	11.7
Wt/day	9.98	31.49	17.3	32.73	12.96	46.92	15.11	40.82
Wt/fish	2.2	6.0	1.6	4.2	1.0	3.0	1.5	3.5
July								
Angler days	1,346	2,566	3,743	518	1,590	3,451	6,679	6,535
Fish/day	4.4	4.7	5.7	7.7	15.6	13.3	7.8	9.5
Wt/day	10.66	25.23	10.30	32.05	20.50	39.60	12.80	33.36
Wt/fish	2.4	5.4	1.8	4.2	1.3	3.0	1.6	3.5
August								
Angler days	1,449	2,582	2,640	402	2,007	3,080	6,096	6,064
Fish/day	8.1	6.4	9.0	7.8	6.6	12.9	8.0	9.8
Wt/day	18.38	32.37	14.59	24.94	9.09	43.38	13.68	37.47
Wt/fish	2.3	5.1	1.6	3.2	1.4	3.4	1.7	3.8
Autumn								
Angler days	964	1,857	2,462	473	—	2,791	3,426	5,121
Fish/day	8.0	5.3	14.5	5.9		17.2	12.7	11.8
Wt/day	16.56	27.11	25.32	16.86	—	51.37	22.86	39.38
Wt/fish	2.1	5.1	1.7	2.9	—	3.0	1.8	3.3
All seasons								
Angler days	5,280	9,954	13,543	1,882	5,086	13,244	23,909	25,080
Fish/day	5.9	5.6	10.1	7.2	11.4	14.7	9.5	10.5
Wt/day	13.79	29.22	16.89	26.52	13.94	45.28	15.58	37.50
Wt/fish	2.3	5.2	1.7	3.7	1.2	3.1	1.6	3.6

[1]No vessels operated in the Cape Hatteras District in 1972. [2]All weights are in pounds.

Table 7.—Catch[1] and effort by Carolina headboats during the 1973 fishing season.

Time	Cape Hatteras, N.C.	Cape Lookout, N.C.		Cape Fear, N.C.		Cape Romain		All areas combined	
	Offshore	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore
Spring									
Angler days	—	1,494	2,741	2,041	452	—	3,422	3,535	6,615
Fish/day	—	8.1	5.0	15.5	9.6	—	9.9	12.3	7.9
Wt/day[2]	—	14.8	29.8	30.5	27.4	—	34.2	23.8	31.9
Wt/fish	—	1.8	5.9	2.0	2.9	—	3.5	1.9	4.1
June									
Angler days	—	1,516	2,341	2,251	501	—	3,638	3,767	6,480
Fish/day	—	8.0	4.5	11.81	9.6	—	11.3	10.3	8.7
Wt/day	—	14.4	23.9	21.2	35.6	—	33.1	18.5	29.9
Wt/fish	—	1.8	5.3	1.8	3.7	—	2.9	1.8	3.4
July									
Angler days	560	1,924	2,459	2,102	1,826	—	4,489	4,026	9,334
Fish/day	5.4	7.6	4.5	10.8	8.3	—	10.4	9.3	8.4
Wt/day	24.9	16.7	25.4	20.0	34.0	—	34.7	18.6	32.5
Wt/fish	4.7	2.2	5.6	1.9	4.1	—	3.3	2.0	3.9
August									
Angler days	695	1,140	2,107	948	1,815	—	3,666	2,088	8,283
Fish/day	5.4	5.3	4.8	14.2	9.6	—	9.3	9.3	7.9
Wt/day	22.3	8.8	27.7	23.1	33.1	—	30.4	15.3	29.6
Wt/fish	4.2	1.7	5.8	1.6	3.5	—	3.3	1.6	3.8
Autumn									
Angler days	343	1,721	3,694	1,108	2,899	—	5,622	2,829	12,558
Fish/day	8.2	6.4	3.4	15.0	9.6	—	9.1	9.8	7.5
Wt/day	40.0	11.9	22.9	27.2	31.1	—	25.3	17.9	26.3
Wt/fish	4.8	1.9	6.8	1.8	3.3	—	2.8	1.8	3.5
All seasons									
Angler days	1,598	7,795	13,342	8,450	7,493	—	20,837	16,245	43,270
Fish/day	6.0	7.2	4.4	13.1	9.6	—	10.0	10.3	8.0
Wt/day	26.9	13.7	25.7	24.2	35.4	—	31.0	19.2	29.7
Wt/fish	4.9	1.9	5.9	1.8	3.7	—	3.1	1.9	3.7

[1]Excluding sea bass.
[2]All weights are in pounds.

vessel, a fast, aluminum catamaran, offered offshore fishing trips for the same price as the slower inshore vessels, attracting business away from the inshore boats, as well as from another offshore boat that charged more.

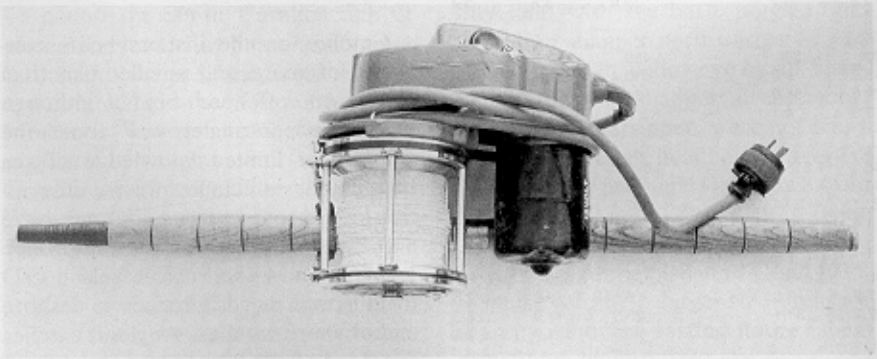
Angling Quality

Angling quality is a concept that relates to the satisfaction experienced by an angler as a result of the fishing trip. This satisfaction is derived from both objective components that relate to the catch, such as number and size of fish caught, and subjective components such as the fellowship experienced and the pleasure of being at sea. For this discussion we measured angling quality in terms of the number and weight of fish caught per angler and the average weight per fish caught (Tables 6, 7).

Headboat anglers aboard offshore boats took large catches and large fish. Weight of the catch per angler day in 1972 averaged 37 pounds for offshore boats; season averages for offshore and subdistricts ranged from 26.5 to 45.3 pounds. In 1973 the overall offshore average was 29.7 pounds and offshore subdistrict averages ranged from 25.7 to 31.0 pounds. Average catches tended to be higher in the Cape Fear and Cape Romain offshore subdistricts, possibly because the average angler day included slightly more fishing time in those subdistricts and possibly because good fishing was found at shallower depths than in the northern subdistricts. For all offshore subdistricts, average weights of fish ranged from a high of 5.9 pounds at Cape Lookout in 1973 to a low of 3.1 pounds at Cape Romain in 1972 and 1973.

Catches on the inshore boats consisted of more and smaller fish than those on offshore boats, although poundage per angler was about the same. Our limited knowledge of sea bass catches precludes precise description of inshore catches, but we have sufficient information from the Cape Lookout and Cape Fear vessels in 1973 to illustrate the differences in inshore and offshore catches. Anglers' catches averaged about 32 pounds per day on inshore vessels versus 28.4 pounds per day on offshore vessels, but the inshore catch was composed of much smaller fish than occur in offshore catches. Nearly half the inshore catch is of sea

The largest species available to Carolina headboat anglers is the Warsaw grouper. The fish pictured weighed 167 pounds, but some weighing over 300 pounds have been taken off the North and South Carolina coasts. Photo courtesy of H. Gordy.



Electrically powered 9/0 reel as used in the headboat fishery. Photo courtesy of H. Gordy.

bass and these rarely exceed a pound. In all inshore areas, species other than sea bass averaged 1.6 pounds in 1972 and 1.9 pounds in 1973; in all offshore areas they averaged 3.6 in 1972 and 3.7 pounds in 1973. The average size of inshore fish was smaller not only because there were fewer large species available, but because fish of the same species were usually smaller inshore than offshore (Tables 3, 4).

THE FUTURE OF OFFSHORE HEADBOAT FISHING IN THE CAROLINAS

Future prosperity in the Carolina headboat fishery will depend on the continued supply of fare-paying fishers, who will fish only if fishing success remains high. The availability of fish will be influenced by both natural and human phenomena. Natural phenomena that might seriously affect fishing would include, among many others, the intrusion of cold waters on the outer shelf such as occurred off Cape Lookout in the winter of 1957-58. Cold water, by fisher's accounts, killed mainly red snapper, which were seen floating at the surface. Since other species such as red porgy, vermilion snapper, groupers, grunts, and black sea bass were not seen, they were presumed to be unharmed. By 1964, when interest revived in fishing the outer shelf in Raleigh and Onslow bays, red snapper populations apparently had recovered. Catches initially were large, but fell off rapidly as fishing pressure continued. Red snapper now make up only a small part of the catch. A recurrence of cold water on the outer shelf, therefore, would probably not greatly affect the current headboat fishery, since it depends primarily on species that appear resistant to cold water.

Human influences on outer shelf fish populations include both indirect effects through environmental modifications and direct effects, especially fishing.

The southeastern Continental Shelf will soon be subject to exploration and development of offshore petroleum resources, and likely will become a site for nuclear-electric power plants. It is inevitable that the development of energy sources will affect fisheries of the South Atlantic Shelf. Some interactions will be deleterious while others may be beneficial.

Fishing affects some fish species much more than others. According to fishers, fishing can quickly reduce the populations of the large groupers and snappers. When fishing off Morehead

City resumed in earnest in the mid-1960's, large red and silk snappers were abundant, but after a few years they constituted only a small fraction of the catch. The best catches of snappers are usually made early in the year after little fishing pressure has occurred during the winter. Groupers as well as snappers seem easily depleted. Return rates of tags on speckled hind and scamp are 26 and 10 times, respectively, the return rate of tags on the abundant red porgy, indicating that these two groupers are much less abundant or much more vulnerable than porgies. In either case, fishing reduces the number of large predators much more quickly than it reduces the number of smaller ones.

Both tag returns and observations by fishers suggest that, because of the sedentary behavior of most species, intensive fishing may quickly reduce the productivity of a given fishing site even though the fish populations as a whole may be minimally affected. Where there are many competing headboats, such as on the east coast of Florida, angling success is reportedly much less than in former years. Where headboats are few and well scattered, as in the Cape Hatteras and Cape Lookout districts, captains tend to fish many sites to prevent overfishing any one, and fishing remains good.

The vulnerability of sites to intense fishing is the focus of a controversy between commercial handline fishers and headboat operators. Intensive fishing on one site probably has little effect on the population of fishes as a whole, but it could handicap headboat fishers by overexploiting accessible fishing spots. Commercial snapper boats will often fish on a productive site until the fish have ceased biting or are "all" caught. Often a year or more elapses before a site again provides acceptable fishing. To a commercial fisher who is highly mobile, the consequence of fishing out several sites is slight. Headboat operators are restricted to a single port and a rather stringent time schedule. They must expect to find good fishing within a few hours of the home port.

If they choose to preserve the present headboat fishery, resource managers would do well to avoid the traditional management goal of maximum sustained yield, and seek instead a goal of maximum catch per unit effort. Maximum sustained yield is usually achieved at some average catch per unit effort that is much less (perhaps 50 percent less) than in a virgin fishery. The success of the headboat fishery depends on a high catch per unit effort of large fish that can only come from lightly exploited populations. Only if anglers are guaranteed a high quality reward will they repeatedly pay $25 to $35 to undergo early morning departures, late returns, and 6-8 hours of pounding, monotonous riding for 4 to 6 hours of fishing. The catch per unit effort is now sufficiently high to earn much repeat business for the headboats. Management to attain maximum sustained yield would likely drop the catch per unit effort low enough to drive most of the sport fishers to other more rewarding, less demanding types of fishing. The collapse of the headboat fishery would be a major loss. In 1973 the Carolina headboat fishery landed 1.6 million pounds of edible fish, brought over a million dollars in fishing fees alone to Carolina coastal communities, and provided 60,000 angler days of recreation.

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