

South Carolina Marine Fisheries 1989

R.A. Low

South Carolina Wildlife and Marine Resources Department
Marine Resources Division
Office of Fisheries Management
Fisheries Statistics Program
Data Report 7
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INTRODUCTION

This report is an information summary of significant events in South Carolina's marine fisheries during 1989 and continues the series that began with 1977. Objectives are to 1) update and describe trends in the principal commercial and recreational fisheries and 2) provide explanatory information relevant to important developments. The contents are intended for a general audience and are not meant to be definitive in the scientific sense. Readers desiring information on general characteristics of the state's marine fisheries and their development between 1977 and 1988 should refer to Technical Report 67 and Data Report 6.

Data on commercial fisheries catch and effort were obtained through 1) mandatory monthly reports by licensed dealers, 2) mandatory shellfish harvest reports, 3) voluntarily submitted shrimp trip tickets from dock operators, and 4) voluntarily submitted fish trip tickets from wholesalers or individual fishermen. Annual fishing effort (e.g. the number of trips or landings) by gear was estimated by dividing total landings from monthly dealer summaries by average catch per unit of effort (CPUE) from trip tickets. The percentage of total landings covered by trip tickets varied considerably by gear type.

Commercial landings data were subject to confidentiality requirements, depending on the number of reporting sources. In some fisheries, the number of reporting participants was too small to reveal gear or species-specific data without violating confidentiality. These figures were included, however, in the total landings for the appropriate general categories.

The major source of recreational fishery catch and effort data was the Marine Recreational Fishery Statistics Survey (MRFSS), conducted annually under National Marine Fisheries Service (NMFS) administration since 1979. This is a generalized survey of rod-and-reel fishing from shore or shore-based facilities (piers, docks, bridges, etc.), charterboats, and private boats. A charterboat is a vessel carrying six or less fishermen on a for-hire basis. A creel census provided catch data, while a telephone survey of randomly selected coastal households collected information on participation and effort. MRD conducted the creel census and the NMFS subcontractor did the telephone survey. Results from both activities were combined to produce estimates of catch by species or species group.

Data on the headboat fishery were obtained from the NMFS Beaufort (N.C.) Laboratory, which has conducted an annual survey since 1972. A headboat is a for-hire vessel carrying more than six fishermen.

MRD conducted two short-term surveys in 1989 directed at recreational fisheries not covered by the MRFSS. These were the shellfish harvest on public grounds and the cast net fishery over bait for shrimp. Information on these activities was obtained during the MRD surveys.

During 1989, the status of most fisheries resources in state waters remained relatively stable. The sturgeon population remained depressed and the fishery continued to be closed. Oyster

stocks recovered somewhat in most areas following several years of environmentally-related problems. The state's most important fishery resource, shrimp, was abundant in 1989, with a particularly strong showing of fall white shrimp. Two species, swordfish and golden tilefish, important to offshore fishermen remained seriously depleted and concern continued to mount over the status of several reef fish species and sharks.

The most significant event to impact the fisheries in 1989 was Hurricane Hugo, which struck Charleston on 21-22 September. Effects were most apparent from Charleston north. The commercial sector suffered direct damage to boats and facilities and storm-related conditions contributed to reduced availability of some estuarine species after the storm. These factors resulted in reduced fishing effort and lower landings. Fortunately, recovery was quite rapid and long-term detrimental effects appeared to be rather minimal. Most of the physical damage to recreational facilities occurred between Charleston and Cherry Grove, with coastal marinas and oceanic fishing piers being hard hit. The charterboat and headboat fleets weathered the storm well. Impacts of the hurricane on specific fisheries are described in the appropriate sections.

COMMERCIAL FISHERIES

The commercial fishing industry is important to small coastal communities (e.g. Murrells Inlet, McClellanville, and Frogmore) with a long tradition of seafood harvesting and relatively few employment alternatives. About 4,300 people were directly employed in this industry during 1989, the majority (79%) of whom were fishermen. The shrimp industry was the largest employer with 2,200 individuals, most (1,700) of whom worked on the trawlers. There were 282 licensed crabbers and 560 shellfishermen. Approximately 850 people were employed dockside. One negative aspect of the employment situation was a decline in all sectors except the offshore finfish fishery (which showed an increase of less than 1%). Another was the continued lack of job opportunities in the processing sector. Although the overall economic contribution of the seafood industry is at least twice the ex-vessel value of its landings, the state continues to receive relatively little benefit in value added to this raw production because of the lack of instate processing operations.

South Carolina's fishing industry is heavily dependent on the productive capacity of the state's estuaries. Estuarine-dependent resources account for nearly 80% of the seafood harvest. The trend in commercial landings of these products is disturbing, with significant declines in most categories. Compared to the 1979-1988 average, the poundage landed in 1989 for many categories of such seafood was depressed: blue crab (-3%), kingfishes (whitings) (-9%), flounders (-42%), whelks (conchs) (-47%), clams (-48%), oysters (-69%). The only significant positive performance was attributed to shrimp (+41%).

Overall weight production from wild stocks increased 11% and was slightly (3%) above the ten-year average (Fig. 1). Above

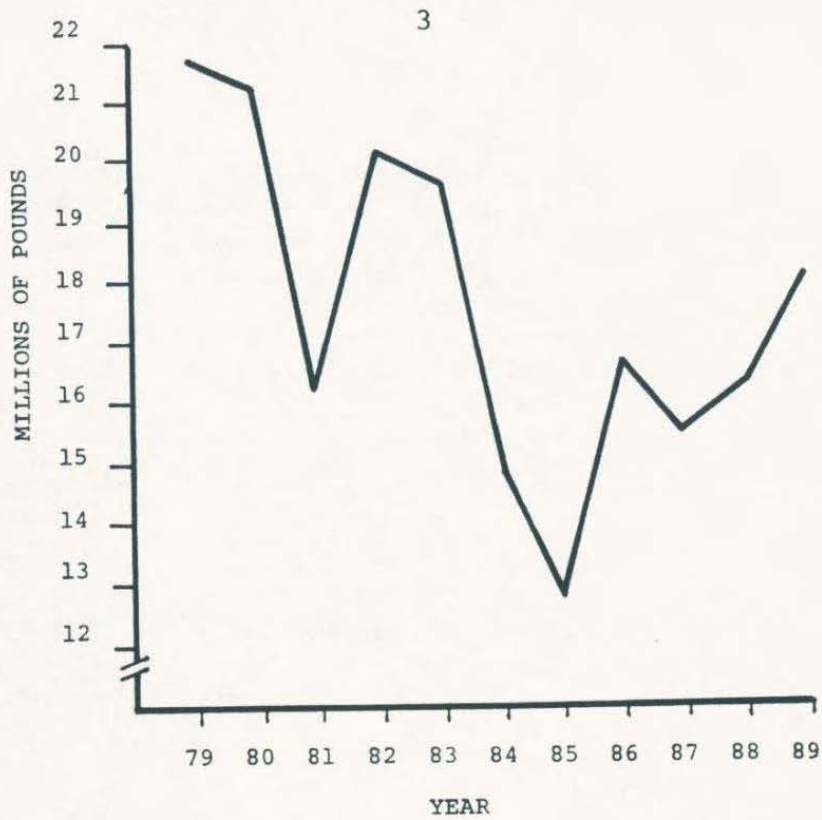


Fig. 1. Total landed weight of commercial marine fisheries products.

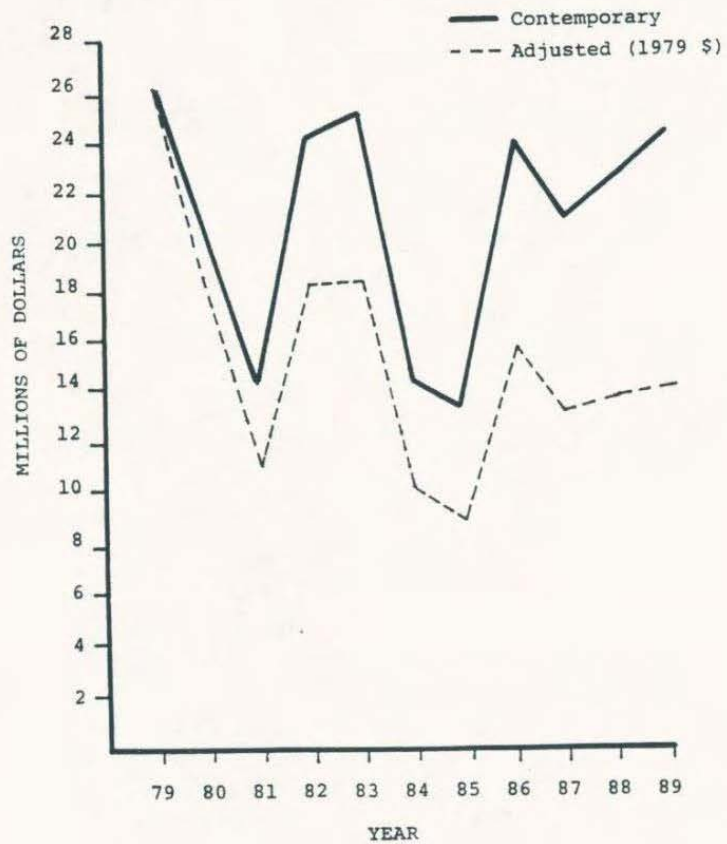


Fig. 2. Total ex-vessel value of commercial landings.

average shrimp and offshore fish landings accounted for the increase. Mariculture production was not considered in any of the following discussion. Current value of 1989's landings represented a modest (7%) increase over 1988's production but, when measured in constant dollars (i.e., adjusted for annual inflation), was about 9% below the ten-year average (Fig. 2). The principal factor for the decline was a sharp drop in shrimp prices.

Commercial seafood categories were composed as follows. Figures for shrimp include whole weights all penaeid species (brown, white, and pink) and rock shrimp unless otherwise stated. Crab/lobster includes whole weights of blue crab (hard and peeler), stone crab (claws), horseshoe crab, spiny lobster, and slipper (bulldozer) lobster: however, practically all of this category is accounted for by hard blue crab. Shellfish includes meat weights of oysters, clams, whelks, (conchs), scallops, squid, and octopus. Most fish landings are in whole weights. The coastal fish category consists of mullet, inshore groundfish (primarily flounders and sciaenids such as spot, kingfishes or whittings, and croaker), sharks taken by inshore gear (gill nets, stop nets, drift nets, inshore fish trawls and shrimp trawls), and coastal pelagics (bluefish and Spanish mackerel). Offshore fish include reef fishes (snappers, groupers, porgies, grunts, sea bass, tilefishes, and wreckfish), billfishes (including swordfish), king mackerel, pelagics primarily taken with offshore gear (bonito, dolphin, cobia, wahoo, and tunas), and those sharks reported caught with offshore gear (handline, longline). River fish include catfishes, sturgeon, shads, and blueback herring.

Shrimp, blue crab, and offshore fish accounted for about 90% of the 1989 landings in both weight and value (Fig. 3). Both shrimp (+ 41%) and offshore fish (+ 32%) volumes were well above the ten-year averages and that of blue crab was only slightly (3%) less. Production in other categories was well below both the 1988 and ten year average levels. Compared to the 1979-1988 means, coastal finfish volume was down 65%, shellfish production was down 63%, and volume of river fish was off 56%. Depressed landings of coastal fish and shellfish were mainly due to Hurricane Hugo, while river fish production reflected the declining abundance of blueback herring.

SHRIMP

Total landings were the highest since 1979, with above-average production of both brown and white shrimp (Fig. 4). Landings of pink and rock shrimp were insignificant. Landings of brown shrimp were 12% above the ten-year average, while the volume of white shrimp, the highest since 1979, was 65% above the 1979-1988 average level. Browns represented about 30% of the total penaeid landings, close to the historical share.

Brown shrimp spawn in nearshore ocean waters and their larvae overwinter there. MRD monitors the abundance of postlarvae moving into the estuaries in March. These catch rates were unusually high in 1989. Water temperatures were below normal in April and early May, contributing to slow growth. High abundance in nursery areas

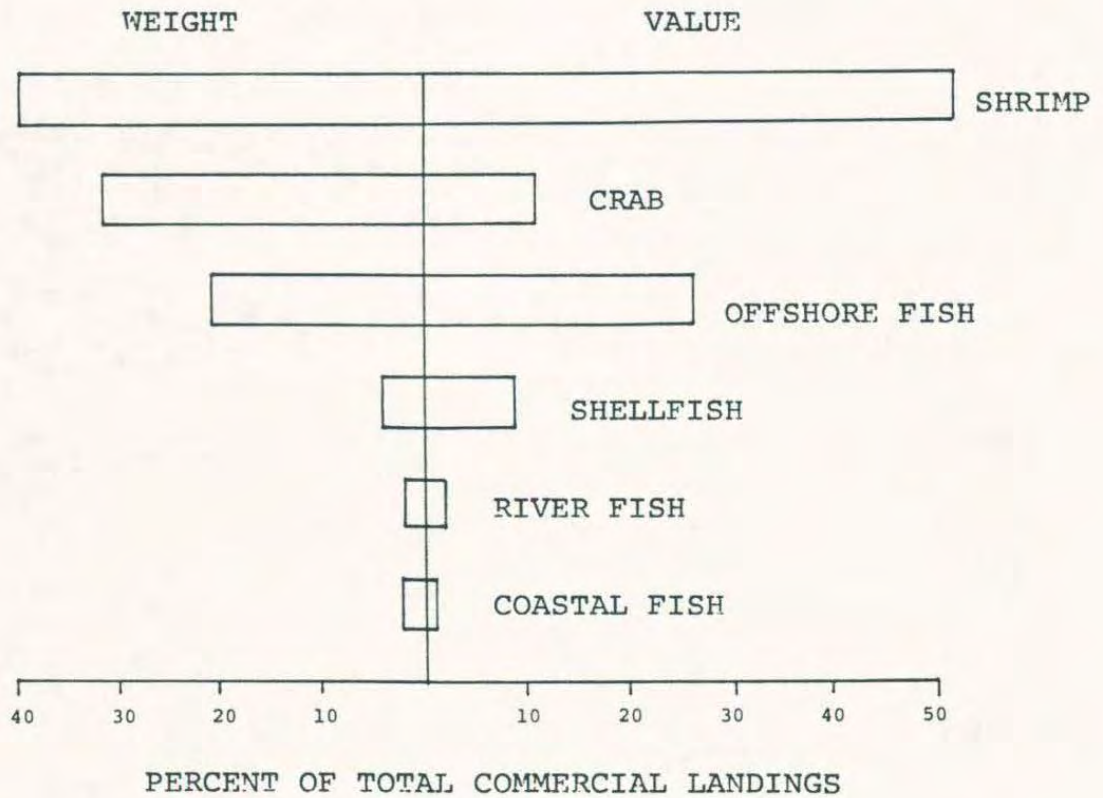


Fig. 3. Weight and value composition of 1989 commercial landings.

increased competition for food and probably contributed to slow growth after water temperatures became favorable. The late start of the growing season may also have resulted in inter-specific competition for food from juvenile white shrimp in early June. Overall size of brown shrimp during the season was below normal and prices were low.

During the brown shrimp season, the Secretary of Commerce at first suspended TED regulations (on 25 July), then provided the option of either using TEDs or following a trawl schedule that limited tow duration to 105 minutes for the balance of the season (until 1 September). Most shrimpers used TEDs rather than cope with the complexity of the trawl schedule. The impact of these regulations on the brown shrimp harvest is difficult to evaluate. MRD conducted an onboard observer study of bycatch aboard Charleston vessels. Results suggested that the shrimp catch rate for Morrison (soft) TED gear was about 6% lower than for non-TED nets.

The winter of 1988-1989 was very mild and unusually large white shrimp overwintered in the lower reaches of the estuaries. MRD catch rates in inside areas during spring sampling were extremely variable, but indicated a good supply of spawning stock. The 1 June opening of coastal waters to trawling was the earliest since 1983 (sampling indicated that most roe shrimp had spawned by then). The catch of roe shrimp (410,000 pounds heads-off, worth \$1.8 million) was the largest since 1976. Catch rates of postlarvae in early June and subsequent catch rates of juveniles in tidal creeks were among the highest reported in MRD's sampling history. Rainfall during July was above average, contributing to both good growth and survival, but the high density of juvenile shrimp was expected to result in smaller than normal shrimp in the fall.

Hurricane Hugo struck as the fall fishery was approaching its traditional peak harvesting period. The area from Stono Inlet to Cape Romain was directly affected, with virtually no adverse impact farther south. About 60 vessels were damaged by the storm, with most of the impact on trawlers at McClellanville, Mt. Pleasant, Folly Beach, and Rockville. At least 40 trawlers were at McClellanville, where the wharf and most packing facilities were destroyed. Only three trawlers there were undamaged. A major shrimp landing port, the town was knocked out of the fishery for the remainder of the season. As of the end of February 1990, the industry there was considered no more than 50% recovered. Fortunately, most of the McClellanville fleet was refloated with assistance from insurance. Eight Mt. Pleasant trawlers suffered heavy damage.

Storm-generated debris was extensive in coastal waters from the north end of Isle of Palms to Bulls Bay, with the area from Dewees Inlet to Bulls Bay undruggable. Areas south of the Charleston jetties were mostly clean. Many shrimpers reported substantial gear damage and the need to periodically haul back and clear fouled nets reduced effective fishing time. Nevertheless, those boats that were able to fish shortly after the storm made excellent catches of large shrimp.

Anoxic conditions in estuarine areas from Charleston to Cape

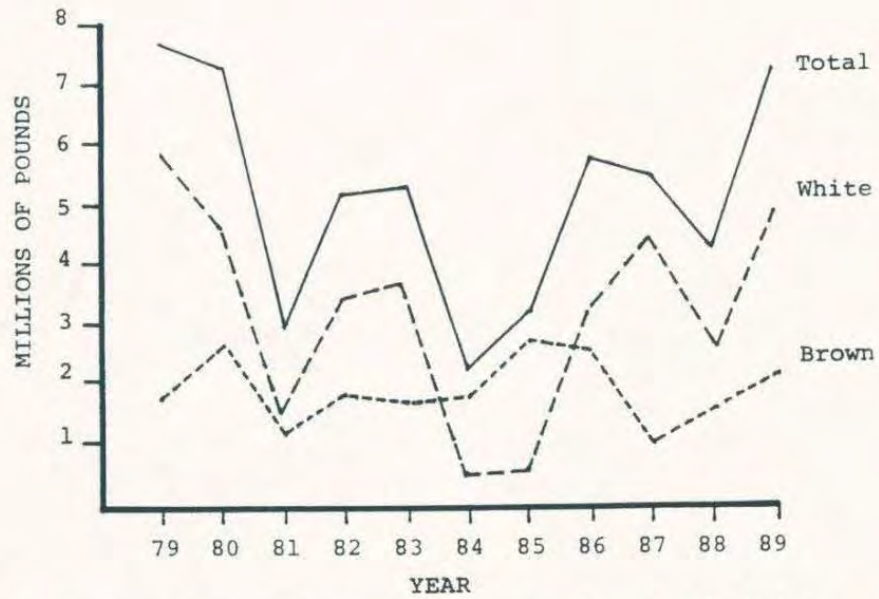


Fig. 4. Annual commercial landings (heads-on) of shrimp.

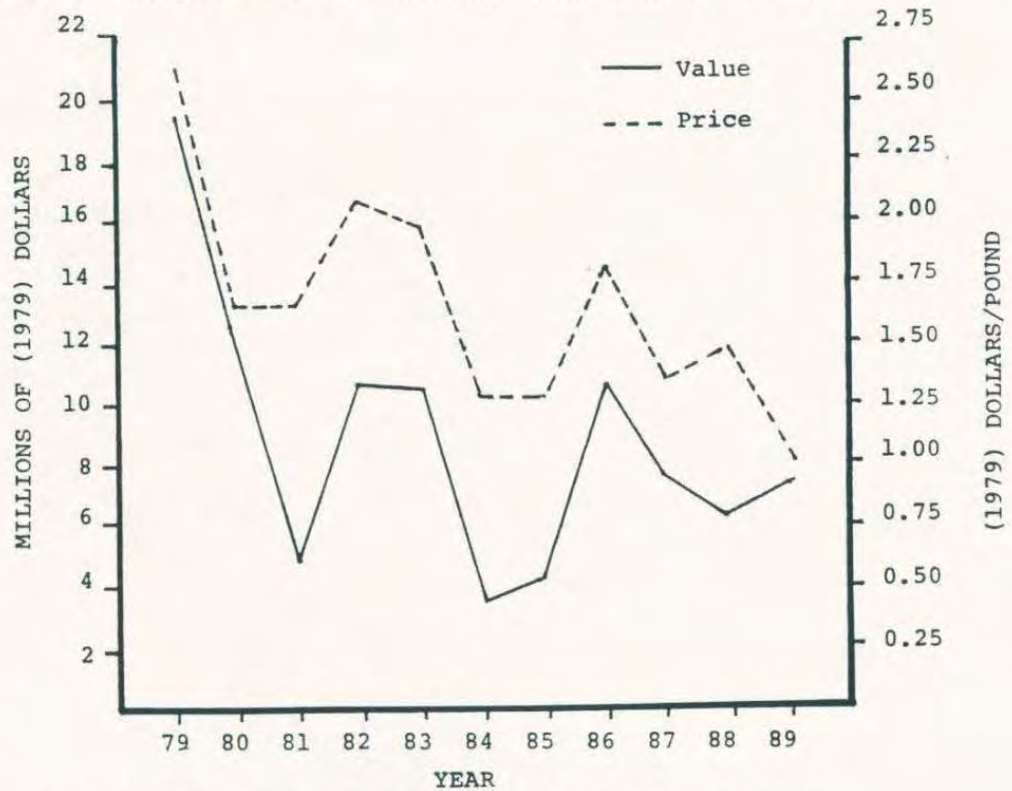


Fig. 5. Adjusted (1979-based \$) ex-vessel value and unit price of penaeid shrimp landings.

Romain drove shrimp into coastal ocean waters. Because of this concentrated and accelerated outmigration, shrimp were very abundant in this area's coastal waters during October. Boats from the Beaufort/Port Royal area worked off McClellanville and reported catching 25-30 baskets per drag early in the month. Charleston shrimpers resumed fishing local waters about a week after the storm, although lack of electricity and damage to docks restricted activity.

The abundance of large roe shrimp may have contributed to a relatively large early spawn, which would have allowed for a longer than normal growing period for much of the fall crop. Summer grow-out conditions were mostly favorable and most of the fall shrimp were relatively large. A high unit value would have been expected from historical price structuring and, if traditional conditions had prevailed, the fall harvest would have generated a very large economic return.

In reality, the inflation-adjusted value of the 1989 shrimp catch was 19% below the ten-year average. This was attributable to the lowest adjusted unit value in many years (Fig. 5). Increasing imports of pond-raised shrimp from China had a significant impact on prices of domestic-produced shrimp in 1989, a trend likely to continue.

These declines in prices aggravated the impact of overcapitalization and increased operating costs for South Carolina's trawler fleet. Given the continued development of coastal areas and related impact on carrying capacity of the habitat, it is unlikely that any sustained increase in wild production can be achieved. The recreational catch is growing, due largely to the expanding fishery over bait for fall white shrimp, and the commercial sector's share may therefore decline. Even in a year of good production - as 1989 was - the commercial catch is incapable of generating as high a net economic yield as in previous years. Fuel cost, a major variable expense, is increasing. Maintenance and insurance expenses, related to vessel age, are consuming an increasing percentage of gross returns. This trend will also continue as the state's trawler fleet continues to increase in age (Fig. 6). These constraints on the profitability of commercial trawling are likely to be reflected in declining participation. After three years of modest increases in trawler license sales, this trend was reversed in 1989 (Fig. 7).

CRAB/LOBSTER

Practically all of the product in this category was hard blue crab from the pot fishery. These landings, while substantially lower than those in 1988 (an exceptionally good year), were close to the ten-year average. Total reported production has been strongly related to the number of crabbers (Fig. 8) and landings likely could be increased with additional participation and/or effort. Many crabbers are part-time participants and adjust their effort according to market conditions. In recent years, there has been less emphasis on supplying local picking houses and more product has been sourced to the "basket" trade because of higher

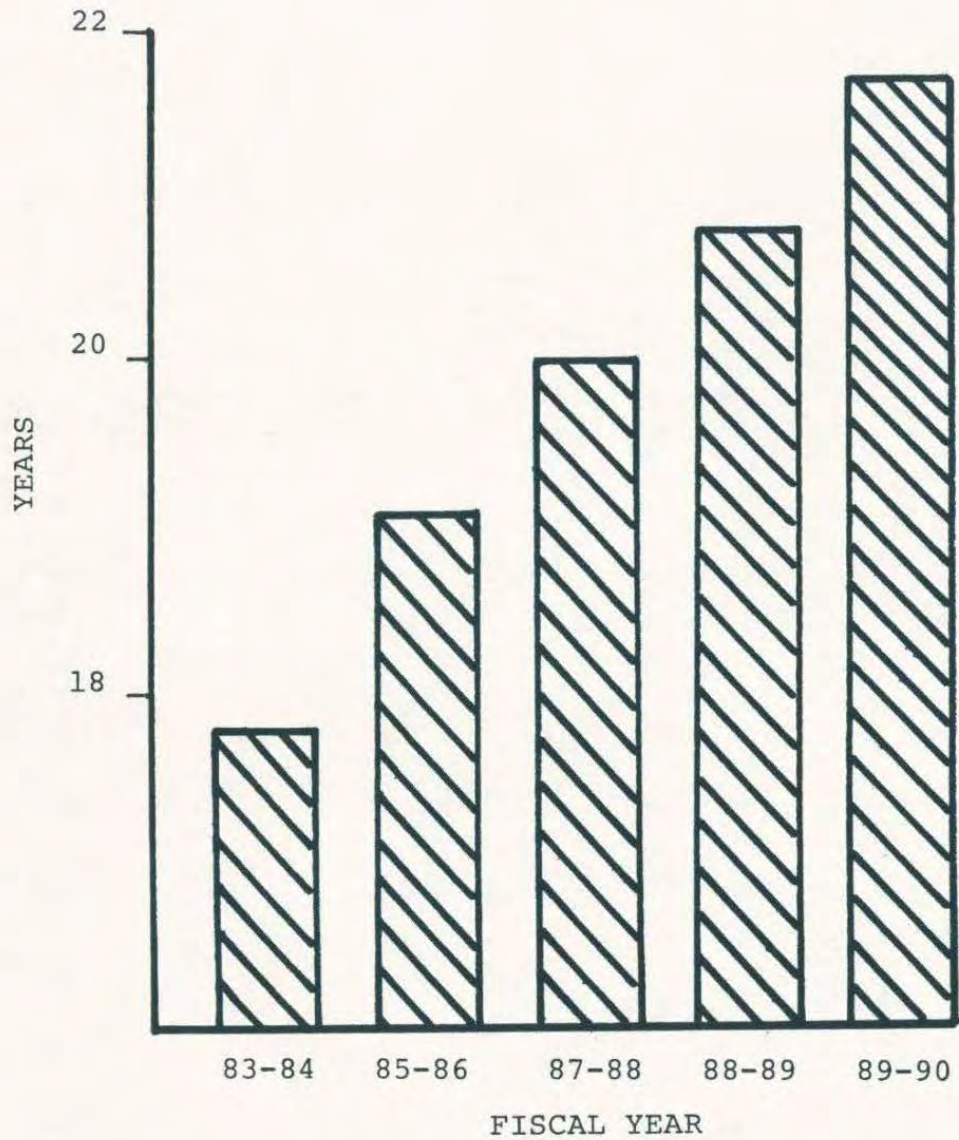


Fig. 6. Average age of diesel-powered trawlers.

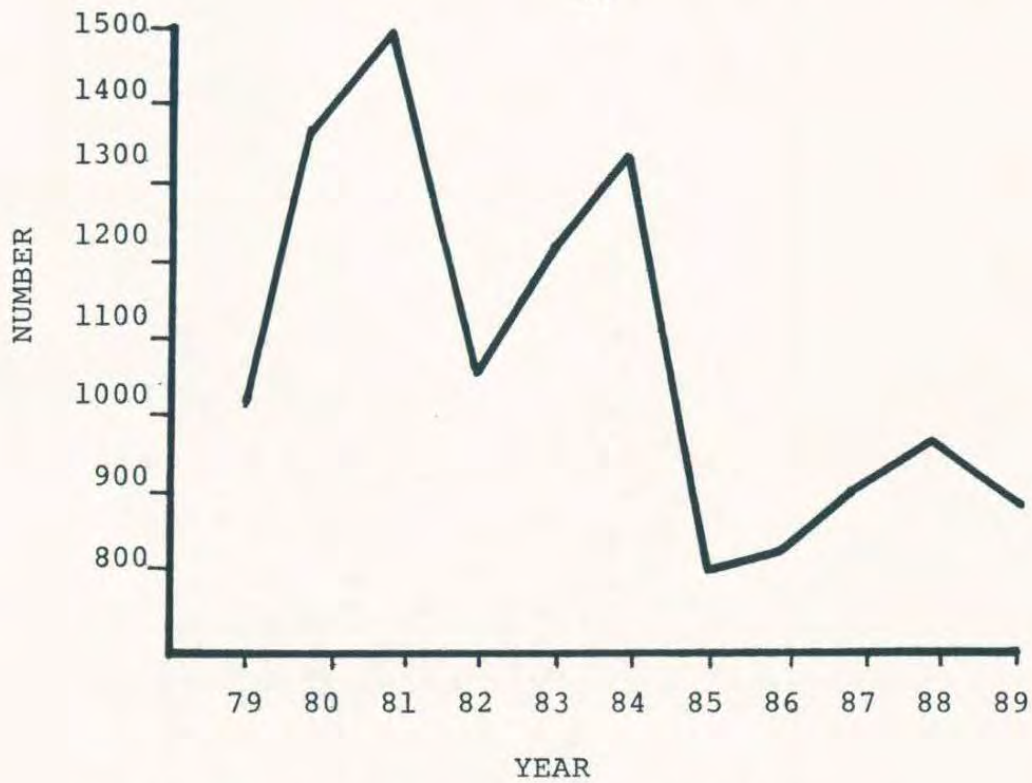


Fig. 7. Number of shrimp trawler licenses.



Fig. 8. Number of crab pot licenses and commercial landings of blue crab.

unit value. As a result, average unit value and overall catch value have trended upward (Fig. 9), although there were modest declines registered in 1989.

Hurricane Hugo had a significant impact on the commercial crab industry in the central and northern coastal areas. MRD surveyed licensed crabbers after the storm to evaluate the extent of storm-related effects. Most of the direct damage consisted of lost pots. Beaufort area crabbers reported losing 27% of their gear, Charleston County fishermen indicated an average individual loss of 76%, and Georgetown County crabbers lost 60% of their pots. Few boats were lost, although some Charleston County fishermen reported significant damage to theirs.

These gear losses, closure of coastal waters to boat traffic, and lack of electricity contributed to a substantial reduction in fishing time, particularly in Charleston County. Beaufort crabbers missed only a few days and Georgetown County fishermen lost about two weeks, but Charleston County crabbers reported an average of one month lost fishing time. Combined with the cost of lost gear, the average total loss to individual crabbers ranged from about \$1,300 (Beaufort area) to nearly \$4,700 (Georgetown crabbers).

Although anoxic conditions in some estuarine areas reduced catches for a couple of weeks after the hurricane, crabbers in other areas reported better catches. The impact on markets was difficult to assess, although the storm hit at a time of low seasonal demand and few shipments to northern markets. At least one local picking house ceased operations because of damage. The overall effect appeared to be somewhat reduced fall landings.

Reported annual landings have been cyclic, with years of very low production occurring every six or seven years. The underlying cause is unknown, although summer-early fall rainfall influences survival of juvenile crab. If this cyclic pattern repeats, then lower landings can be anticipated in the next few years.

SHELLFISH

South Carolina has about 140,000 acres of shellfish growing waters. About 58,000 acres are closed or restricted for harvesting because of pollution. Shellfish culture permits (formerly leases) managed by individuals or companies paying usage fees to the state, comprise 57,000 acres. About 21,000 acres are state shellfish grounds open to commercial and recreational harvest. The remaining acreage is accounted for by grant lands (held by private individuals under crown or legislative grants) and public oyster grounds, on which recreational harvest only is allowed. Shellfish production continued to be depressed in 1989 and was about 6% below 1988's total. Total volume was only 37% of the 1979-1988 average.

Most of the decline in shellfish production has been attributable to oysters and whelks (Fig. 10). Historically, intertidal oysters have accounted for most of South Carolina's shellfish harvest. A combination of environmental conditions and market factors has significantly reduced oyster production since

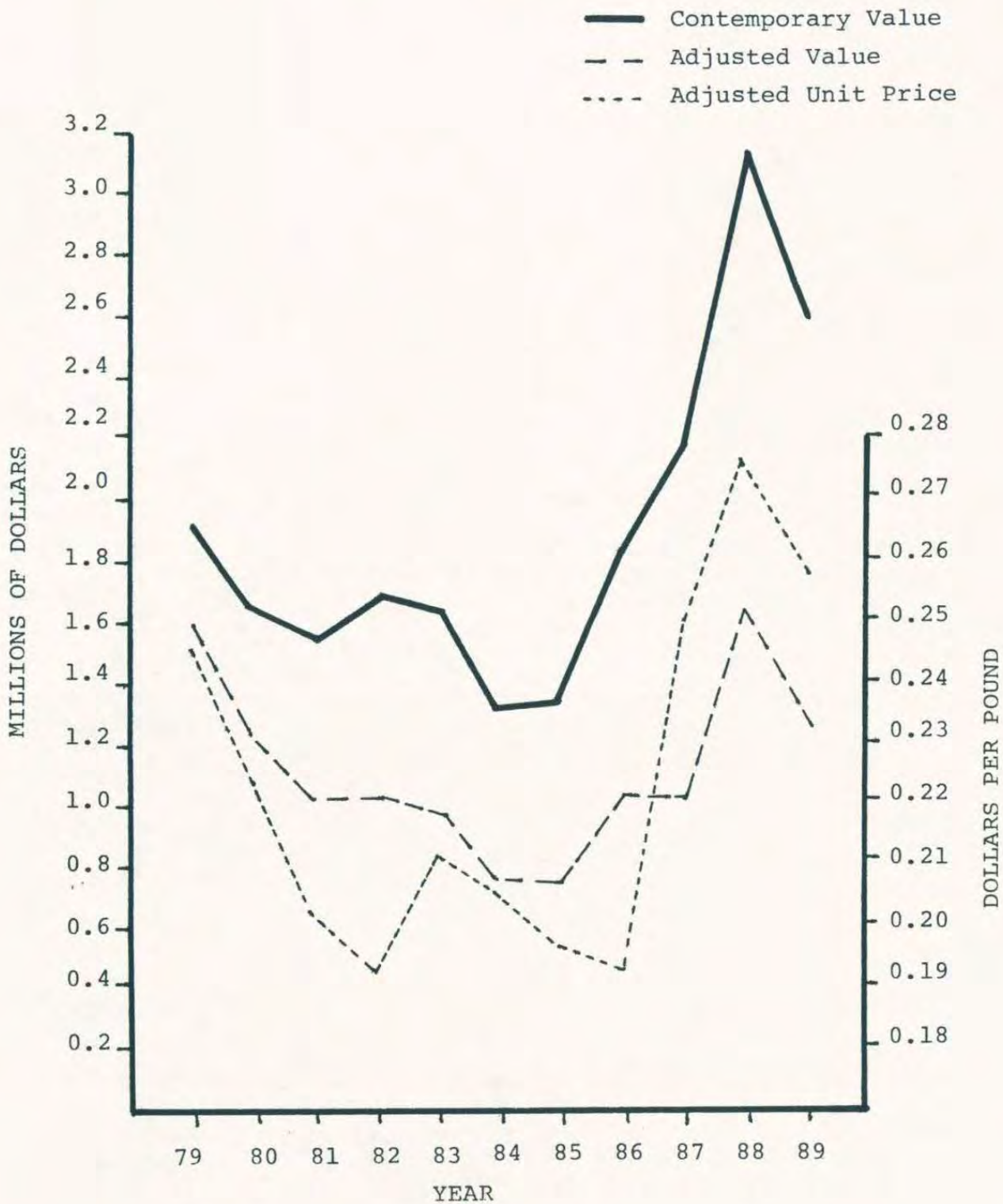


Fig. 9. Ex-vessel value of commercial blue crab landings. Adjusted value units are 1979-based dollars.

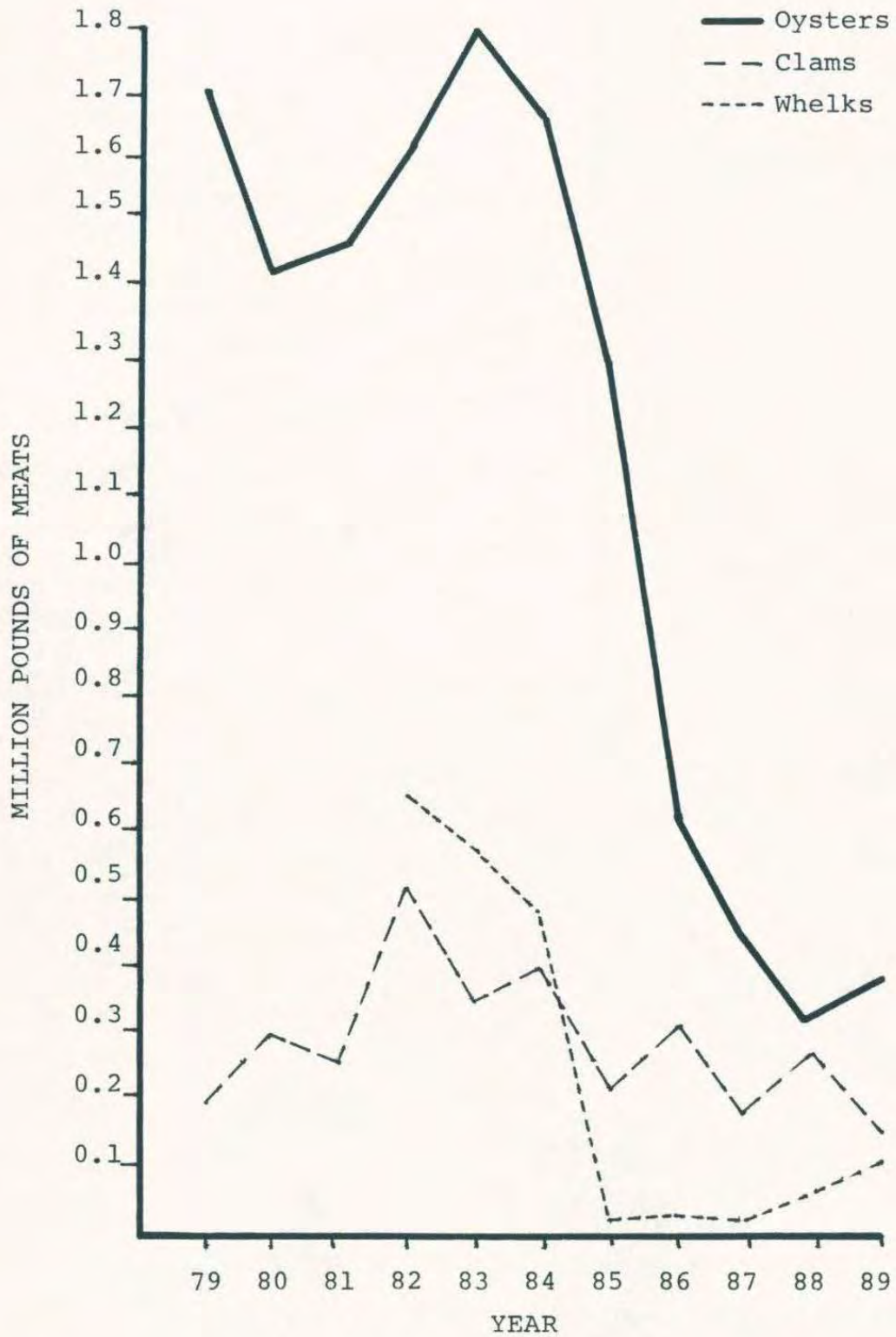


Fig. 10. Commercial shellfish landings.

1985. Mortality due to the parasite Dermo (Perkinsus marinus) reduced oyster stocks during 1986-1988, while red tide closures of northern grounds limited output in 1988 and early 1989. Most state shellfish grounds were opened for oyster harvesting on 14 January and were closed on 15 March.

Very mild weather persisted throughout the early 1989 season. This may have reduced local demand for cluster oysters, which account for the bulk of production. With the continued closure of the state's last steam-shuck cannery operation, a major market for clusters was shut down. Also impacting local demand for clusters was the increasing availability of shell stock from Gulf states, particularly Texas. Gulf oysters are more attractive in appearance, which increases their marketability relative to local clusters.

The originally scheduled opening of the fall 1989 season was delayed until 2 October because of hot, wet weather and the depleted condition of the resource in some areas. Pollution from damaged sewage systems and heavy runoff attributable to Hurricane Hugo caused an additional delay. The southern portion of the state was minimally affected by the storm and the area from S. Edisto River to the Georgia border was opened on 11 October. Most grounds north of S. Edisto River were opened on 8 November, although Murrells Inlet and parts of North Inlet remained closed longer.

Bushel prices for oysters declined slightly in 1989. The overall value of the harvest, as measured in 1979-based dollars, was 25% below the ten-year average (Fig. 11).

Clam production was the lowest since 1976, due to substantially lower escalator landings. Value of 1989's harvest, after adjustment for inflation, was 21% below the ten-year average (Fig. 11), even though unit value rose about \$1 per pound due to an increased proportion of littlenecks.

Whelks were first harvested on an appreciable scale in 1981. Landings peaked in 1982, then declined rapidly to a very low level (Fig. 10). Although production increased substantially in 1989, the whelk resource has been overexploited and remains a minor economic contributor to shellfish landings. The product is sourced to northern buyers for canning and export and has a low unit value in the raw state.

About 42% of South Carolina's potential shellfish production area is closed to harvest because of pollution. Although acreage is usually lost gradually in small parcels due to encroaching pollution, large tracts are occasionally involved. The Santee Delta is the most recent example. The rediversion project, completed in 1985, has changed the delta from a marine to freshwater system. The increased freshwater flow down the Santee, which drains most of the state, has brought more pollution to the shellfish grounds. The number of beds restricted because of pollution has grown dramatically and no direct harvesting is now allowed. Some shellfish can be taken under permit for relocation in clean areas, but this doubles the production cost for the final product. In addition to increased operating costs, the area's shellfish harvesters have progressively less resource available. Influx of seed oysters and clams has declined because of the reduction in salinity. The oyster stock currently is no more than

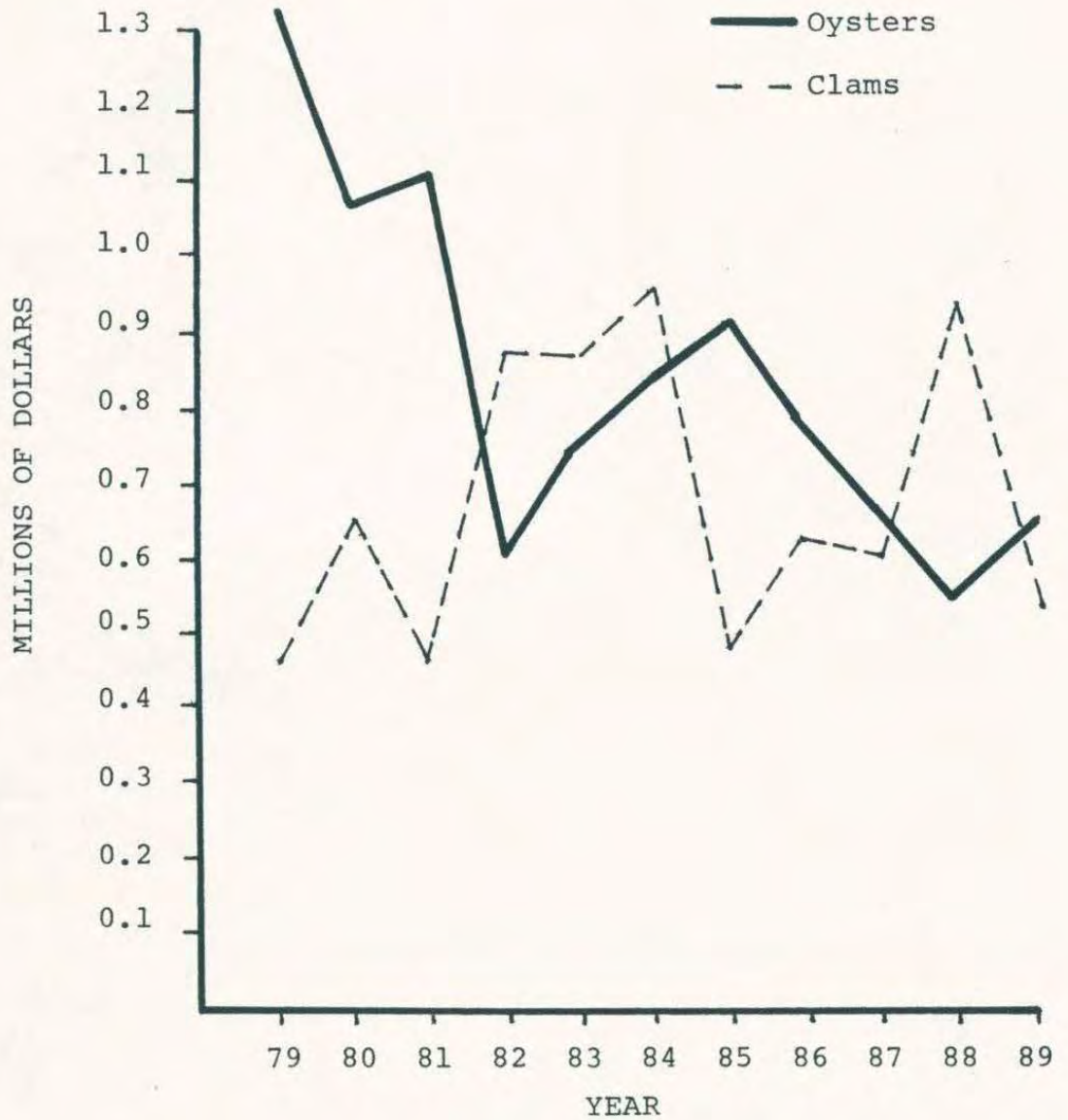


Fig. 11. Ex-vessel value of shellfish landings in 1979-based dollars.

10% of the pre-rediversion level and the area's shellfish population is expected to eventually die out. The Santee delta formerly produced an abundance of deep-water single oysters, one of the state's most valuable shellfish products, but this resource is now virtually gone.

OFFSHORE FISH

Landings of offshore fish continued the improving trend begun in 1986 (Fig. 12). Most of the 19% increase over 1988's production was attributable to wreckfish and groupers. In contrast, there was practically no change in landed value after adjustment for inflation (Fig. 12) and figures in both 1988 and 1989 approximated the ten-year average.

The handline (power-assisted reel) fishery maintained its dominance as the most productive sector of the offshore fishery (Fig. 13), accounting for about half of both volume and value. The rapidly expanding deep-water handline fishery for wreckfish was second in volume production, but a distant third in value contribution (11%) due to the relatively low unit value of this species. In contrast, the surface longline fishery targeted high-priced species, primarily swordfish, and maintained its position of recent years as the second most valuable component despite decreased landings. About 27% of 1989's offshore fishery value was produced by this gear. Changes in bottom longline and trap landed weight from 1988 were minor. In aggregate, these fisheries accounted for 12% of the total value production from offshore fish.

Swordfish continued to be the most important individual species in terms of landed value (Fig. 14). Other major contributors were wreckfish, gag grouper, and vermilion snapper. In aggregate, reef fishes (e.g. groupers, snappers, porgies, and black seas bass) were the most important species group in both volume and value. Compared to 1988's landings, there were volume increases for tilefishes (57%), groupers (44%) and snappers (13%). Landings of black sea bass remained steady, while there was a 19% decline for porgies.

Hurricane Hugo had a minor direct impact on the offshore fishery. Little vessel damage was reported. Of the principal ports (Murrells Inlet, Georgetown, Charleston, and Rockville) used by offshore boats, only Charleston sustained appreciable damage to shoreside facilities. Most of the offshore catch is trucked out as iced, gutted product, thus there was minimal disruption of processing. Perhaps the most notable storm-related effect was reflected in fishing success. Catch rates for reef fish typically improve temporarily after a storm and those following the hurricane were very high.

Swordfish

Although surface longline boats elsewhere have shifted a substantial amount of effort from swordfish to tunas, South Carolina fishermen continued to target swordfish almost

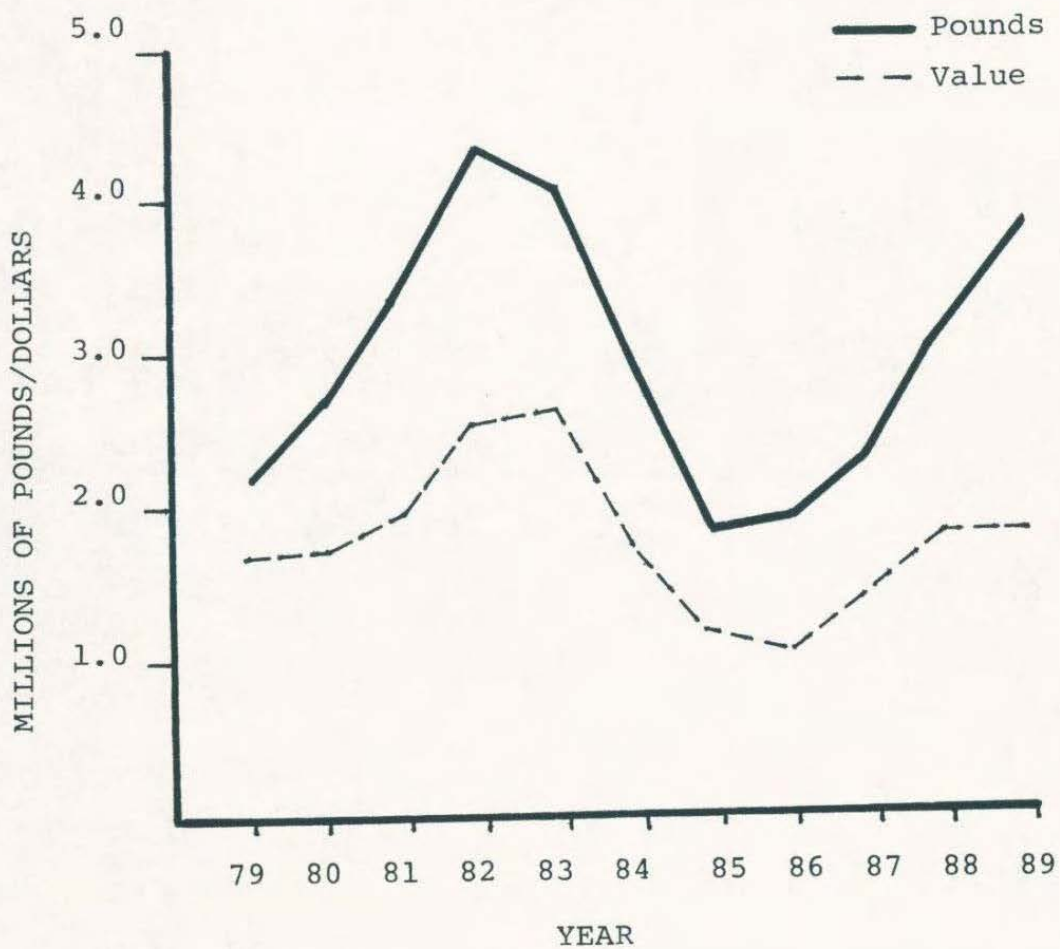


Fig. 12. Landed weight and ex-vessel value (in 1979-based dollars) of commercially produced offshore fish.

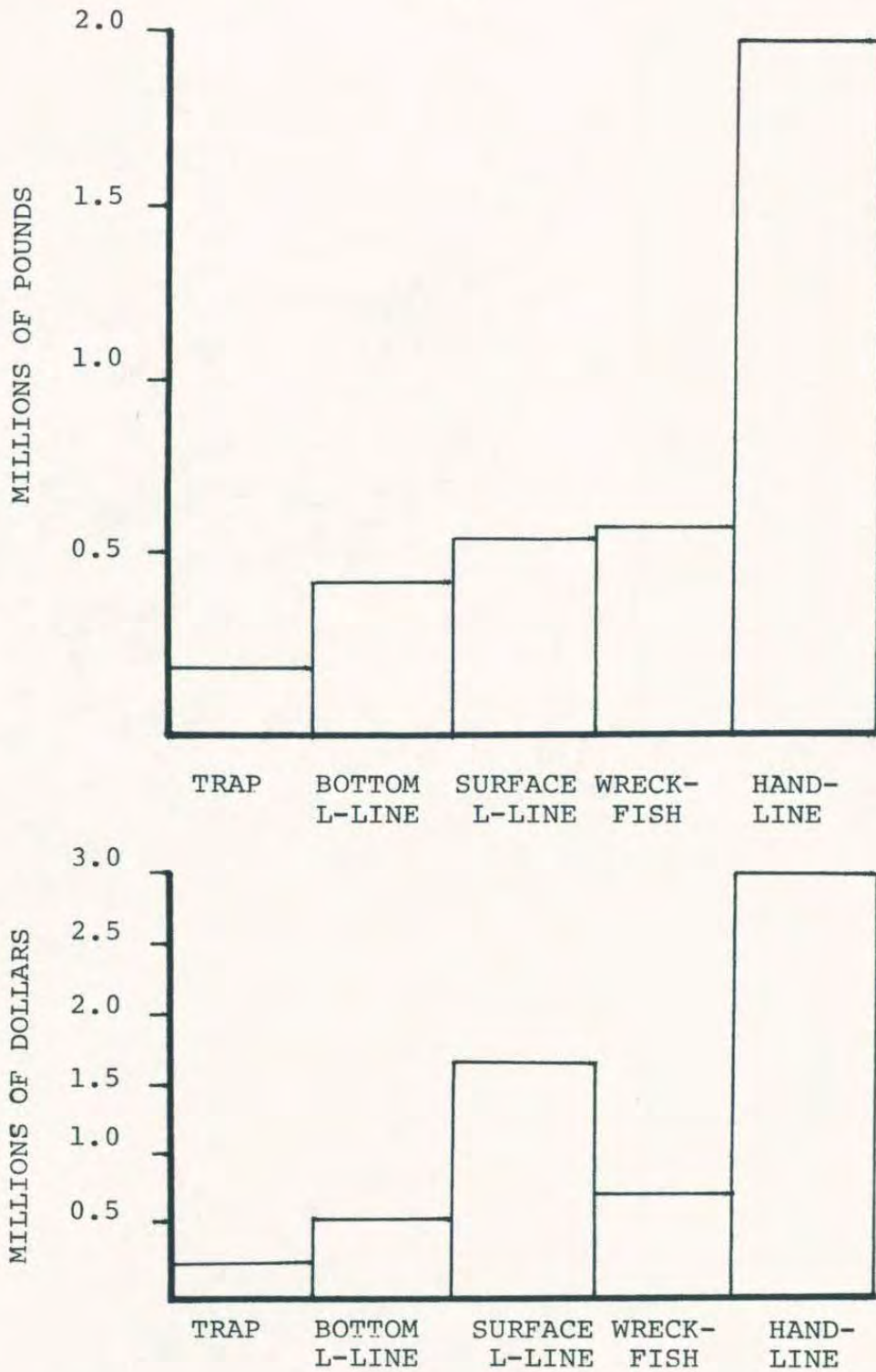


Fig. 13. Landed weight and contemporary ex-vessel value of commercially landed offshore fish by gear in 1989.

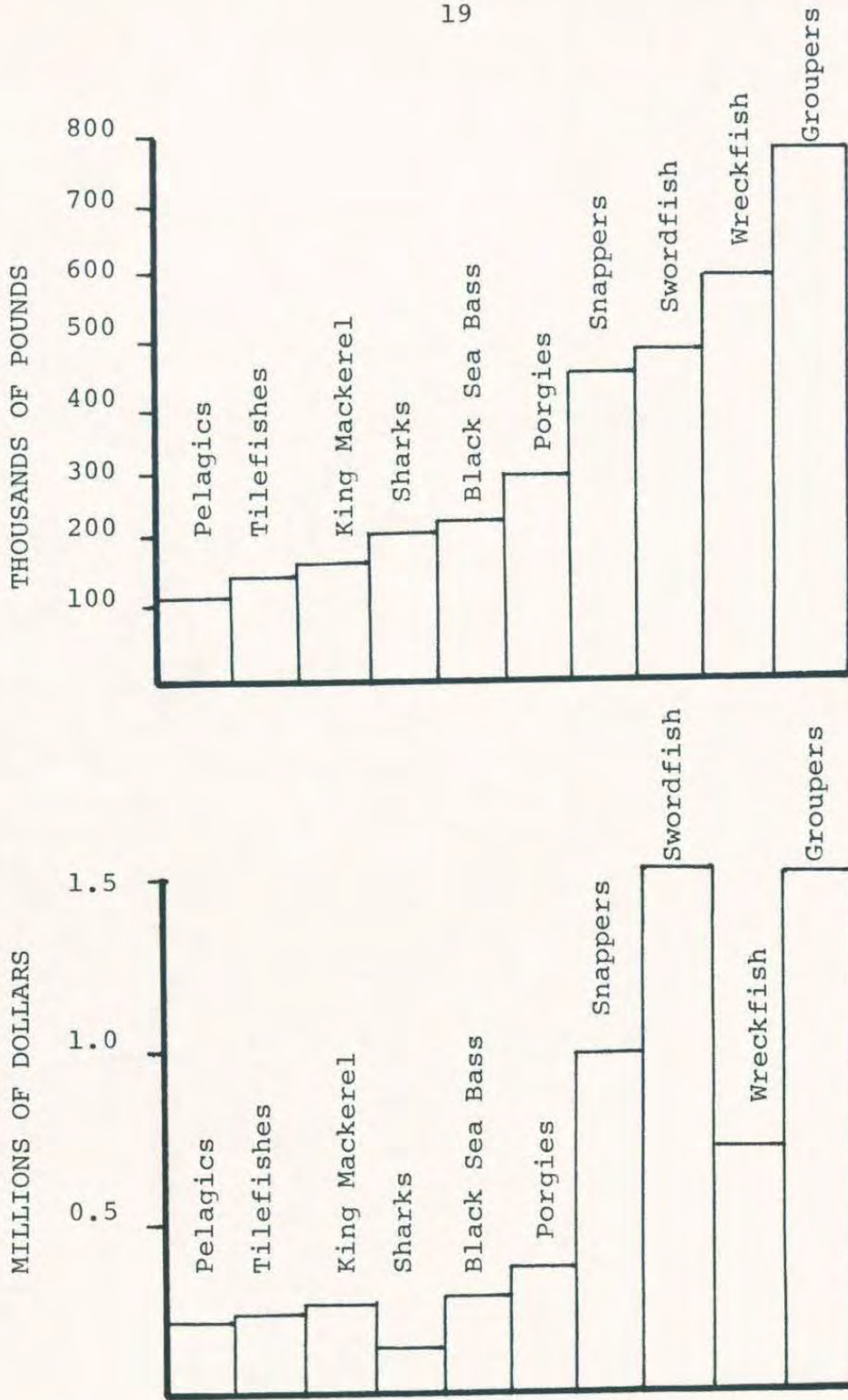


Fig. 14. Species group composition of offshore fish landings in 1989.

exclusively. This species represented 84% of the surface longline landings in both 1988 and 1989. Estimated effort (133 trips) declined 17%.

Stringent harvest controls have been recommended for swordfish, which is believed to be severely overfished in the western North Atlantic. South Carolina's landings in 1989 were only 42% of those reported in the state's peak year (1983) of production (Fig. 15). Historically, fish landed in South Carolina have been relatively small and one of the objectives of swordfish management is to reduce the catch of immature fish. Future regulations are likely to significantly affect landings here. Many of the boats have moved to northern states or the Caribbean in search of better fishing.

Reef Fish

Groupers, snappers, and porgies have been the mainstay of the handline fishery, generally accounting for 60-70% of this sector's production. The gear consists of a vertically fished hook-and-line rig retrieved by a power-assisted reel, colloquially called a "snapper reel." Estimated effort in 1989 was 1,590 trips, an increase of 20% over 1988's. Average trip production (1,220 pounds) was slightly less than in 1988. Percentage composition (Fig. 16) of the 1989 handline landings was very similar to that in 1988.

Gag grouper has historically been the most important reef species in terms of volume, but its relative contribution to the handline fishery in both 1988 and 1989 (18%) was the lowest since 1978. Landings in 1989, however, were the highest since 1983. Landings of scamp were the highest recorded. These two species accounted for most of the handline grouper volume, as well as the bulk (73%) of total grouper production (Fig. 17). Landings of deep-water grouper, almost exclusively snowies, were also relatively high in 1989 and represented 25% of overall grouper volume. The bottom longline fishery accounted for about 15% of total grouper production.

Snapper landings, composed primarily of vermilion and red snapper, were the highest recorded to date, as were those for each of these species (Fig. 18). Since 1983, vermilion snappers have consistently represented 15-18% of total handline landings in volume. The aggregate value of snapper landings increased by 33% and was nearly \$1 million in 1989.

In the late 1970's, red porgies were the largest volume contributor to handline landings. Although 1989 handline landings of this species were the highest since 1982, the relative contribution was the lowest to date. Handline-caught red porgies represented 92% of total porgy production in 1989: due to closure of the trawl fishery, the catch of other species (knobbed, whitebone, "scup") was minimal. The slight increase (2%) in 1989 handline landings of red porgies did not compensate for volume previously contributed by the trawl fishery, thus aggregate landings for all species declined (Fig. 19). The SAFMC sponsored a regulatory amendment to the management plan that established a

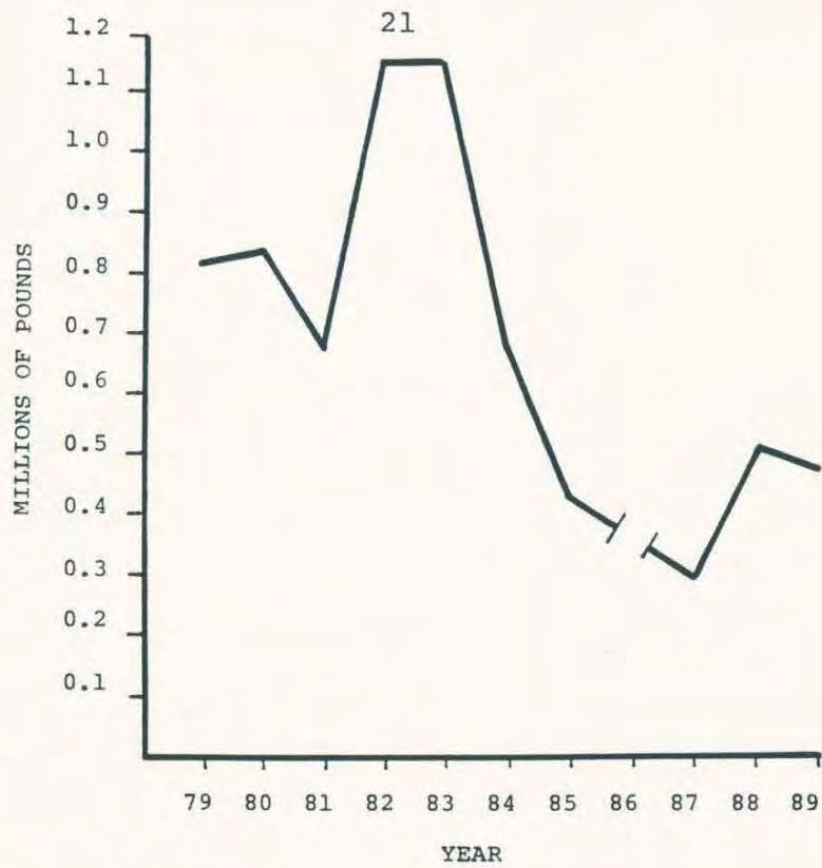


Fig. 15. Landed weight of commercially produced swordfish. The 1986 landings were confidential.

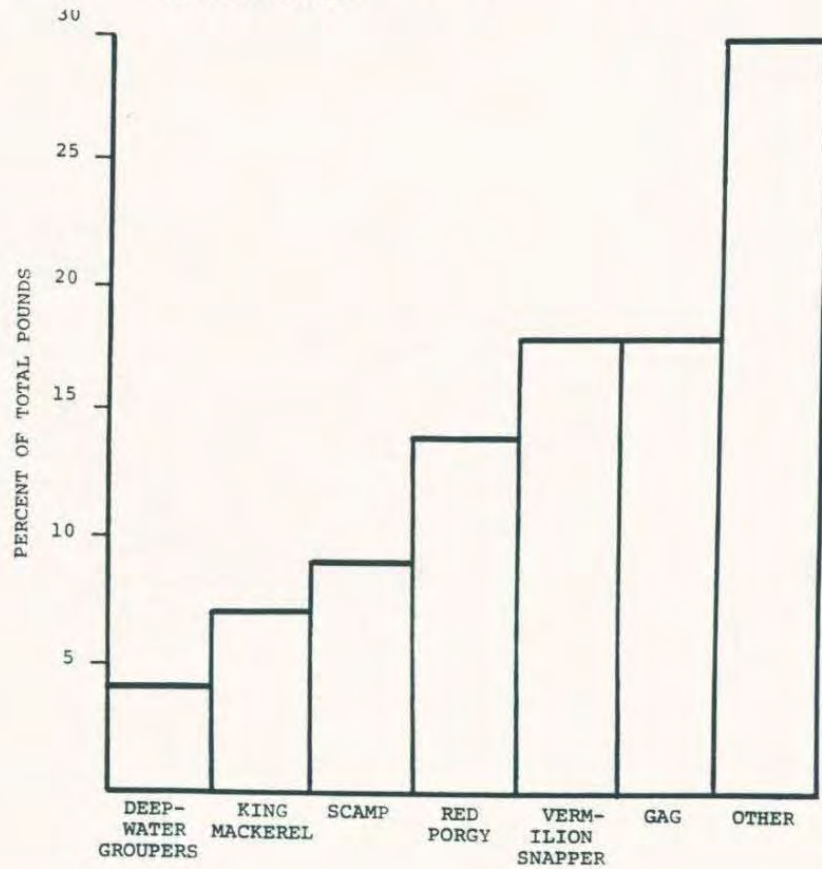


Fig. 16. Species group composition of 1989 handline landings (not including wreckfish).

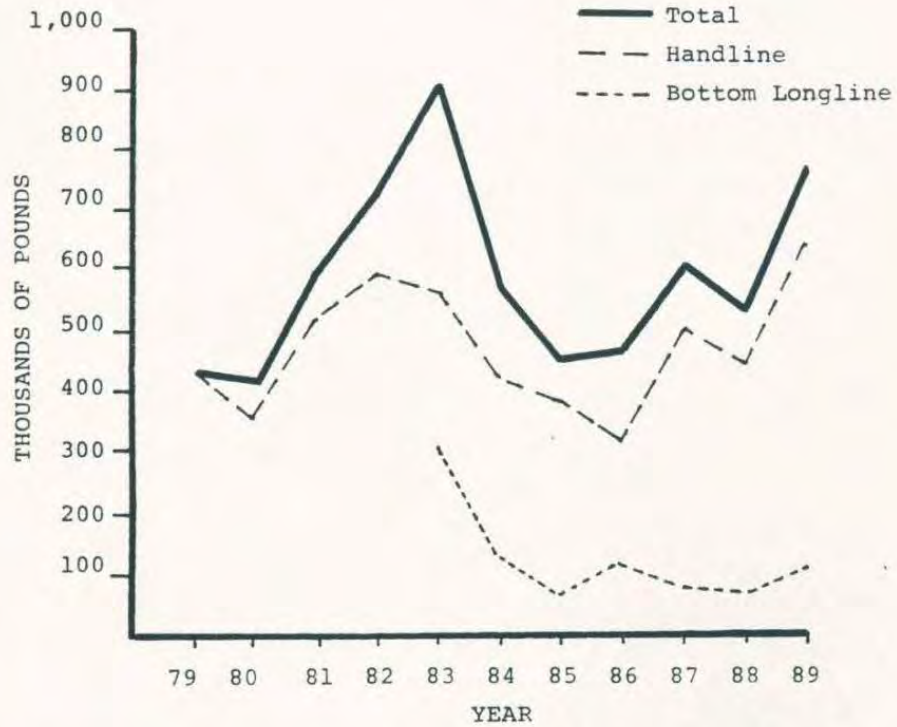


Fig. 17. Landed weight of commercially produced groupers. Handline landings consist mostly of gag and scamp, while bottom longline landings are almost exclusively snowies.

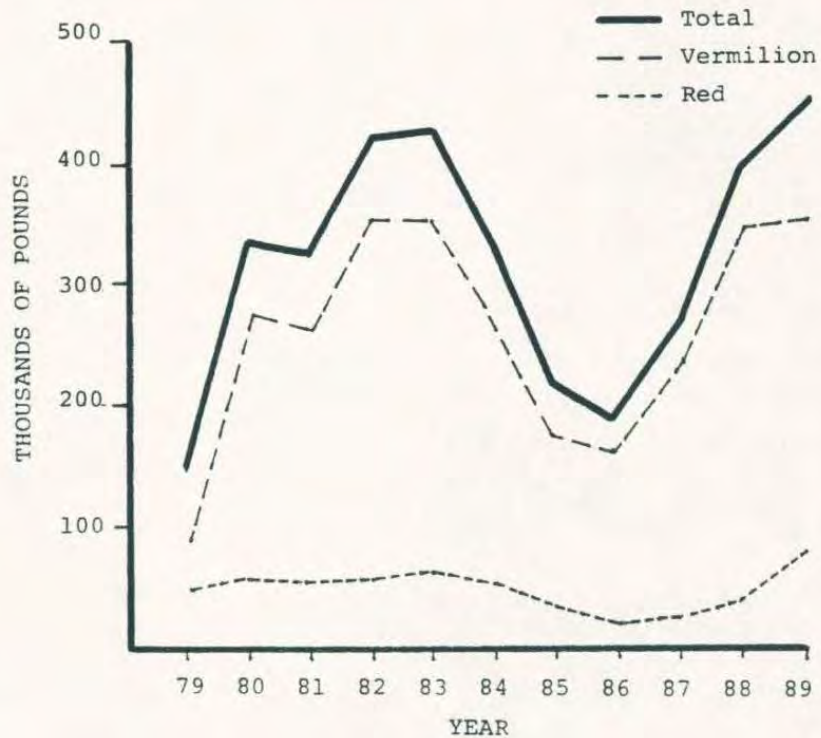


Fig. 18. Landed weight of commercially produced snappers.

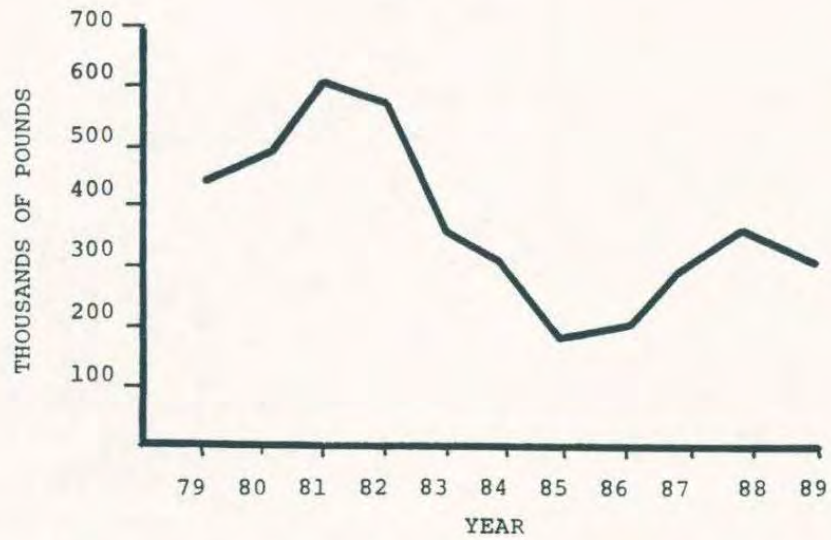


Fig. 19. Landed weight of commercially produced porgies.

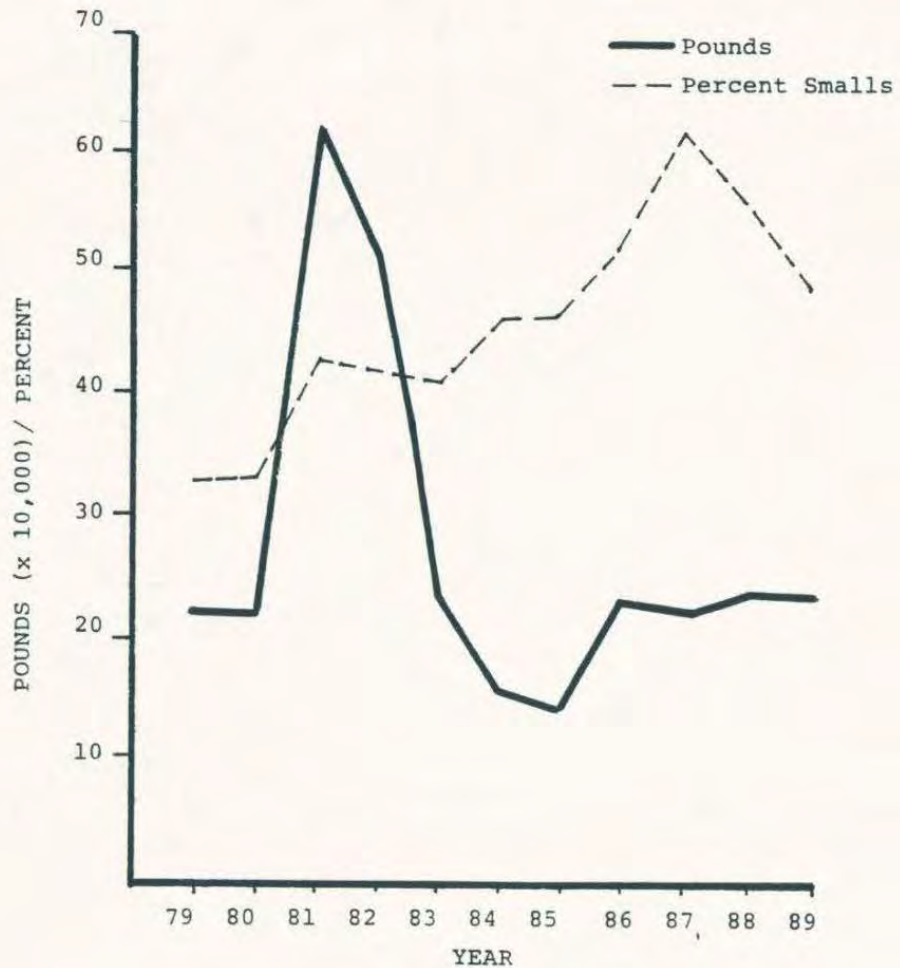


Fig. 20. Landed weight of commercially produced black sea bass and percentage of smalls in graded trap landings.

prohibition on trawls in the directed snapper-grouper fishery effective 12 January, 1989.

The other major reef species exploited commercially off South Carolina has been the black sea bass. Although the percentage of total landings accounted for by it has steadily decreased (63% in 1989 compared to 90% historically), the directed trap fishery is still the major source of product. In 1989, estimated effort was 235 trips, a 36% increase over 1988's level. Landings (Fig. 20) were about 6% lower and the average catch rate per trip was off nearly a third. One positive aspect was the reduction in percentage of small sea bass (<0.75 lb) in graded trap landings. Unit value of sea bass is size-dependent, with large (>1.25 lb.) fish bringing a disproportionately high price. Trap fishermen commonly have stated that they will not aggressively fish unless they can maintain a 1:1:1 ratio of large:medium:small fish. There has been no correlation however, between total landings and their percentage composition.

Tilefishes

Two species, the (golden) tilefish and the blueline (gray) tilefish, comprised the landings. The blueline tilefish was an incidental catch of both the handline and bottom longline fisheries, while the golden tilefish was targeted by bottom longliners. Estimated effort in the bottom longline fishery (163 trips) increased 61% over the 1988 level. Although volume was down 10%, aggregate value increased 24%. This reflected the increased contribution of snowy grouper and golden tilefish: sharks represented 61% of 1988's production, but only 34% of the 1989 landings.

The golden tilefish is habitat-restricted in its distribution and was severely overfished during the mid-1980's. Landings of tilefishes increased in 1989, but were still only 29% of those in the peak year (1983) of the fishery (Fig. 21). There is only a remnant of a directed longline fishery for golden tilefish and its harvest, combined with incidental landings by boats targeting snowy groupers, is thought to exceed the annual level of sustainable long-term yield. One management option suggested for this stock is a moratorium on landings (zero retention) for enough years to restore the spawning population.

Pelagics

The principal pelagic species fished commercially (other than swordfish) has been the king mackerel. Although some boats targeted kings in a directed troll fishery (an estimated 98 trips) in 1989, their landings represented only about a quarter of the total production. The majority was taken by handline boats which, although fishing primarily for reef fish, also exploited king mackerel on an opportunistic basis.

The "fishing year" for management purposes runs from April through March. There has been concern about the status of the

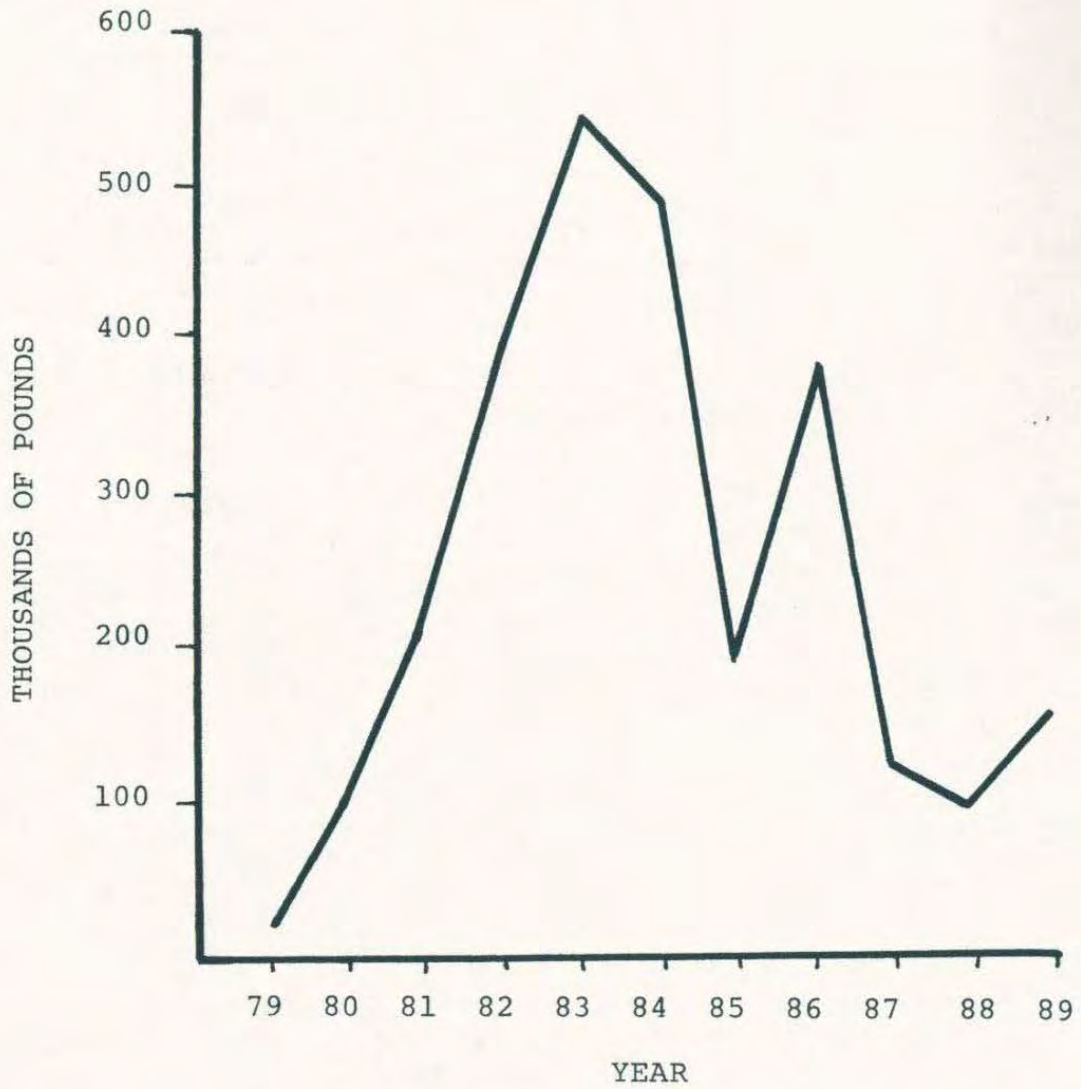


Fig. 21. Landed weight of commercially produced tilefishes.

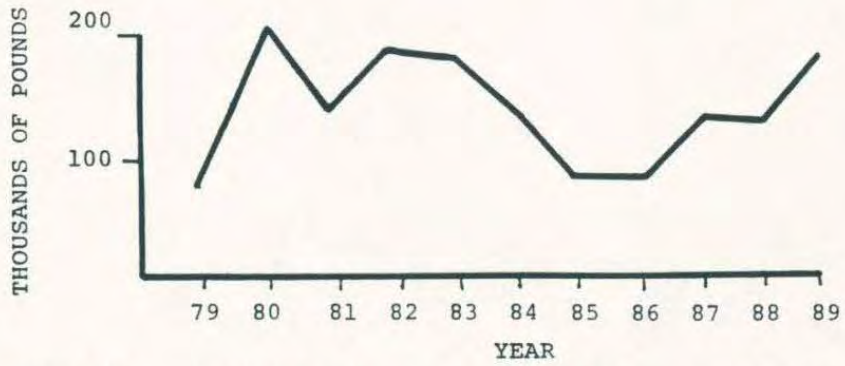


Fig. 22. Landed weight of commercially produced king mackerel.



Fig. 23. Landed weight of commercially produced pelagic species, excluding swordfish and mackerels.

Atlantic king mackerel stock in recent years and annual quotas have been in effect. The 1988-1989 fishing year's commercial quota was filled by late November 1988 and the fishery was to have been closed. North Carolina fishermen took legal action to prevent this and an injunction kept the fishery open. A series of legal proceedings followed, the NMFS-ordered closure was eventually upheld, and the commercial fishery was closed from 28 February through 31 March of 1989.

At that time, seasonal availability was low and the impact on 1989 landings was presumably minor. The final total for the year was the highest since 1983 (when there were no restrictions) and about 31% above the ten-year average (Fig. 22). This appeared to reflect increased effort rather than greater abundance of fish.

Other pelagic species (billfishes, cobia, dolphin, tunas, and wahoo) were primarily taken as incidental catches, although there has been some directed effort for yellowfin tuna. The recent rapid expansion in landings of these species (Fig. 23) provoked concern by recreational interests and concurrent regional declines in sport fishing catch rates of billfishes exacerbated the controversy over allowance of commercial billfish landings. As part of the billfish management plan prepared by the South Atlantic Fishery Management Council (SAFMC), a federal regulation effective 1 September, 1988 prohibited retention of billfishes (except swordfish) by commercial fishermen. This provision was primarily responsible for the decline in pelagics landings in 1989, as the aggregate catch of other species increased slightly.

Sharks

Historically, there has been a strong demand for small sharks among coastal South Carolina residents, supplied mostly by shrimp trawlers prior to 1981. Since then, effort in other fisheries has been increasingly directed at sharks in response to growing demand for an economical and nutritious seafood and overall landings have generally trended upward. This increase was especially pronounced since 1986, when landings by offshore fishermen expanded greatly (Fig. 24). Since 1987, the offshore fisheries have supplied most of the product.

Most of the 1988 increase was attributable to a fourfold increase in bottom longline landings (in part to compensate for reduced catches of tilefishes and snowy groupers). In 1989, the bottom longline fishery achieved a 53% increase in landings of these higher-valued species and shark landings dropped 49% due to the shift in directed effort. This decrease more than offset an 89% increase in inshore production, thus there was an overall modest (7%) decline in total shark landings. Unit value of sharks increased appreciably from \$0.49/lb in 1988 to \$0.59.

The reproductive capacity of shark stocks is substantially lower than that of most other fish populations and there is grave concern about the current high regional harvest. Very little is

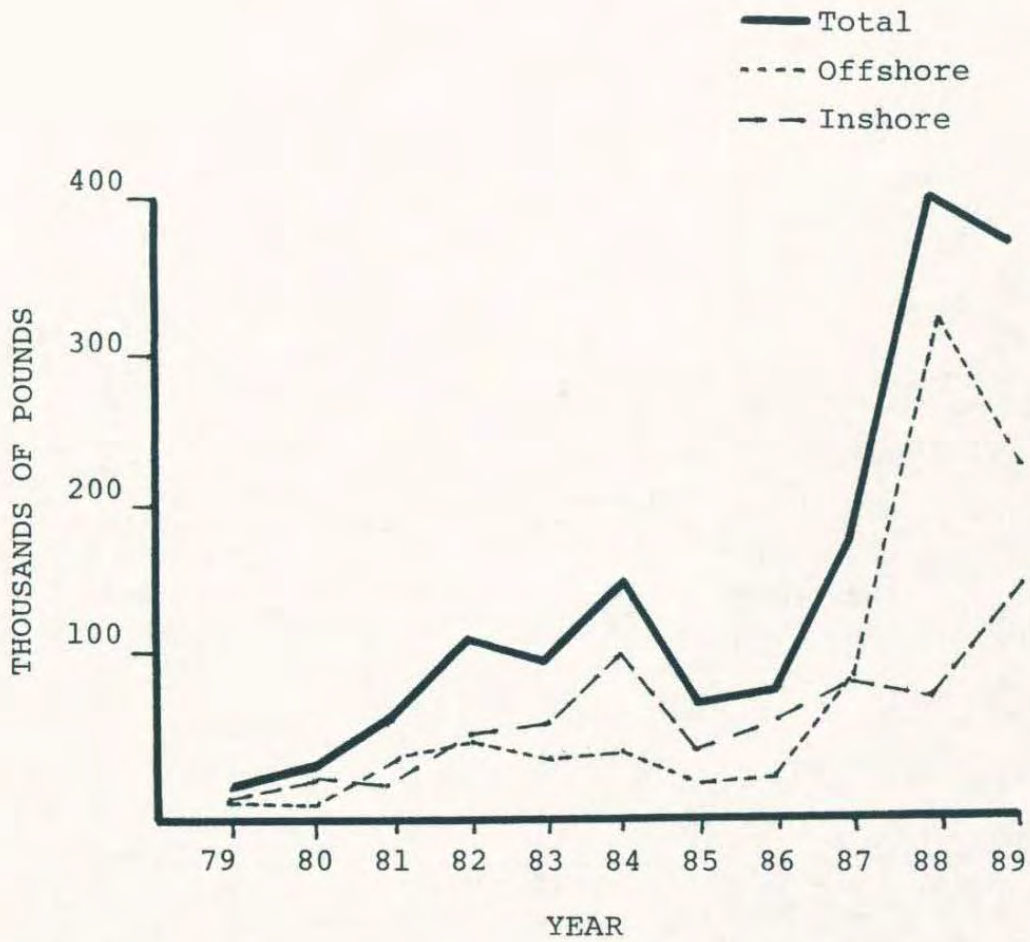


Fig. 24. Landed weight of commercially produced sharks.

known about the migratory movements of the principal species, or their recruitment mechanisms. Significant reductions in overall shark landings have been proposed, although management measures are currently on hold.

Wreckfish

This grouper-like fish is taken in very deep (>175 fathoms) water by heavy-duty hydraulic handline reels. The first landings were made in 1987. About five boats participated in the 1988 fishery and produced several hundred thousand pounds. More than 20 boats fished during 1989 and landings in South Carolina were about 590,000 pounds.

Development of other deep-water fisheries in the region has been largely limited by the extent of habitat and the self-sustaining capacity of the relatively small populations of slow-maturing fish occurring in it. Although only a small area has produced the bulk of the wreckfish landings, there appears to be extensive suitable habitat and the recruitment mechanism is very different from that of the other deep-water species. Given the restrictions on other offshore fisheries either in effect or proposed, the commercial industry is hopeful that the wreckfish fishery can expand in an orderly fashion toward an appreciably higher sustainable yield.

COASTAL FISH

This category includes species taken in state waters (out to three miles from the beach), except for anadromous fish. Unlike for offshore fish, overall unit value has been typically low and was unchanged in 1989.

Landings in 1989 were the lowest to date (Fig. 25), representing only 2% of the state's overall seafood volume and 1% of its value. The Grand Strand haul seine fishery, which normally accounts for most of the production, was eliminated by the hurricane. This fishery normally supplies nearly all of the mullet and most of the spot, the two major coastal species. There essentially was no mullet catch in 1989 and spot landings were less than 10% of the previous year's (Fig. 26).

Sharks were by far the major volume component, with most of the inshore production coming from drift nets. Landings were up appreciably (89%) from those in 1988.

Those of the other main species, flounders and kingfishes (whitings), were down moderately. Most of the catch came from shrimp trawlers. Annual production of both species has fluctuated similarly (Fig. 27) and probably reflects conditions in the shrimp trawl fishery more than any other factor. The declines in 1989's landings probably were due primarily to the hurricane, which displaced and reduced trawling effort during the fall, normally the time of heaviest landings of these species. The use of TEDs during brown shrimp season probably had only a minor impact. Summer landings of flounders and kingfishes are generally low and the TED

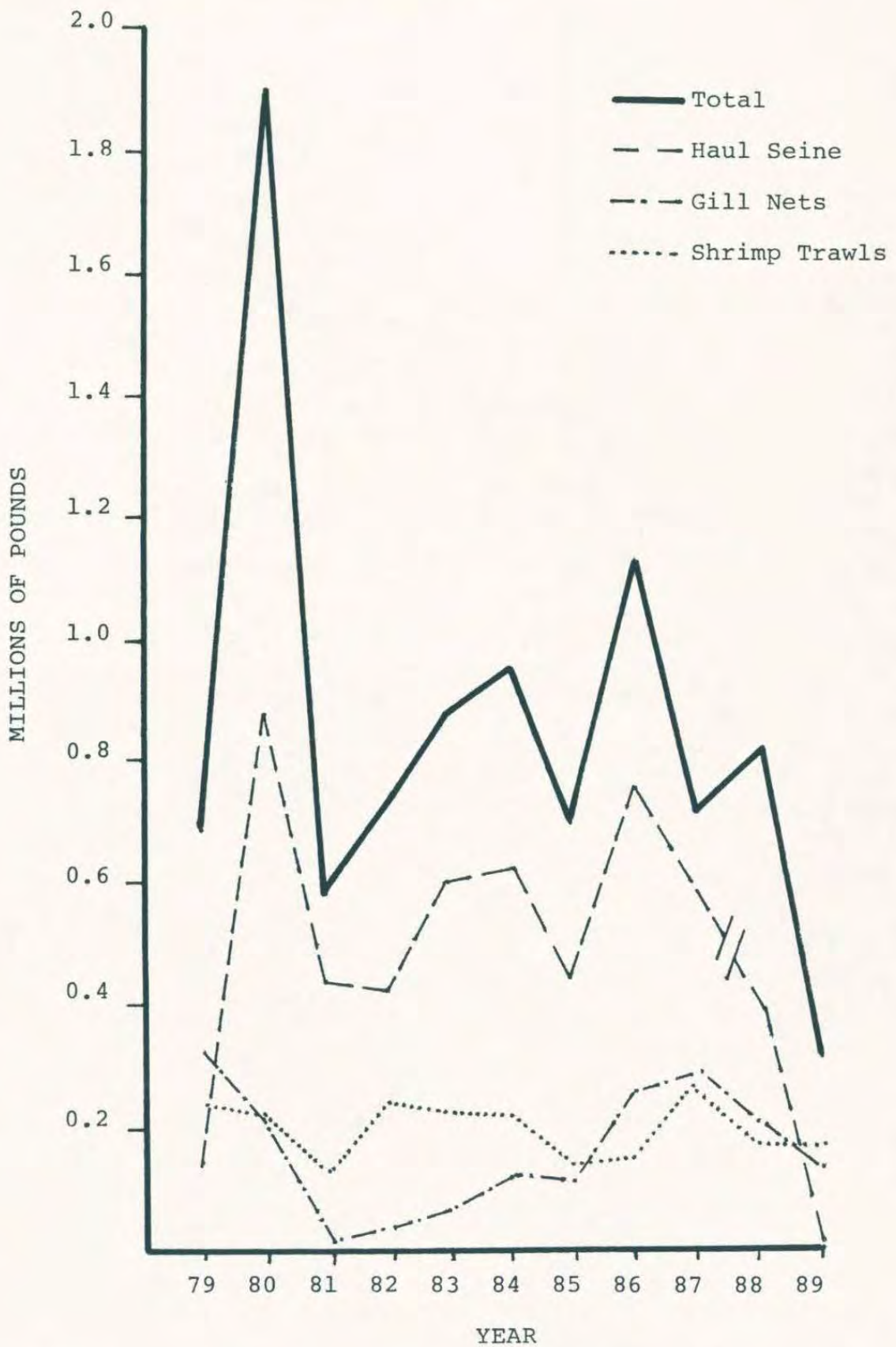


Fig. 25. Landed weight of commercially produced coastal fish. The 1987 haul seine landings are confidential.

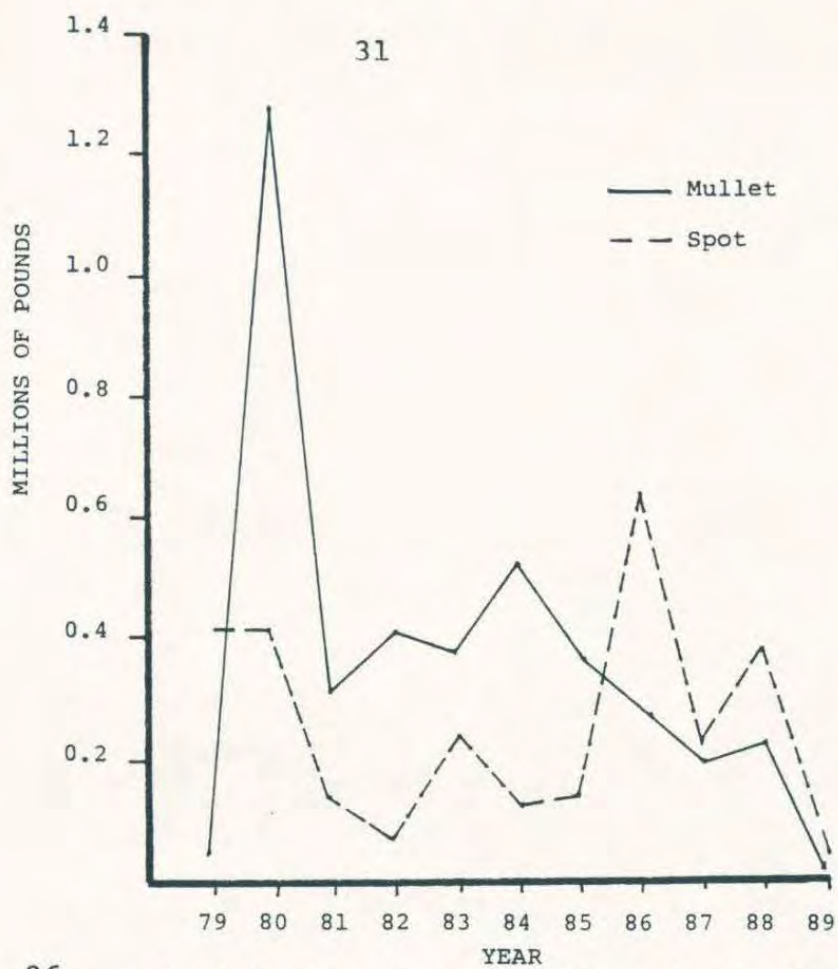


Fig. 26. Landed weight of commercially produced mullet and spot.

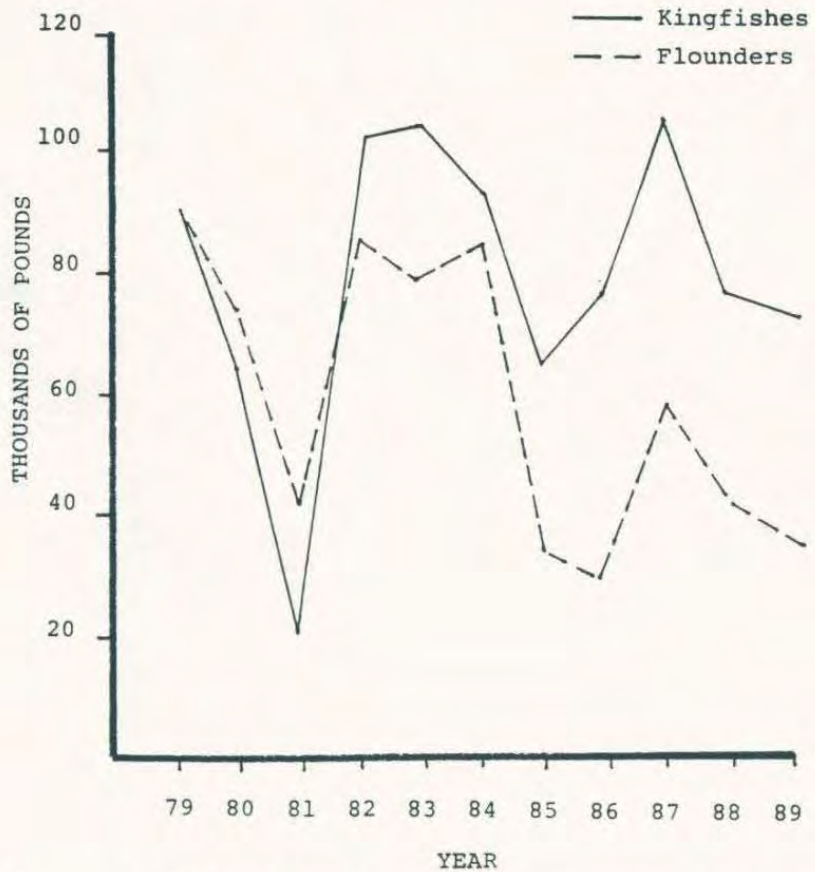


Fig. 27. Landed weight of commercially produced kingfishes (whitings) and flounders.

requirement was in effect only until 31 August. Results from MRD's bycatch study during the 1989 season suggested a 43% reduction in aggregate number of flounders and mackerels with Morrison-equipped gear, but relatively few flounders were caught with all types of gear and most were too small to retain. After the hurricane, finfish catch rates were low despite the fact that TEDs were no longer in use.

An inshore finfish trawl fishery has been allowed under permit. This fishery operates during January through April off the Grand Strand beaches and targets small flounders. Only a few boats participated in 1989, making an estimated 22 trips, and their landings were insignificant.

RIVER FISH

This category includes catfishes, eels, blueback or river herring, hickory shad, and American (white) shad. The sturgeon fishery has been closed since 1985. Catfish production has been negligible since 1982. Landings of herrings and shads contributed 2% of the volume and value of 1989's total state seafood production.

Landings of blueback herring have been confidential since 1983 because of the small number of wholesalers involved. Production has declined steadily since 1984 at an average rate of 39% per year: in 1989, it was 8% of that in 1983. Most of the catch comes from the Cooper River. Since completion of the rediversion project in 1985, SCWMRD has documented an average decline in spawning herring from pre-project levels of about 72%, equivalent to a decrease in spawning stock from 5.7 million fish to 1.6 million. The decline in commercial landings thus appears to be abundance-related. In order to restore this fishery, increased water flow is needed to enhance spawning migrations up the Cooper River.

Most of the 1989 shad catch came from areas around Winyah Bay. There were three sectors: 1) an ocean fishery 2) a fishery in downriver areas, and 3) an upriver fishery. The ocean fishery took place from Little River to Cape Romain, although most of the catch was made between North Island and Cape Romain. The ocean drift net fishery supplies fish for northern markets at a time when there are few competing sources and enables South Carolina producers to exploit a "window" of market opportunity. Twenty to 25 fishermen participated in the ocean fishery. Most of the fish harvested originated in the Winyah Bay-Waccamaw-Pee-Dee drainage system, thus the ocean fishery mainly impacted fisheries on the rivers in this area.

The downriver(below the 40-mile limit) or Winyah Bay area fishery used anchored gill nets and accounted for about 35% of the landings. Upriver production occurred late in the spring after other sources of supply for northern markets had come on-line and most of it was probably sold locally. Relatively few fish were reported from upriver areas and the total catch there was probably underestimated.

Shad production declined slightly in 1989 (Fig. 28). Catches have tended to reflect availability rather than abundance, with

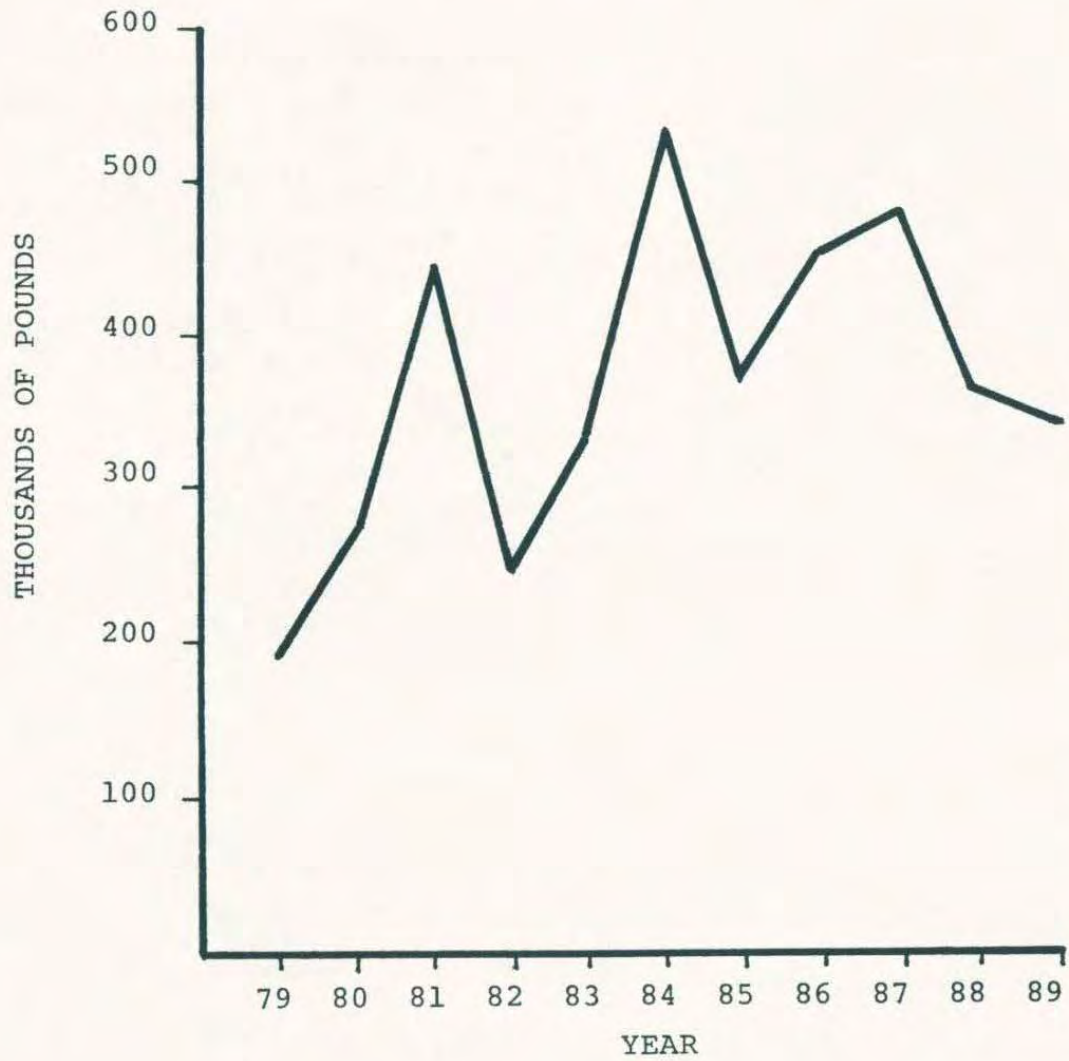


Fig. 28. Landed weight of commercially produced shad.

this factor being influenced by a number of environmental elements, e.g. water temperature, turbidity, and runoff level. Abundance in most rivers is believed to be relatively stable in recent years. A probable exception is the Edisto system where a gradual decline appears to be in progress.

RECREATIONAL FISHERIES

OVERVIEW

Of 4,154 coastal South Carolina households contacted during the 1989 MRFSS telephone survey, 5.9% contained a marine angler. In 1987 and 1988, the figures were 8.0% and 10.0%, respectively. Total participation in 1989 (Fig. 29) was the lowest reported since the MRFSS began in 1979, with significant declines in all residential categories. There was a 58% decline in the estimated number of state resident fishermen and a 38% decrease in out of state anglers from the 1988 levels. Estimated total effort (Fig. 30) was also down appreciably (46%) from the 1988 figure and was the second lowest reported since the MRFSS was initiated. Participation and effort estimates for 1982 and 1984 are not shown because the values were exceptionally high, probably due to sampling error, and are considered statistical outliers. In 1989, participation was 40% below the 1979-1988 average and effort was 34% lower.

Many coastal fishing facilities are located near Charleston and in the northern half of the state. Physical damage from Hurricane Hugo was greatest to coastal marinas and ocean fishing piers from Charleston north. Two dry stack marinas and most of the boats they contained were destroyed. Approximately 50% of the wet slips in marinas north of Charleston were either damaged or destroyed and all of the ocean fishing piers along the Grand Strand were lost. These piers attracted a large following of out of state anglers during the fall runs of spot and the economic loss associated with them was enhanced by the fact that their peak season was just beginning as the storm struck.

In contrast to fixed facilities, the mobile component of the sport fishing industry fared well. No headboats suffered serious damage and only three charterboats needed significant repairs. There was still an appreciable economic loss incurred by the boat for-hire sector, however, due to loss of their moorage and ticket offices. Many boats had to relocate temporarily and their schedules were curtailed for the remainder of the season.

In addition to damaged facilities, inshore waters were adversely affected by debris and anoxic conditions for as much as a month following the storm. Normally, October through mid-December is a popular fishing season for red drum, spotted seatrout, and spot. The number of anglers fishing in the heavily populated Charleston area appeared to be much lower than normal after the hurricane. It therefore appeared that much of the decline in participation and effort in 1989 could be attributed to hurricane-related factors.

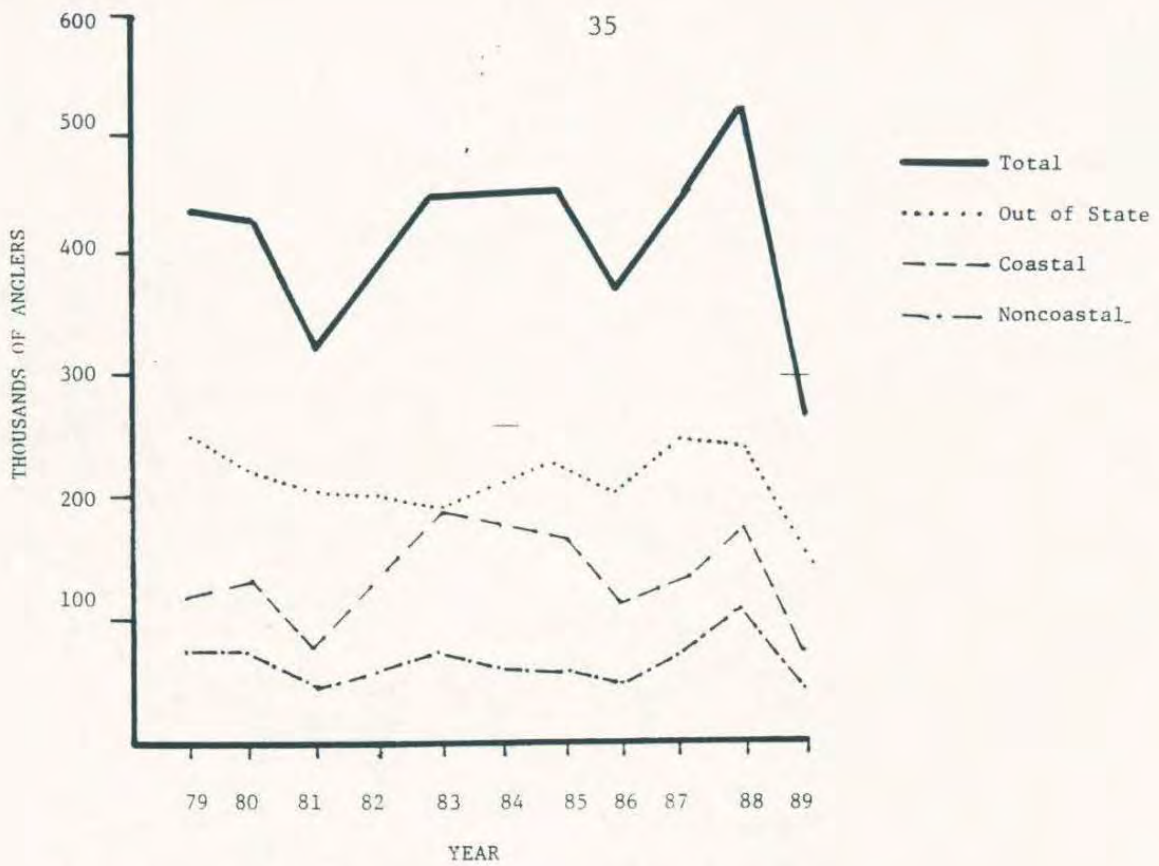


Fig. 29. Estimated number of anglers in the South Carolina marine recreational hook-and-line fishery. Data for 1982 and 1984 are omitted as outliers.

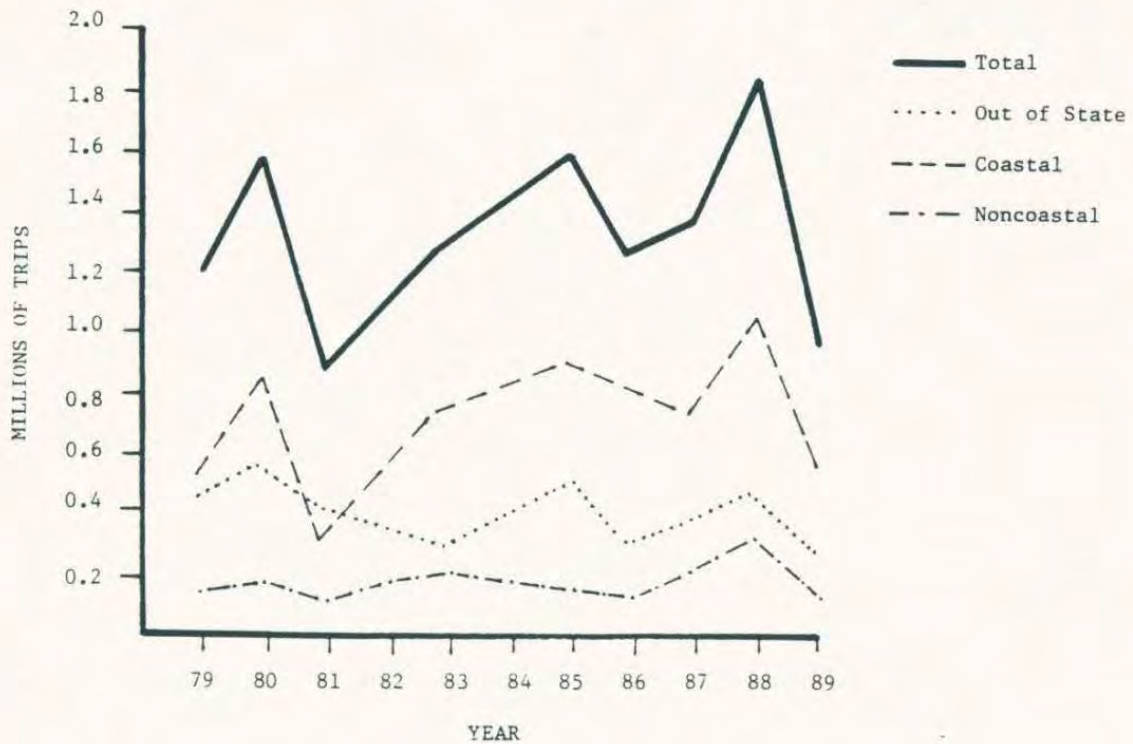


Fig. 30. Estimated number of trips by South Carolina marine recreational anglers. Data for 1982 and 1984 are omitted as outliers.

MRFSS catch estimates have been subject to significant sampling error, depending on such factors as the number of fishermen interviewed and catches inspected (sample size), the range in numbers of fish in individual catches, and the frequency of occurrence of unusually large catches. When particular species are of interest, correct identification is essential. Misidentification can cause gross errors in the estimated landings of similar species: problems have been noted in previous survey results for offshore bottomfish and flounders. Tournaments are not covered by MRFSS sampling and such events contribute significantly to the landings of offshore pelagic species (some data are available from MRD sampling). These factors should be kept in mind when evaluating results from the MRFSS. The absolute values for many species or groups are probably somewhat meaningless. For the most frequently caught species or groups, e.g. many of those listed in Table 1, the relative ranking and long-term trends in catch are probably fairly realistic.

Given these limitations, some tentative assessments of fishing success in 1989 can be made. Offshore fishing was characterized by unusual events. CPUE data from spring tournaments showed a 400% increase from 1988 in the catch rate of dolphin and large (20-40 pound) fish were exceptionally abundant. Yellowfin tuna, which comprise most of the fish categorized as "tunas," were less common than in recent years. Based on results from an independent survey of billfishing conducted annually by MRD, 164 billfish were reported caught. About 70% were released, the majority after being tagged, an appreciably higher percentage than in previous years. This reflected growing recognition of the conservation value of this practice as well as minimum size limits for marlins and sailfish.

The private boat sector accounts for a relatively small portion of the recreational landings of offshore bottomfish, with the exception of black sea bass. This is the most abundant bottomfish of recreational value in nearshore areas (<60 ft of water) and on the artificial reefs. Although it was still one of the most numerous fishes in overall landings, the private boat catch of black sea bass in 1989 was the lowest reported since the MRFSS began and probably was not directly related to abundance. With the increasing availability of sophisticated offshore fishing equipment, emphasis on large sports fish such as king mackerel and sharks, and increased abundance of popular nearshore species such as Spanish mackerel, it is likely that directed effort for black sea bass has decreased in recent years, at least in nearshore waters. Very few anglers indicated that this was their target species. About 37% of the black sea bass catch was released alive, presumably because of the 8-inch minimum size limit.

Fishing success for coastal pelagic species, primarily king mackerel, Spanish mackerel, and bluefish, was mixed. The most popular ocean fish sought by South Carolina anglers is the king mackerel. Landings in 1989 were the second lowest in the last ten years. The recreational fishery year for this species runs from 1 April through 31 March. The sport fishery was closed on 17 October (1988) upon reaching the quota, but reopened on 25 November following legal action by commercial fishermen seeking to prevent

Table 1. Estimated catch of South Carolina marine recreational anglers, in thousands of fish. Figures prior to 1986 include catches of headboat fishermen. * indicates none reported, - less than 30,000 fish.

| Category | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|----------------------------|--------|-------|--------|-------|--------|-------|-------|-------|-------|-------|
| <u>Offshore Pelagics</u> | | | | | | | | | | |
| Dolphin | 36 | * | * | * | - | 62 | 72 | - | - | - |
| Little tunny | - | - | * | - | - | - | 34 | - | - | - |
| Tunas | - | * | - | * | - | 41 | 65 | - | - | - |
| <u>Offshore Bottomfish</u> | | | | | | | | | | |
| Black sea bass | 2,415 | 3,108 | 3,106 | 860 | 4,683 | 1,231 | 531 | 732 | 798 | 444 |
| Groupers | * | * | * | - | 60 | 42 | - | - | - | - |
| Vermilion snapper | * | - | 4,291 | - | 1,688 | 286 | - | - | - | - |
| Other snappers | - | 134 | 33 | 33 | 126 | 52 | - | - | - | - |
| Red porgy | * | 103 | 2,802 | 52 | 633 | 118 | - | - | - | 70 |
| Other porgies | - | 44 | 39 | - | 171 | 34 | * | 47 | - | - |
| Grunts | - | 84 | 1,577 | 60 | 523 | 387 | * | - | 50 | - |
| <u>Coastal Pelagics</u> | | | | | | | | | | |
| King mackerel | 194 | 188 | 106 | 83 | 93 | 157 | 254 | 71 | 118 | 74 |
| Spanish mackerel | 104 | 515 | 128 | - | 212 | 57 | 163 | 69 | 103 | 170 |
| Bluefish | 458 | 50 | 494 | 215 | 355 | 571 | 159 | 177 | 147 | 297 |
| Barracuda | - | * | - | - | - | - | 62 | - | - | - |
| <u>Inshore Sportfish</u> | | | | | | | | | | |
| Red drum | 207 | 47 | 141 | 91 | 142 | 456 | 196 | 509 | 542 | 150 |
| Spotted seatrout | 502 | 30 | 711 | 181 | 163 | 325 | 576 | 444 | 345 | 203 |
| Summer flounder | - | - | - | 47 | 93 | * | * | 45 | 47 | - |
| Southern flounder | 119 | - | 48 | - | 54 | 225 | 206 | 65 | 103 | 51 |
| Weakfish | 81 | - | - | - | - | 59 | 78 | - | - | - |
| <u>Inshore Bottomfish</u> | | | | | | | | | | |
| Kingfishes | 545 | 168 | 533 | 98 | 156 | 239 | 1,049 | 474 | 424 | 169 |
| Spot | 1,852 | 622 | 1,152 | 1,092 | 1,072 | 2,629 | 1,863 | 757 | 1,810 | 1,125 |
| Croaker | 625 | 274 | 228 | 167 | 1,236 | 440 | 616 | 227 | 254 | 287 |
| Sheepshead | 54 | - | - | 73 | 51 | 96 | 70 | - | 75 | 54 |
| <u>Other</u> | | | | | | | | | | |
| Sharks | 215 | 42 | 170 | 364 | 188 | 134 | 207 | 391 | 168 | 111 |
| <u>Total</u> | 10,088 | 7,659 | 19,254 | 7,663 | 15,234 | 9,448 | 7,527 | 6,416 | 6,897 | 4,558 |

closure of their fishery. The entire king mackerel fishery was eventually closed from 28 February-31 March 1989. Since there is normally minimal effort at this time, the impact on 1989 landings was negligible. The early (May-June) run was weaker than in 1988 and the fall run did not materialize because of the hurricane. There was no fall closure because of the low landings.

In contrast, landings of Spanish mackerel were the highest in several years. The fishery year for this species also runs from 1 April-31 March. The sport fishery was closed from 2 October (1988)-31 March (1989), although the impact on 1989 landings was insignificant. Fishing was best off the Grand Strand and Hilton Head. About 33% of the catch was released alive. The catch of bluefish was the largest since 1985. This is not a particularly popular species with South Carolina fishermen and many of the fish caught in inland waters are very small. About 37% of the total catch was released alive.

Inshore fishing success for most species was somewhat below average. Landings of red drum, the state's most popular marine sport fish, were the lowest since 1984 (Fig. 31). During 1979-1989 (with 1984's data not included because of suspected sampling error), annual catches of red drum have tended to vary directly with effort. Effort by coastal residents (the group of anglers most likely to fish from private boats and target this species) has been used here as a proxy for directed red drum effort. In such a situation (technically termed a noncompetitive fishery), some measure of fishing success (e.g. catch per trip or CPUE) is usually the best fishery-dependent index of abundance. Both catch and CPUE have shown very similar trends (Fig. 31). In 1989, there was a marked reduction in effort by coastal residents, particularly during the fall peak season for this species, because of the hurricane. This in part could have accounted for the lower landings of red drum. The CPUE index was also lower (slightly below the 1979-1988 average), implying that the decreased landings also reflected lower abundance to some extent. The size limits did not appear to affect the retention rate as much as in previous years, with less than 20% of the catch reported released.

The spotted seatrout is the second most popular inshore gamefish. Catches of this species have not been strongly correlated with effort and both landings and catch/effort ratios have fluctuated over a wider range than for red drum (Fig. 32). Annual abundance is believed to be largely determined by winter water temperatures and the catch data tend to support this theory. The 1981, 1984, and 1985 seasons followed cold winters and three of the four lowest annual catches occurred during those years. Landings in 1986 through 1988 were above average and followed very mild winters. The 1989 catch, which also followed a mild winter, was 39% below the ten-year average. Storm-related factors appear to have been partly responsible. Directed effort for this species (and catches) peaks in late fall, when 1989 effort was much lower than normal because of the hurricane. A large part of the Cooper River was also closed in 1989 due to Navy restrictions and this portion historically was very productive of both spotted seatrout and red drum. The catch rate index was also a little below average, however, which implies that abundance of spotted seatrout

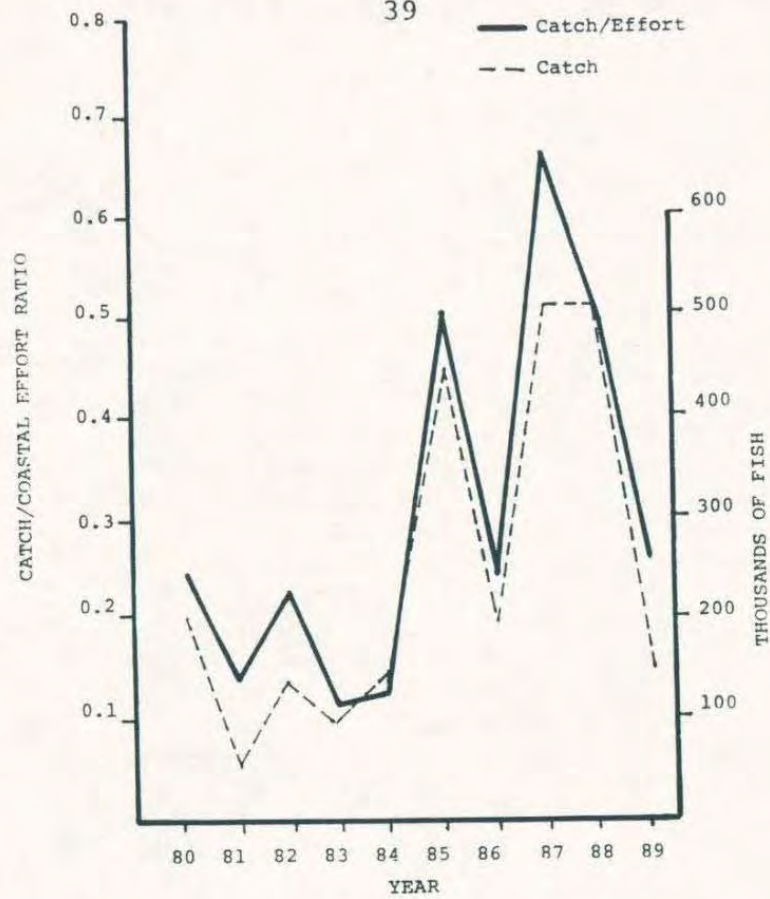


Fig. 31. Trends in catch/effort ratios and catch of red drum.

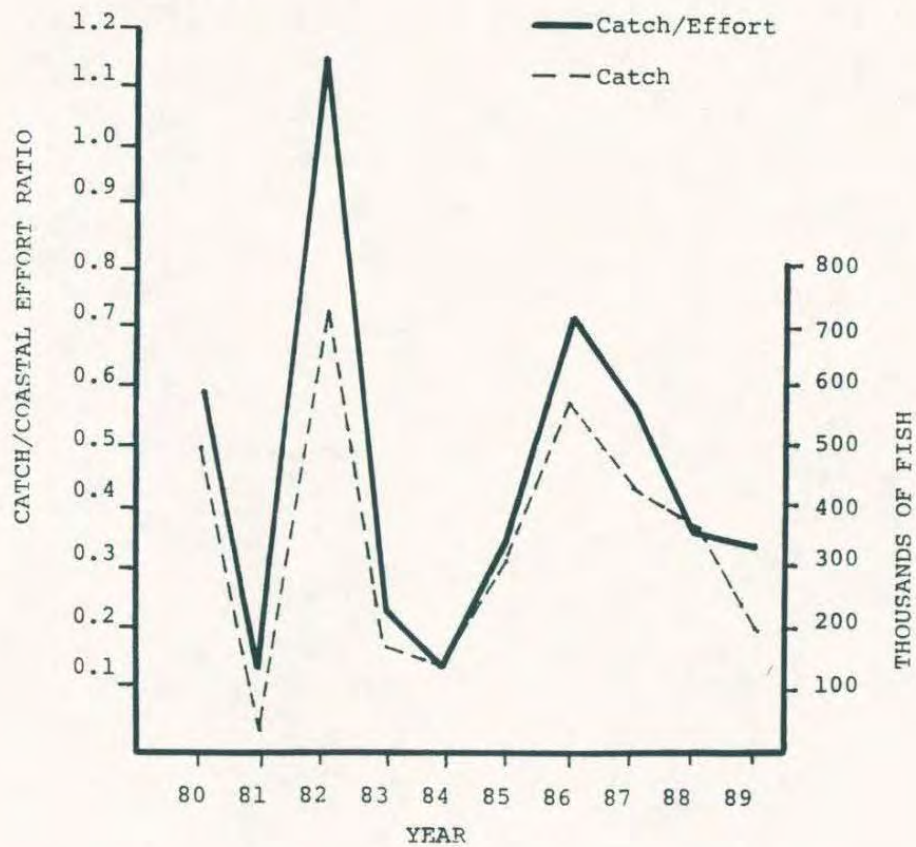


Fig. 32. Trends in catch/effort ratios and catch of spotted seatrout.

was somewhat below normal. About 21% of the 1989 catch was released, presumably because of the 12-inch minimum size limit.

Landings of both species of flounders were also down significantly. The catch of summer flounder probably reflected the depressed stock condition of this species throughout its range. Landings from Massachusetts through North Carolina were down markedly and the intensive recreational fishery in the New York Bight virtually collapsed in the summer of 1989. Landings of southern flounder were also off appreciably, with no obvious explanation. The majority of the flounder catch is landed during the summer, so the 1989 flounder catch should not have been markedly affected by the hurricane.

Spot and kingfishes (whitings) are normally a sizeable component of inshore recreational catches. Catches of both were well below the 1988 levels. Both species are major contributors to catches of the Grand Strand pier fishery. Its elimination by the hurricane probably accounted for much of the apparent decline in landings.

Sharks have become increasingly popular with South Carolina anglers in recent years. The 1989 catch was the lowest since 1981. Although regional stock status has become a matter of increasing concern, most of the South Carolina catch historically has been released. In 1989, 57% were released. Perhaps the decline in landings reflected stock conditions, although the most numerous component (Atlantic sharpnose) is thought to be abundant. Since most of the shark catch also is made during the summer, it is unlikely that the hurricane had much effect on the annual landings.

HEADBOAT FISHERY

South Carolina headboats fished primarily for bottom-dwelling reef fish, with minor landings of pelagic species such as king mackerel and dolphin. Since nearly the entire fleet was based out of Charleston, Murrells Inlet, and Little River, the hurricane significantly disrupted its operations in the fall of 1989. None of the boats was lost or seriously damaged, but some lost their dock facilities and many had to modify their sailing schedules for the remainder of the season. Effort (angler-days) in 1989 was the lowest since 1981 (Fig. 33).

Despite excellent fishing immediately after the storm, overall landings declined markedly (26%) from those in 1988 (Fig. 33), with decreases in each major species group (Fig. 34). Overall catch per unit of effort (10.9 pounds per angler-day), which also decreased, was about 11% below the ten-year average.

Black sea bass continued to be the principal species landed, representing 37% of the total headboat catch by weight. This was, however, the lowest percentage contribution of this species since 1978 (Fig. 35). Trends in relative importance of other major species groups remained unchanged from those in recent years. Red pogy comprised almost 60% of the total catch by weight (excluding black sea bass) during the late 1970's. Its relative contribution in both numbers of fish and weight has been steadily declining. In 1989, this species contributed only 20% of the weight production

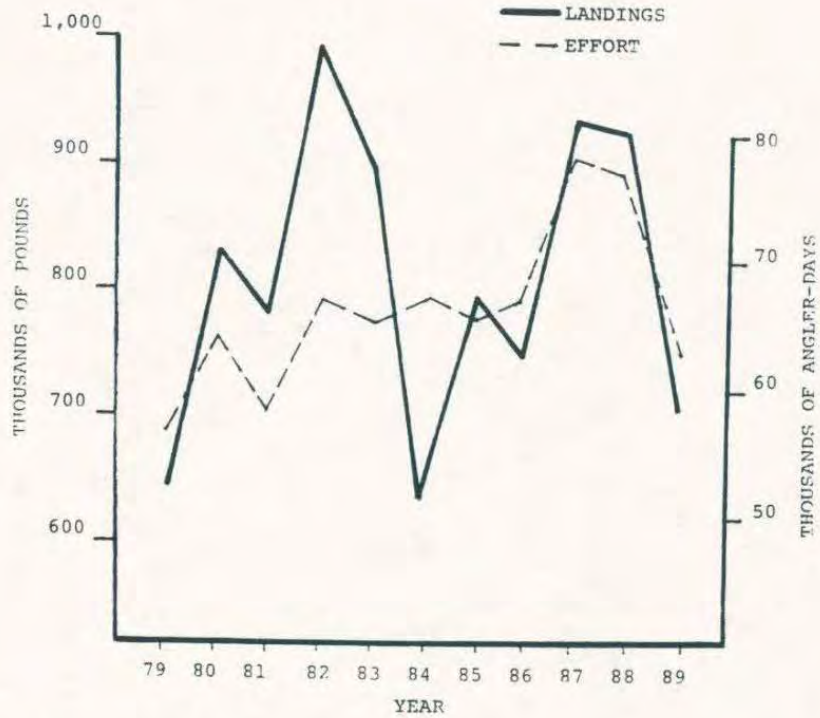


Fig. 33. Trends in headboat catch and effort.

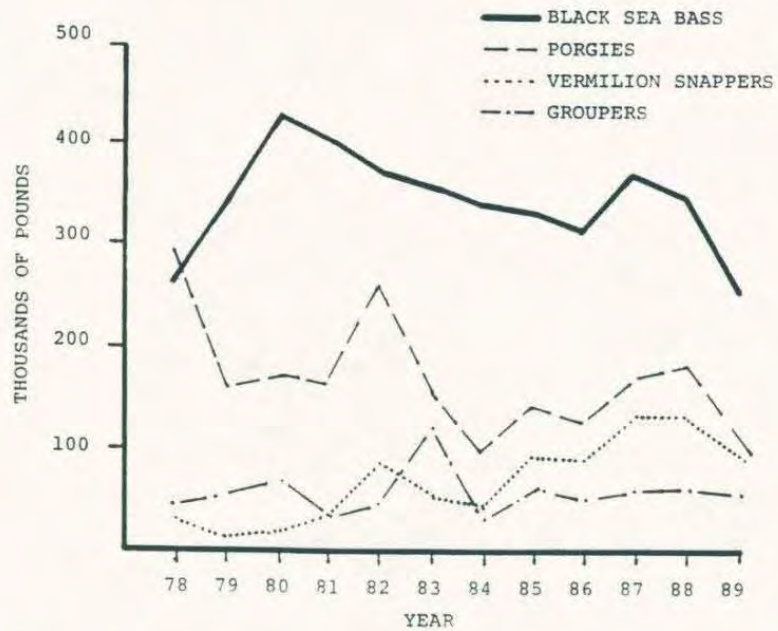


Fig. 34. Landed weight of principal species in the South Carolina headboat catch.

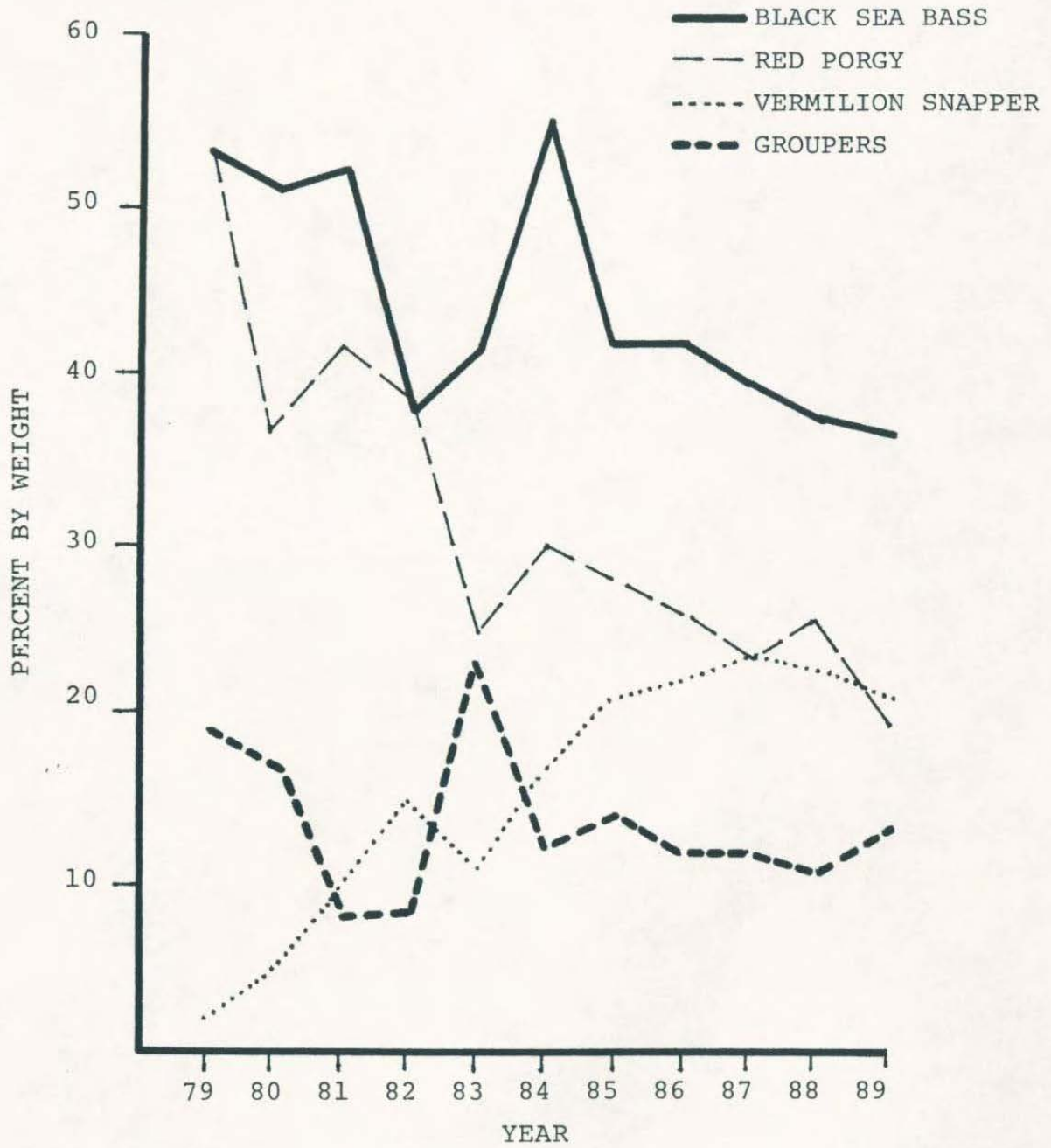


Fig. 35. Composition of headboat catches.

(excluding black sea bass) of the headboat fishery. Vermilion snappers, which represented less than 5% of weight production (excluding black sea bass) at the start of the decade, accounted for 21% in 1989, down slightly from the last three years. After much fluctuation in the early 1980's, the weight contribution of groupers has remained stable since 1984.

SHRIMP BAITING FISHERY

A total of 6,644 people obtained permits for the 1989 season, a 21% increase over the 1988 level. Due to the hurricane, which struck within a week of the season's opening, overall participation and effort were lower in spite of the higher number of permit holders. Nearly 18% did not go shrimping, compared to 8% in 1988.

Most of the nonparticipation was accounted for by residents in areas most affected by the storm, e.g. Charleston County (29% of the permit holders did not go shrimping) and the Berkeley/Dorchester area (24% nonparticipation). Overall participation (17,171 individuals) declined 3% and total estimated effort (about 31,500 trips) was down 10%. Effort normally is greatest in the Charleston area, where storm-related conditions precluded significant activity for several weeks after the storm. The fishery in the Beaufort area was not affected and effort there was high.

Shrimp were exceptionally abundant prior to the storm. Anoxic conditions in northern Charleston County estuarine waters temporarily displaced shrimp, but catch rates from mid-October on were good. Shrimping in the southern sounds and rivers was good the entire season. The statewide seasonal catch rate (26.5 quarts of whole shrimp per boat trip) was 19% above the 1988 figure. The estimated total catch was 1.25 million pounds of whole shrimp, representing about 24% of the 1989 total (recreational and commercial) white shrimp harvest.

Shrimp baiters spent an estimated minimum of \$756,000 for permits and expenses directly related to their trips. Their catch was worth about \$3.75 million. Had it not been for the hurricane, projected participation would have been 25% higher, effort 42% greater, and total catch about 1.77 million pounds. The total direct economic impact of the storm on the fishery was estimated at \$1.77 million.

SHELLFISH GATHERING

During October 1988 through April 1989, an intercept survey was conducted at public boat landings in Beaufort, Charleston, and Georgetown Counties. Interviews were obtained from about 500 recreational shellfish gatherers. Most observations (77%) were made at the Folly River (Charleston County) public landing, which is the most heavily used public access point for shellfishing in the state. One reason for this popularity is the access by foot to a large public oyster ground: boats are required to reach nearly all of the state's other public shellfish areas.

Practically all gatherers were instate coastal residents on one-day outings. Most (77%) targeted oysters, with only 2% expressly seeking clams. Average oyster harvest was about one bushel per person per day, or half of the legal limit. Average clam harvest was 0.04 bushel per person per day, with 86% of the total clam harvest taken incidental to oyster gathering. The average number of shellfishing trips made during the previous (1987-1988) season was 2.9 per person, although 48% of the fishermen had not participated.

Harvesters offered mixed opinions as to the quality (size) and quantity of oysters available. Ratings in both categories for the Murrells Inlet grounds were very low (quality very small, quantity very few), not surprising given the combined effects of Dermo, red tide, and heavy utilization. Gatherers on grounds in the Beaufort area rated quality as adequate (average), but quantity as very few. Harvesters in Charleston County assessed both quality and quantity of the oysters available to them as adequate (average).

Compared to results from the last statewide survey (1980/1981 season) of recreational shellfish gatherers, it appeared that harvest rates and effort (trips per season) were lower. The residency of participants had also changed, becoming almost exclusively coastal.

The fall 1989 shellfish season was delayed by Hurricane Hugo. Grounds south of the S. Edisto River opened on 11 October, while most grounds to the north opened on 8 November. Those around Murrells Inlet remained closed longer. The recreational grounds from Charleston to the North Carolina border were surveyed in the month following the hurricane. Little or no physical damage, e.g. from sedimentation or washout, was evident except around Awendaw, where the storm surge was greatest.

TOURNAMENTS

The inaugural Governor's Cup Billfishing Series was held as a result of the initiative of Governor Campbell. This series was developed at the Governor's suggestion to draw attention to South Carolina's marine sportfishing opportunities and promote conservation (through tag-and-release) of the valuable billfish resource. Five tournaments comprised the 1989 series: 1) Bohicket Marina Billfish Tournament, 10-14 May; 2) 22nd Annual Georgetown Blue Marlin Tournament, 17-21 May; 3) 5th Annual Marlin Quay/Michelob Invitational Billfish Tournament, 22-27 May; 4) Harbourgate Invitational Billfish Tournament, 7-11 June; and 5) 4th Annual Toler's Cove Marina Open Billfish Tournament, 22-25 June. The 93 boats participating landed 13 billfish while tagging and releasing 28.

Hurricane Hugo had a significant effect on tournament activity. A survey of sponsors indicated that six events were canceled and three rescheduled. The Arthur Smith King Mackerel Tournament was reduced from three ports to one (Little River). This event was postponed for three weeks and drew 250 boats compared to 827 in 1988.

ARTIFICIAL REEFS

There were 23 permitted reefs in the system in 1989. Despite significant financial cuts to the program, material was added to three reefs. The Capers Reef off Charleston received 49 experimental steel cube reef units, the deck section of the MRD's old mechanical oyster harvester and over 900 small cement cylinders. The Y-73 reef, also off Charleston, received one 90 foot tug boat hull donated by Whitestack Towing Company. An additional tug boat and two 55 foot ex-Navy landing craft were placed on the Hilton Head Reef, 12 miles off Hilton Head island later in the year.

Routine monitoring and evaluation of numerous offshore reefs was continued throughout the year, with some interruption due to the effects of Hurricane Hugo. Prior to the storm, direct evidence of the potential impact of commercial bang-sticking on the offshore reefs was obtained and recommendations regarding the future restriction of this type activity were made by reef program biologists.

Impacts of Hurricane Hugo were examined for the remainder of 1989, and further evaluation will continue into 1990. Preliminary observations indicated that the storm did cause changes on many of the reefs, especially those in shallow water closer to shore. Parts of Capers Reef were covered with mud and some structures were either damaged or moved inshore.

Effects of the storm were also noted in deeper water north of Charleston where some offshore shipwrecks and reefs were either damaged or moved. One 460 foot long ship in 110 feet of water was moved up to 700 feet from its original position. The impact of the storm on reef fish populations was examined to a limited degree during 1989, but more work will be done in this area in 1990.

Sixteen buoys were replaced on 12 artificial reefs during 1989. Many of these were needed as a result of loss or damage due to Hurricane Hugo. Also in 1989, work was begun on the development of the State marine Artificial Reef Management Plan, a document intended to provide direction for the Marine Artificial Reef Program in all future reef development.

The total printing cost for this document was \$269.19. Two hundred copies were printed at a cost per unit of \$1.35.

