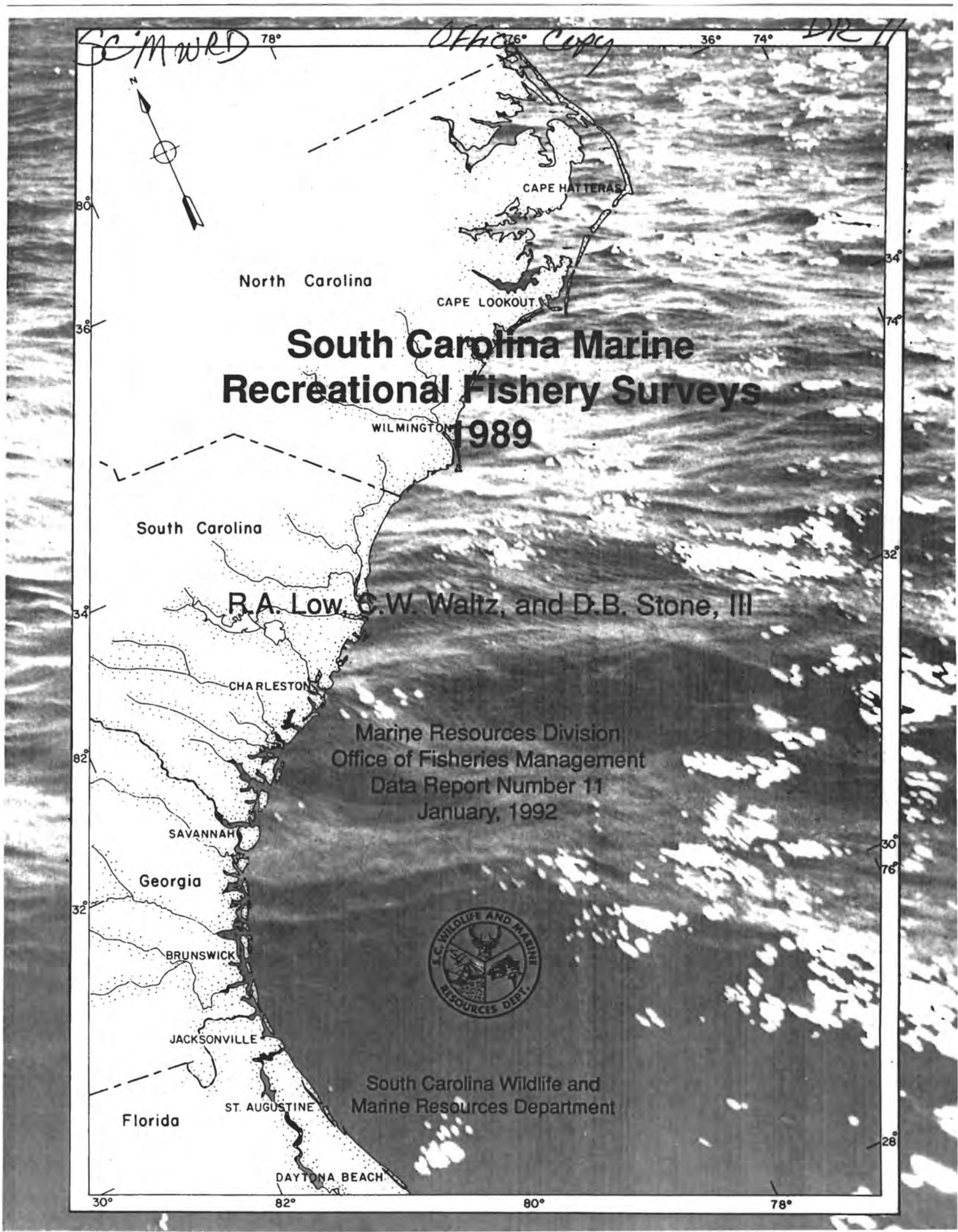
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SOUTH CAROLINA MARINE RECREATIONAL FISHERY SURVEYS, 1989

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Office of Fisheries Management

Marine Resources Division

South Carolina Wildlife and Marine Resources Departmer

Charleston, South Carolina

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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INTRODUCTION

Marine recreational fishing is a major leisure activity in coastal South Carolina. Unlike swimming and boating, sport fishing is principally a consumptive activity dependent upon a finite resource base. Primary responsibilities of the Marine Resources Division (MRD) include the orderly development of such resources, including their recreational usage, and management for the best overall interest of the state's citizens. Proper development and management require detailed knowledge about the participants in recreational fishing, the extent of their effort, what they catch, where they catch it, how much of it, and what they do with it. Such information is used to compile a fishery-dependent data base. Combined with fishery-independent information obtained from research projects such as life history studies and habitat evaluations, these data provide the factual basis for equitable and objective management strategies.

MRD in cooperation with the National Marine Fisheries Service (NMFS) conducts the Marine Recreational Fishery Statistics Survey (MRFSS) annually to obtain this information. The MRFSS is a regional survey initiated by NMFS in 1979. It has two components: 1) a telephone poll of coastal households to obtain information on participation and effort and 2) an on-site intercept survey (creel census) to collect catch, effort, and demographic data. In South Carolina, the MRFSS is conducted during March through December and includes anglers fishing from shore or manmade shore facilities (e.g. docks, bridges, and piers), charterboats, and private boats. Since 1986, headboat fishermen have not been interviewed because they are sampled during an independent NMFS survey. Fishermen using gear other than hook and line are very seldom intercepted, therefore the results do not pertain to activities such as gill netting, gigging, and spearfishing.

MRD has performed the South Carolina creel census since July, 1987. MRD obtains additional catch and effort data from a State Finfish Survey (SFS) using procedures similar to those of the MRFSS. In 1989, most SFS effort was directed at private boat fishermen fishing in inland (estuarine) waters. This report describes procedures and results of these surveys during 1989. Information for 1988 was summarized by Waltz et al. (1990) and that for 1987 by Low and Waltz (1988). Low et al. (1986) described MRD surveys and their results during 1986 and 1985. Similar reports for previous years are unavailable.

METHODOLOGY

MRFSS procedures for the telephone and intercept surveys are described in Essig et al. (1991) and Low and Waltz (1988). MRD personnel conducted the 1989 MRFSS creel census at 17 sites utilized by shore-based anglers, 14 charterboat docks, and 31 public launching points (Table 1). The sampling schedule, provided by KCA Research, Inc. (the NMFS contractor), was based on historical usage

Table 1. Site List for the MRFSS by mode and county.

County	Shore	Charterboat	Private Boat
Beaufort	Series of bridges on road to Hilton Head	South Beach Marina, Hilton Head	All Joy Landing, Bluffton
	Harbor River bridge Harbor River	Harbor Town Marina, Calibogue Sound	
	C.C. Haigh Landing Pinckney Island recreational area	Palmetto Bay Marina, Hilton Head	E. C. Glenn Landing, Chechessee River
	Paradise Pier, Hunting Island	Fripp Island Marina, Fripp Island	Port Royal Landing, Battery Creek
	H. E. Trask landing, Victoria Bluff	Shelter Cove Marina, Hilton Head	Sam's Point, Lucy Creek
	Broad River bridge, Broad River	Schillings Boat House Hilton Head	Gray's Hill, Intracoastal Waterway
			C. C. Haigh Landing, Pinckney Island
			Russ Point Landing, Hunting Island
			H. E. Trask Landing, Victoria Bulff
			Broad River Landing, Broad River
			Station Creek Landing, St. Helena Island

County	Shore	Charterboat	Private Boat
Charleston		Charleston City Marina, Charleston	Shem Creek Landing, Mt. Pleasant
	Remley Point pier, Mt. Pleasant	Wild Dunes Yacht Club, Isle of Palms	Charleston City Marina, Charleston
	Breach Inlet bridge, Isle of Palms	Toler's Cove Marina, Mt. Pleasant	Remley Point Landing, Mt. Pleasant
		Bohicket Marina	Cast-a-way Marina, Isle of Palms
	Limehouse pier, Johns Island		Wild Dunes Yacht Club, Isle of Palms
	Live Oak Landing, Edisto Island		Cherry Point Landing, Rockville
			Wappoo Cut Landing, Charleston
			Battery Island (Sol Legare) Landing, James Island
			Folly River Landing,Folly Beach
			Limehouse Landing, Johns Island
			R. E. Ashley Landing, McClellanville
			County Farm Landing, N. Charleston

County	Shore	Charterboat	Private Boat
			Live Oak Landing, Edisto Island
			Toogoodoo Landing
Georgetown	Murrells Inlet jetty, Huntington Beach Park	Capt. Dick's Marina, Murrells Inlet	South Island Ferry Landing, Winyah Bay
		Marlin Quay Marina, Garden City	Murrells Inlet Landing, Murrells Inlet
		Voyagers View Marina Murrells Inlet	
			Boulevard Landing, Georgetown
Horry	Springmaid Pier, Myrtle Beach	Vereen's Marina, N. Myrtle Beach	
	Kingfisher Pier, Garden City Beach	Harbor Gate Marina, Cherry Grove	Cherry Grove Landing, Hwy. 17 Cherry Grove
	Cherry Grove Pier, Cherry Grove		
	Myrtle Beach State Park		

patterns by fishing mode (shore, charterboat, private boat) and sampling wave (two month intervals, beginning with March-April). Site assignments reflected relative usage rates, with the most heavily utilized locations receiving selection priority. Those for the private boat mode, at MRD's request, were divided approximately equally between Beaufort County, Charleston County, and the Georgetown/Horry County area. About 60% of the sampling effort was allocated to weekend days and 40% to weekdays, with most interviews being obtained between 1000 and 1700 hours.

On a scheduled sampling day, the creel clerk proceeded to the assigned site. If the clerk determined that the assigned location would be unproductive (e.g. by absence of anglers on shore or no trailers at a boat ramp), he proceeded to a nearby alternate location. The clerk normally remained at the site until the day's MRFSS interview quota was obtained or further effort seemed unwarranted. Upon completion of the MRFSS assignment, the clerk usually continued with SFS sampling, either at the same location or a nearby site. SFS interviews were collected at the locations listed in Table 2.

Interviews were conducted in accordance with procedures and guidelines described in KCA's Intercept Interviewer Training Manual (1989 revision), using the appropriate survey forms. Anglers had completed their fishing, except in the case of shore fishermen. Up to one half of the day's quota for this group could be based on incomplete trips. An MRFSS interview pertained to an individual fisherman, while an SFS interview could include one or more anglers if they fished as a group (e.g. from the same boat). Responses were voluntary and all information was confidential as to personal identity.

Routinely obtained information included the number of anglers in the group, hours spent fishing, area fished, targeted species, and residency of the respondent. Catch data consisted of the number of fish caught by species and their disposition (i.e., retained, discarded dead, or released alive). Up to ten fish of priority species were measured and/or weighed per catch (individual or group aggregate). In cases where catches were pooled for a group (e.g. on charterboats) and anglers did not recall how many fish they had caught individually, the group catch was divided by the number of anglers to obtain catch rates. It should be noted that the fish discarded or released represented the respondents' estimates and could not be verified either as to number or species identity.

For the 1989 MRFSS, MRD coded and edited interview forms, then forwarded them to KCA for data processing. Information for this survey was subsequently provided in tabular form or on tapes by the NMFS Washington, D.C. office and its accuracy is therefore the responsibility of NMFS and its contractor (KCA). Expanded estimates (e.g. total catch, total participation, etc.) were prepared by NMFS. Data for the SFS were processed by MRD.

RESULTS

Summary tables of annual participation, effort, and total catch by state and region are contained in Essig et al. (1991), based on the MRFSS. They described considerations pertinent to

Table 2. Site list for the State Finfish Survey (SFS) by mode and county.

County	Shore	Charterboat	Private Boat
Beaufort	Russ Point landing, Hunting Island	Harbor Town Marina, Calibogue Sound	All Joy landing, Bluffton
			E.C. Glenn landing, Chechessee River
			C.C. Haigh landing, Pinckney Island
Charleston		Charleston City Marina, Charleston	Charleston City Marina, Charleston
		Bohicket Marina	Remley Point landing, Mt. Pleasant
			Folly River landing, Folly Beach
			Wappoo Cut landing, Charleston
			Limehouse landing, Johns Island
			Toogoodoo landing
			R.E. Ashley landing, McClellanville
Georgetown			Murrells Inlet landing, Murrells Inlet
			Boulevard landing, Georgetown
Horry	Myrtle Beach State Park	Harbor Gate Marina	Cherry Grove landing, Hwy. 17 Cherry Grove

interpretation of these results, e.g. sources of variation and their implications, potential elements of bias, and possible effects of data adjustments. Most of these factors are relevant to MRFSS results in South Carolina and have been cited in previous reports (Low and Waltz 1988, Waltz et al. 1990). They are reiterated below where appropriate.

Survey Logistics

A total of 2,571 interviews were conducted during the MRFSS, distributed by wave as indicated in Table 3. About 44% of the total time was spent on travel. On average, each interview represented an investment of 0.5 man-hours and 9.4 miles of travel. An additional 123 interviews, representing 302 anglers, were obtained during the SFS (Table 4). All were collected prior to Hurricane Hugo and the majority were from private boat fishermen.

Annual Overview

Of 4,154 coastal households contacted during the South Carolina telephone survey, 5.9% contained a marine angler (Table 5), with an average of 1.53 fishermen per fishing household. Total participation was an estimated 269,000 fishermen, including 72,000 coastal residents, 47,000 non-coastal residents, and 150,000 out of state anglers (Essig et al. 1991).

Estimated total effort was 988,697 trips, distributed by wave, mode, and residential category as shown in Table 6. Coastal residents accounted for 574,923 trips, about 58% of the total effort. About 13% (128,379 trips) were contributed by non-coastal state residents. Fishermen from out of state made an estimated 285,395 trips, 29% of the total effort.

About 54% of the estimated total effort was expended in the private boat mode. Coastal residents accounted for 75% of the private boat trips, non-coastal residents 14%, and out of state residents contributed 11%. Shore fishing trips represented 35% of the total effort. Coastal residents accounted for 48% of the shore-based fishing effort. Out of state fishermen made 40% of the trips and non-coastal residents 12%. About 11% of all fishing trips were in the charterboat mode. Out of state residents made 81% of these. Non-coastal residents accounted for 11% and coastal residents 8%.

Seasonal distribution of effort varied according to mode. The peak activity period was wave 4 (July-August), with 30% of the annual effort. Private boat effort, the major component, was substantially greater in wave 4 than in the other intervals. The next most active period was wave 3 (24% of total effort). Waves 6 (13%) and 2 (12%) had the least fishing activity. Wave 4 was the most active period for shore fishing activity, followed by wave 3. Charterboat effort was lowest in wave 6 and at relatively high levels during waves 3-5. Private boat effort was relatively low in wave 2, highest in wave 4, and roughly comparable in the other intervals.

A total of 3,277 anglers provided information on the species targeted during their trips. Forty four percent indicated that they were fishing for "anything." Preferences of the remaining fishermen

Table 3. MRFSS logistics by wave. Totals are not additive due to sites, travel, etc. shared among modes for some assignments.

Wave (mo.)	Mode	Sites	Travel Hours	Travel Miles	On-site Hours	Inter-views
2	Shore	9	46.00	2,269	58.50	129
MAR/APR	Charter	5	56.25	2,514	57.75	175
	Private	13	54.25	2,480	77.25	169
	Total	23	110.00	4,880	126.50	473
3	Shore	8	71.75	3,178	75.00	187
MAY/JUN	Charter	6	59.50	2,756	60.75	175
	Private	18	69.50	2,944	101.00	300
	Total	32	127.75	5,586	164.50	662
4	Shore	10	50.50	2,165	54.75	165
JUL/AUG	Charter	12	52.75	2,264	67.00	168
	Private	27	84.00	3,652	145.50	337
	Total	46	140.75	5,857	204.25	670
5	Shore	6	33.25	1,469	36.75	100
SEP/OCT	Charter	8	57.25	2,737	65.50	158
	Private	11	47.75	2,042	71.50	173
	Total	25	91.00	4,160	119.25	430
6	Shore	4	34.75	1,489	37.75	64
NOV/DEC	Charter	8	43.50	1,690	44.75	71
	Private	12	65.75	2,570	88.75	200
	Total	21	92.25	3,618	108.75	335
ANNUAL	Shore	17	236.25	10,570	262.75	645
	Charter	14	269.25	11,961	295.75	747
	Private	31	321.25	13,688	484.00	1,179
	Total	48	561.75	24,101	723.25	2,571

Table 4. SFS effort by wave, mode, and county.

Wave	Mode	County	Interviews	Anglers
1				
JAN/FEB	Shore	Beaufort	1	3
	Private boat	Beaufort	7	19
	(inland)	Charleston	9	19
2				
MAR/APR	Shore	Charleston	5	6
	Charterboat	Beaufort	5	25
	Private boat			
	(>3 mi.)	Charleston	13	28
	(0-3 mi.)	Charleston	1	2
	(inland)	Colleton	1	1
		Charleston	11	17
		Horry	2	5
3	Private boat			
MAY/JUN	(>3 mi.)	Charleston	2	5
	(inland)	Charleston	9	18
		Georgetown	1	4
4				
JUL/AUG	Shore	Charleston	4	9
		Horry	7	7
	Charterboat	Charleston	4	21
		Horry	9	37
	Private boat			
	(0-3mi.)	Charleston	4	13
		Georgetown	1	3
	(inland)	Charleston	27	60

Table 5. Percentages of coastal households interviewed that contained a member who had fished in saltwater during the previous two months (i.e., the wave indicated). Source: Kubota et al. (1991).

Year	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
1987	5.9	9.4	8.8	9.1	8.4
1988	7.0	6.7	10.2	7.8	5.0
1989	7.5	5.5	7.1	5.7	5.1

Table 6. Estimated effort (number of trips) by wave, mode, and residential category. Source: NMFS.

Wave	Coastal residents	Non-coastal residents	Out of state residents
		Wave 2	
Shore	26,030	2,264	19,617
Charterboat	895	1,040	8,173
Private boat	48,901	9,098	6,444
		Wave 3	
Shore	42,841	14,431	37,429
Charterboat	1,922	1,730	29,984
Private boat	87,784	14,430	7,616
		Wave 4	
Shore	56,362	17,518	46,460
Charterboat	2,548	3,907	22,081
Private boat	106,625	20,207	16,768
		Wave 5	
Shore	27,883	7,604	27,249
Charterboat	2,400	4,273	27,510
Private boat	77,245	16,365	19,639
		Wave 6	
Shore	10,457	1,376	5,504
Charterboat	870	1,378	2,756
Private boat	82,160	12,758	8,165

are shown in Table 7 for those species sought by at least 1% of this group.

King mackerel was the principal species sought by ocean charterboat and private boat anglers, while spotted seatrout and red drum were the primary targets of private boat fishermen in estuarine areas. Spot were very popular with shore-based fishermen, particularly pier anglers, while flounders were sought by both shore-based and private boat fishermen. These species have consistently been the most frequently targeted fish in South Carolina's marine recreational hook-and-line fishery since annual surveys began in 1979. The percentage of anglers seeking Spanish mackerel is increasing as this species becomes more abundant. Several other species warrant mention on the basis of the fact that they were particularly popular in certain areas and/or during specific seasons. These include sheepshead (spring), sharks (summer), and cobia (Beaufort area, spring). Finally, it should be noted that the black sea bass, though seldom the specific target of a trip, was the most numerous fish caught by ocean anglers, who frequently resorted to bottomfishing if efforts for the target species were unsatisfactory.

The total catch in 1989 was estimated at 4,558,000 fish, broken down by species and fishing area in Table 8 and by species and disposition in Table 9. Annual catches for the last four years are listed in Table 10 to facilitate historical comparisons.

Offshore pelagics represented less than 2% by number of the overall catch. Landings were not well represented in the MRFSS because tournaments, which contribute substantially to this category, were not covered by the survey. Independent MRD monitoring of major events indicated that dolphin landings were above average in 1989, while catches of tuna (primarily yellowfin) were below the levels of recent years.

Offshore bottomfish comprised about 12% of the total numerical catch. Black sea bass, which represented about 10% of the total all-species landings in 1989, was the most numerous species, although relatively few anglers targeted it. About 61% of the catch was retained, compared to only 38% in 1988. The other major contributor in this category was red porgy. Landings of this species were the highest since 1985, with about 84% being retained. Catches of other species (primarily grunts and vermilion snappers) were relatively insignificant.

Most ocean anglers targeted coastal pelagic species, particularly king mackerel. Landings of kings were down substantially (37%) from 1988 and were only half of the preceding three years' average. Landings of other popular species, e.g. Spanish mackerel, were substantially higher than in recent years. About one-third of the Spanish mackerel were released. The catch of bluefish was above average. Only about half of these fish were retained, reflecting the small size of the fish typically caught in inland areas and the low esteem of this species as a food fish. As a group, coastal pelagics represented about 12% of the total overall landings by number.

Inshore sportfish is an arbitrary classification for the most frequently targeted inshore species, including red drum, seatrouts (spotted and weakfish), and flounders (summer and southern). The

Table 7. Targeted finfish species, all modes combined, of those anglers who designated a particular species.

Species	1989 Percentage of anglers	1989 Rank	1988 Rank
King mackerel	24	1	1
Spotted seatrout/trout	14	2	3
Red drum	13	3	2
Spot	10	4	4
Flounders	8	5	5
Spanish mackerel	7	6	7
Sharks	7	7	6
Sheepshead	4	8	8
Bluefish	2	9	-
Cobia	2	10	10
Black sea bass	2	11	9
Kingfishes	2	12	-
Dolphin	1	13	-
Croaker	1	14	-

Table 8. Estimated 1989 catch by fishing area, in thousands of fish. Source: NMFS

Category	Inland	Nearshore ocean	Offshore ocean
Offshore Pelagics			
Dolphin	-	-	11
Little tunny/bonitos	<1	-	9
Tunas/other	-	-	3
Offshore Bottomfish			
Black sea bass	112	42	290
Other sea basses	6	3	19
Groupers	1	-	6
Vermilion snapper	-	-	28
Other snappers	-	-	6
Red porgy	-	1	69
Other porgies	<1	-	3
Grunts	6	15	28
Triggerfish	-	3	2
Coastal Pelagics			
King mackerel	1	3	89
Spanish mackerel	3	78	85
Bluefish	159	134	4
Jack crevalle	4	<1	2
Blue runner	-	-	<1
Amberjacks	-	<1	5
Barracuda	-	-	9
Inshore Sportfish			
Red drum	134	16	1
Spotted seatrout	190	13	-
Weakfish	3	4	-
Summer flounder	15	2	-
Southern flounder	51	<1	-
Flounders	14	1	-
Inshore Bottomfish			
Kingfishes	87	81	<1
Spot	961	164	<1
Croaker	260	26	1
Black drum	11	<1	-
Sheepshead	49	4	1
Pompano	1	41	-
Miscellaneous			
Sharks	79	27	6
Skates/rays	34	11	-
Eels	9	<1	-
Catfishes	181	24	<1
Toadfish	78	6	1
Searobins	3	2	-
Pigfish	34	-	3
Pinfish	462	47	5
Silver perch	47	3	-
Mullets	-	<1	-
Puffers	55	6	-

Table 9. Estimated 1989 catch by disposition, in thousands of fish
NR - none reported.
Source: NMFS
Removed includes retained and discarded dead.

Species	Removed	Released	Total
Offshore Pelagics			
Dolphin	11	<1	11
Little tunny/bonitos	7	2	9
Tunas/other	3	NR	3
Offshore Bottomfish			
Black sea bass	280	164	444
Other sea basses	9	18	27
Groupers	7	<1	7
Vermilion snapper	26	2	28
Other snappers	6	NR	6
Red porgy	59	11	70
Other porgies	3	<1	3
Grunts	26	23	49
Triggerfish	5	NR	5
Coastal Pelagics			
King mackerel	70	3	74
Spanish mackerel	114	56	170
Bluefish	189	109	297
Jack crevalle	3	3	6
Blue runner	<1	NR	<1
Amberjacks	3	1	5
Barracuda	3	6	9
Inshore Sportfish			
Red drum	120	30	150
Spotted seatrout	160	43	203
Weakfish	6	1	7
Summer flounder	17	NR	17
Southern flounder	48	4	51
Flounders	4	11	15
Inshore Bottomfish			
Kingfishes	125	43	169
Spot	1016	109	1,125
Croaker	239	47	287
Black drum	9	1	11
Sheepshead	52	2	54
Pompano	18	24	42
Miscellaneous			
Sharks	47	63	111
Skates/rays	7	38	46
Eels	<1	8	9
Catfishes	100	105	205
Toadfish	21	64	85
Searobins	1	4	5
Pigfish	7	30	37
Pinfish	170	347	517
Silver perch	33	17	50
Mullets	NR	<1	<1
Puffers	6	56	61
Other	19	54	73
Total	3,051	1,503	4,558

Table 10. Total catches during 1986-1989, in thousands of fish.
NR indicates none reported. Source: NMFS.

Category	1986	1987	1988	1989
Offshore Pelagics				
Dolphin	72	<30	26	11
Little tunny/bonitos	34	<30	18	9
Tunas/other	65	<30	1	3
Offshore Bottomfish				
Black sea bass	531	732	798	444
Groupers	<30	<30	4	7
Vermilion snapper	<30	<30	25	28
Other snappers	<30	<30	1	6
Red porgy	<30	<30	27	70
Other porgies	NR	47	17	3
Grunts	NR	<30	55	49
Coastal Pelagics				
King mackerel	254	71	118	74
Spanish mackerel	163	69	103	170
Bluefish	159	177	147	297
Barracuda	62	<30	25	9
Inshore Sportfish				
Red drum	196	509	542	150
Spotted seatrout	576	444	345	203
Weakfish	78	<30	1	7
Summer flounder	NR	45	47	17
Southern flounder	206	65	103	51
Inshore Bottomfish				
Kingfishes	1,049	474	424	169
Spot	1,863	757	1,810	1,125
Croaker	616	227	254	287
Sheepshead	70	<30	75	54
Sharks	207	391	168	111
Total, all species	7,527	6,416	6,897	4,558

aggregate landings of this group were down appreciably in 1989, as were the individual species totals. The red drum catch declined by 72% from the 1988 figure and was the lowest since 1984. The release rate (20%) was also below the level of recent years. Landings of spotted seatrout during 1986-1988 were relatively large, reflecting mild winters. The 1989 catch, which also followed a mild winter, was 41% less than the 1988 catch and 55% below the preceding three-year average. About 21% of the fish was released, comparable to the level observed in other years since the minimum size limit was enacted. Aggregate flounder landings were about 60% less than in 1988. The overall inshore sportfish catch represented about 10% of the total 1989 landings.

Inshore bottomfish comprised the largest component of the landings in numbers of fish, about 37%. The most numerous species was spot, which accounted for 25% of the overall all-species catch and the vast majority of the landings in this category. The other popular species in this group were the kingfishes or whitings. Landings of both spot and kingfishes were down appreciably from 1988 levels. Those of croaker were up slightly.

Sharks have become increasingly popular with South Carolina anglers in recent years. The 1989 catch, which comprised about 2% of the overall landings, was the lowest since 1981. Historically, most sharks have been released. In 1989, 57% was released, a relatively low level. Although species identification often was lacking, the Atlantic sharpnose appeared to constitute most of the landings.

South Carolina anglers, particularly those fishing in inland waters, typically landed numerous species of little socioeconomic importance. Included were pigfish, pinfish, toadfish, and the always-popular saltwater catfish. About 25% of the total 1989 numerical landings was composed of miscellaneous fish. Catches of miscellaneous species were about two-thirds of the average for the preceding three years.

Shore Mode

A total of 645 shore-based anglers were interviewed during the MRFSS, while SFS interviewing accounted for 25 fishermen. About 60% of the anglers were interviewed in the Georgetown/Horry County area, 29% in Charleston County, and 11% in Beaufort County. Because of the hurricane damage to Grand Strand piers, the number of fishermen interviewed in the fall was relatively low and very few pier fishermen were included. This somewhat affected the annual results in comparison to past years, since the Grand Strand pier fishermen typically represented about half of the MRFSS interviews in the shore mode.

The majority (68%) of shore-based anglers expressed no species preference and were fishing for "anything " (Table 11). Spot was the principal fish targeted (9% of the total anglers interviewed), particularly in the Grand Strand area.

Shore fishermen landed 20% of the estimated total catch, most of it during waves 3 and 4 (Table 12). The dominant component was inshore bottomfish, which represented 44% of the estimated shore landings. This group included spot, the most numerous species in

Table 11. Target species of shore-based anglers by wave and area, in numbers of anglers designating each species.

Species	North	Central	South	Total
		Wave 1		
Anything	0	0	3	3
		Wave 2		
Anything	45	23	8	76
Spot	4	11	0	15
Spotted seatrout	2	13	0	15
Red drum	0	10	0	10
Bluefish	5	0	0	5
Sharks	0	0	4	4
Kingfishes	4	0	0	4
Flounders	3	0	0	3
King mackerel	1	0	0	1
		Wave 3		
Anything	88	49	25	162
Spanish mackerel	19	0	0	19
Flounders	1	7	2	10
Kingfishes	5	0	3	8
Spot	4	3	0	7
King mackerel	6	0	0	6
Bluefish	2	0	0	2
Sheepshead	2	0	0	2
Sharks	0	0	2	2
		Wave 4		
Anything	64	51	7	124
Flounders	14	2	0	16
Spot	12	4	0	16
Red drum	0	6	0	6
Kingfishes	4	0	0	4
Croaker	4	0	0	4
Sheepshead	2	0	0	2
Pompano	1	0	0	1
King mackerel	1	0	0	1
Mullet	0	1	0	1
		Wave 5		
Anything	38	14	4	56
Spot	18	0	0	18
Bluefish	7	1	0	8
King mackerel	7	0	0	7
Flounders	0	2	4	6
Spanish mackerel	2	0	0	2
Red drum	1	1	0	2
Kingfishes	2	0	0	2
		Wave 6		
Anything	35	3	12	50
Spot	5	0	0	5
Spotted seatrout	2	1	0	3
Bluefish	2	0	0	2
Kingfishes	2	0	0	2
Red drum	1	0	0	1

Table 12. Estimated catch of shore anglers by wave, in thousands of fish
Source: NMFS.

Category	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Total
Offshore Bottomfish						
Black sea bass	-	3	1	-	1	5
Red porgy	-	-	1	-	-	1
Coastal Pelagics						
Spanish mackerel	-	72	-	2	-	74
Bluefish	11	102	63	20	7	203
Inshore Sportfish						
Red drum	<1	-	10	-	1	11
Spotted seatrout	-	1	-	-	-	1
Weakfish	-	1	<1	1	-	3
Summer flounder	<1	-	3	-	-	3
Southern flounder	-	1	2	8	-	11
Flounders	-	5	1	1	-	7
Inshore Bottomfish						
Kingfishes	<1	43	29	16	1	90
Spot	2	104	72	52	13	244
Croaker	<1	1	27	3	<1	31
Sheepshead	-	2	-	-	-	2
Pompano	-	1	25	15	-	42
Miscellaneous						
Sharks	<1	4	13	1	-	18
Skates/rays	1	6	7	-	-	14
Eels	<1	-	-	-	-	<1
Catfishes	-	3	20	7	-	30
Toadfish	1	12	17	-	-	29
Searobins	-	<1	<1	1	-	2
Pinfish	-	5	31	8	<1	45
Silver perch	-	15	14	-	-	29
Puffers	-	6	-	3	2	12
Other	8	4	8	2	3	25

the shore catch (26% of the total). The shore landings represented 22% of the overall catch of this species. About 53% of the total catch of kingfishes were taken by shore anglers, as well as virtually the entire state landings of pompano.

Shore anglers also landed a surprisingly large number of coastal pelagic fish (30% of the shore catch), particularly bluefish. About 68% of the overall landings of this species was accounted for by shore fishermen. This group also landed almost 44% of the total catch of Spanish mackerel.

Charterboat Mode

During March-December, 747 charterboat anglers were interviewed in the MRFSS. An additional 83 were accounted for in SFS sampling. About 40% were interviewed in the Georgetown/Horry Counties area, 26% in Charleston County, and 34% in Beaufort County.

Half of the charterboat fishermen indicated that they had targeted "anything" (Table 13). The predominant type of fishing was surface trolling, which was relatively nonspecific as to target species and likely to catch various pelagic fishes. Nearly all charterboat fishermen were inexperienced anglers with little or no effort in recent months prior to their trip, therefore they often were "just fishing." Few trips were directed initially at bottomfish, although these species often were a secondary priority, and very few anglers sought estuarine species.

King mackerel was the principal targeted species, particularly by boats from Georgetown/Horry Counties and Charleston County. Beaufort County boats tended to target Spanish mackerel, particularly during the summer. There was relatively little effort for other specifically identified fish.

Estimated catch is listed in Table 14. Charterboat fishermen landed about 10% of the overall state catch. The principal species was black sea bass, which accounted for 32% of the total charterboat catch in numbers of fish. Other offshore bottomfish species in aggregate represented 25%. Most of the reported bottomfish landings were made by northern boats during wave 2, when fishing for black sea bass is considered to be at its best.

Coastal pelagic species comprised 33% of the annual charterboat landings. About 79% of this group consisted of mackerels, nearly evenly divided between king and Spanish. Georgetown/Horry County boats brought in 81% of the reported king mackerel catch, while Beaufort County boats landed 92% of the reported Spanish mackerel landings. Catches of both species were greatest in waves 3 and 4. Charterboat landings of kings represented 78% of the total catch of this species, while accounting for 35% of the Spanish mackerel catch. It is interesting to note that shore fishermen caught more Spanish mackerel than did the charterboat anglers.

Catch and effort data for interviewed anglers by wave and area are summarized in Table 15. Most of the trips in the northern counties were all-day outings, while those by Beaufort County boats were usually half-day affairs. The northern boats typically fished offshore for king mackerel and Gulf Stream pelagics, while Beaufort County charters concentrated on Spanish mackerel in near-shore waters. Length of trips and distance offshore were more variable

Table 13. Target species of charterboat anglers by wave and area, in numbers of anglers designating each species.

Species	North	Central	South	Total
		Wave 2		
Anything	69	35	62	166
King mackerel	8	10	0	18
Bluefish	2	6	0	8
Amberjack	0	0	4	4
Dolphin	0	3	0	3
Red drum	0	0	1	1
		Wave 3		
King mackerel	58	26	0	84
Anything	2	5	59	66
Spanish mackerel	0	0	24	24
Sharks	0	0	1	1
		Wave 4		
King mackerel	38	71	10	119
Spanish mackerel	6	0	29	35
Anything	14	0	9	23
Sharks	0	7	0	7
Black sea bass	0	3	0	3
Spotted seatrout	0	0	2	2
		Wave 5		
Anything	25	0	44	69
King mackerel	36	20	0	56
Bluefish	0	0	12	12
Amberjack	0	0	8	8
Spotted seatrout	0	0	4	4
Spanish mackerel	0	0	4	4
Tunas	3	0	0	3
Sharks	0	0	2	2
		Wave 6		
Anything	70	15	0	85
Spotted seatrout	0	12	0	12
King mackerel	2	0	3	5

Table 14. Estimated catch of charterboat anglers by wave, in thousands of fish. Source: NMFS.

Category	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Total
Offshore Pelagics						
Dolphin	<1	-	1	1	-	2
Little tunny/bonitos	1	1	<1	1	1	5
Tunas/other	-	<1	<1	-	-	<1
Offshore Bottomfish						
Black sea bass	80	7	35	15	7	144
Other sea basses	8	-	5	6	-	19
Groupers	1	1	<1	1	1	5
Vermilion Snapper	9	4	12	1	-	26
Other Snappers	3	-	1	1	<1	5
Red porgy	21	5	8	<1	1	36
Other porgies	1	1	-	-	<1	2
Grunts	<1	<1	17	2	1	22
Triggerfish	<1	<1	<1	-	-	1
Coastal Pelagics						
King mackerel	4	22	14	13	4	58
Spanish mackerel	<1	33	19	8	-	60
Bluefish	1	2	<1	16	-	18
Jack crevalle	<1	<1	<1	1	-	1
Blue runner	-	-	<1	-	-	<1
Amberjacks	<1	<1	1	2	<1	5
Barracuda	-	<1	6	1	<1	8
Inshore Sportfish						
Red drum	<1	-	-	1	-	1
Spotted seatrout	-	-	<1	10	<1	11
Weakfish	-	-	-	<1	-	<1
Southern flounder	-	-	<1	-	-	<1
Inshore Bottomfish					-	<1
Kingfishes	-	-	<1	<1	-	<1
Sheepshead	-	-	<1	-		
Miscellaneous						
Sharks	<1	1	3	1	-	5
Skates/rays	-	-	-	1	-	1
Catfishes	<1	-	3	2	-	5
Toadfish	<1	<1	<1	-	<1	1
Pinfish	<1	<1	3	4	2	9
Puffers	-	-	-	1	-	1
Other	1	1	1	-	-	2

Table 15. Charterboat catch and effort of interviewed anglers by wave and area, MRFSS and SFS combined. Catch is in numbers of fish.

	Wave					
	2	3	4	5	6	Total
		Georgetown/Horry Counties				
Hours fished	444.5	304.5	313.0	419.0	185.0	1,666.0
Mean hours/trip	5.6	5.1	5.4	6.5	3.9	5.4
Anglers interviewed	79	60	58	64	72	333
Anglers with no fish	6	13	15	14	46	94
King mackerel	64	110	21	62	62	319
Spanish mackerel	2	5	9	9	0	25
Other pelagics	31	11	14	13	10	79
Black sea bass	1,280	2	127	72	43	1,524
Other bottomfish	734	63	273	56	22	1,148
Sharks	2	0	0	0	1	3
Total catch	2,113	191	444	212	138	3,098
		Charleston County				
Hours fished	141.5	97.5	371.0	109.0	104.0	823.0
Mean hours/trip	2.9	3.1	5.8	5.4	4.3	3.5
Anglers interviewed	54	31	81	20	27	213
Anglers with no fish	27	9	22	11	17	86
King mackerel	3	7	62	2	0	74
Spanish mackerel	0	4	0	4	0	8
Other pelagics	7	7	50	2	0	66
Black sea bass	21	34	87	0	54	196
Other bottomfish	25	1	1	0	0	27
Sharks	0	0	46	1	0	47
Spotted seatrout	0	0	0	0	4	4
Other inshore fish	0	0	1	0	0	1
Total catch	56	53	247	9	58	423
		Beaufort County				
Hours fished	138.0	192.0	142.5	228.5	6.0	707.0
Mean hours/trip	2.9	2.3	2.9	2.8	2.0	2.7
Anglers interviewed	67	84	50	80	3	284
Anglers with no fish	14	17	19	35	2	87
King mackerel	0	0	2	0	0	2
Spanish mackerel	75	163	93	28	0	359
Other Pelagics	1	1	8	81	0	91
Black sea bass	81	0	1	0	0	82
Other bottomfish	4	2	10	21	1	38
Sharks	1	6	11	2	0	20
Spotted seatrout	0	0	3	49	0	52
Red drum	1	0	0	3	0	4
Other inshore fish	1	0	23	20	0	44
Total catch	164	172	151	204	1	692

for Charleston County boats.

Charterboat fishing success is difficult to quantify in meaningful analytical categories because of diversified effort and multi-species catches. Statewide, 32% of the anglers interviewed had caught no fish. The success rate was lowest in Charleston County (60%) and highest (72%) in the northern counties. It progressively declined during the year. In waves 2 and 3, 77% of the fishermen caught something. In waves 4 and 5, 67% of the anglers landed at least one fish. During wave 6, only 36% caught something.

Annual catch rates in fish/angler trip are summarized as follows:

	Georgetown/Horry	Charleston	Beaufort
All pelagic species	1.3	0.7	1.6
All bottomfish species	8.0	1.0	0.4
All species combined	9.3	2.0	2.4

Principal species-specific interest is in king and Spanish mackerel landings. Because of species preferences and seasonal/area distribution of the landings, the most reliable indicator of fishing success for king mackerel was the catch rate by Georgetown/Horry County boats. For the entire year, the catch rate was 0.96 king mackerel/angler trip. Success was highest during wave 3 (1.83 fish/angler trip), followed by wave 5 (0.97 fish/angler trip). Fishing in July and August was markedly less productive (0.36 fish/angler trip). The best index of success for Spanish mackerel was the catch rate of Beaufort County boats in waves 2, 3, and 4. In 1989, this was 1.65 fish/angler trip.

Private Boat Mode

Creel clerks interviewed 1,179 anglers during the MRFSS and collected 88 interviews in SFS sampling (the information in Table 18 includes more anglers because some interviews represented group effort). Nearly all information was collected at public boat landings and no fishermen were interviewed at private access points.

Of the total number of anglers, 31% indicated no species preference and were targeting "anything" (Table 16). The most popular species statewide were red drum and spotted seatrout, each being targeted by 13% of all anglers. At least 5% of the fishermen in each area were seeking each species. Preferences for other species reflected geographic differences. Flounders and spot were each targeted by 7% of all anglers statewide, but were principally sought by fishermen in the northern counties. Six percent of all private boat fishermen sought sharks, although this group was most targeted by Beaufort County fishermen. Sheepshead also were most popular with Beaufort County anglers. King mackerel were most frequently targeted by fishermen in the northern area and Charleston County, while Spanish mackerel were seldom mentioned as principal species sought by fishermen in any area.

The estimated total catch in the private boat mode is listed in Table 17. Inshore bottomfish represented 40%, with spot the most numerous species (28% of the total private boat landings). About 90% of the reported spot catch came from Georgetown and Horry

Table 16. Target species of private boat anglers by wave and area, in numbers of anglers designating each species.

Species	North	Central	South	Total
		Wave 1		
Sheepshead	0	0	11	11
Anything	0	7	3	10
Spotted seatrout	0	7	2	9
Red drum	0	5	3	8
		Wave 2		
Anything	36	27	9	72
Red drum	0	22	12	34
Flounders	18	4	5	27
Sheepshead	0	8	16	24
Black sea bass	3	11	0	14
King mackerel	0	12	0	12
Spotted seatrout	0	4	5	9
Dolphin	0	9	0	9
Black drum	0	0	7	7
Spot	6	0	0	6
Red snapper	0	3	0	3
Spanish mackerel	0	2	0	2
Wahoo	0	2	0	2
Sharks	0	0	2	2
		Wave 3		
Anything	35	38	22	95
King mackerel	21	45	0	66
Flounders	26	11	7	44
Cobia	0	0	39	39
Red drum	18	16	5	39
Sharks	4	9	23	36
Spotted seatrout/trout	0	15	6	21
Spot	20	0	0	20
Blue marlin	0	13	0	13
Red snapper	0	8	0	8
Dolphin	0	7	0	7
Sheepshead	2	1	3	6
Spanish mackerel	1	3	2	6
Black drum	0	0	4	4
Black sea bass	0	4	0	4
Kingfishes	0	3	0	3
Bluefish	1	0	0	1
Spadefish	0	0	1	1

		Wave 4		
Anything	67	98	45	210
Red drum	20	30	24	74
Sharks	10	33	23	66
King mackerel	29	16	6	51
Spotted seatrout/trout	1	29	21	51
Flounders	20	9	6	35
Spanish mackerel	24	4	1	29
Spot	9	2	4	15
Croaker	14	1	0	15
Sheepshead	3	6	5	14
Black sea bass	0	9	0	9
Kingfishes	0	3	2	5
Dolphin	4	0	0	4
Tarpon	1	0	0	1
Bluefish	0	0	1	1
		Wave 5		
Anything	67	14	13	94
Spot	61	0	0	61
Red drum	21	4	28	53
Spotted seatrout/trout	8	8	17	33
Spanish mackerel	7	0	1	8
Flounders	6	1	1	8
King mackerel	6	0	0	6
Sharks	0	0	3	3
Bluefish	0	0	3	3
Sheepshead	0	0	2	2
		Wave 6		
Spotted seatrout	35	57	13	105
Anything	29	23	3	55
Spot	19	0	0	19
Red drum	2	10	2	14
Sheepshead	0	0	6	6
King mackerel	2	0	1	3
Catfish	0	2	0	2
Black drum	0	2	0	2
Flounders	2	0	0	2
Bluefish	0	0	1	1

Table 17. Estimated catch by private boat anglers by wave, in thousands of fish. Source: NMFS.

Category	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Total
Offshore Pelagics						
Dolphin	-	9	<1	-	-	9
Little tunny/bonitos	-	1	1	2	-	4
Tunas/Other	-	2	-	-	-	2
Offshore Bottomfish						
Black sea bass	62	105	44	57	26	295
Other sea basses	-	1	6	2	<1	9
Groupers	<1	1	1	-	-	2
Vermilion snapper	-	2	-	-	-	2
Other snappers	-	1	-	-	-	1
Red porgy	21	14	-	-	-	35
Other porgies	<1	1	<1	<1	-	2
Grunts	-	6	1	21	-	27
Triggerfish	-	4	<1	-	-	4
Coastal Pelagics						
King mackerel	-	6	9	-	<1	15
Spanish mackerel	-	3	27	7	-	37
Bluefish	3	5	24	37	8	76
Jack crevalle	-	1	2	-	-	3
Blue runner	-	-	1	-	-	1
Amberjacks	-	<1	-	<1	-	1
Barracuda	-	1	-	-	-	1
Inshore Sportfish						
Red drum	3	13	22	78	23	139
Spotted seatrout	4	5	18	42	121	191
Weakfish	<1	1	2	<1	<1	4
Summer flounder	1	6	4	2	1	14
Southern flounder	<1	17	10	9	4	40
Flounder	-	4	3	1	-	8
Inshore Bottomfish						
Kingfishes	1	17	35	16	9	79
Spot	36	47	79	397	324	882
Croaker	<1	28	192	33	3	256
Black drum	<1	3	3	2	2	10
Sheepshead	6	4	13	11	17	52
Pompano	-	-	1	-	-	1
Miscellaneous						
Sharks	2	35	46	8	-	90
Skates/rays	-	7	20	4	-	31
Eels	-	2	1	2	2	7
Catfishes	12	42	98	20	-	170
Toadfish	1	18	17	14	5	54
Searobins	-	-	3	<1	-	3
Pigfish	-	-	6	26	5	37
Pinfish	-	30	81	244	108	463
Silver perch	-	-	8	11	1	20
Puffers	1	3	3	29	11	48
Others	<1	11	27	10	1	50

Counties, taken mostly during waves 5 and 6. Croaker was the other major component in this category, landed mostly in the same area during wave 4.

Inshore sportfish accounted for 12% of the private boat catch. The state's two most popular estuarine species, red drum and spotted seatrout, represented about 10% of the overall mode landings. The area distribution of reported red drum landings was relatively uniform, while most of the spotted seatrout catch was made in Charleston County. Red drum catches peaked in wave 5 and those of spotted seatrout in wave 6. Most of the flounder catch came from Georgetown and Horry Counties, particularly the Murrells Inlet area, with landings peaking in waves 3 and 4.

Offshore bottomfish also represented 12% of the overall mode catch. Black sea bass was the dominant species, with peak landings in waves 2 and 3. Charleston, Georgetown, and Horry Counties contributed nearly all of the sea bass landings. The only other species landed in significant quantity was red porgy.

Coastal pelagics comprised 4% of the estimated private boat catch. In contrast to normal years, virtually no king mackerel were reported during the fall and most of the Spanish mackerel were landed during wave 4.

Miscellaneous species constituted about one-third of the mode catch, with pinfish, catfishes, sharks, and toadfish the major components. Shark landings peaked in summer, while pinfish , catfishes, and toadfish provided ample aggravation for anglers during most of the year.

Interview catch and effort data for private boat anglers are summarized in Table 18. Because of the hurricane, the number of interviews for Charleston County during waves 5 and 6 was substantially below normal sample size. This should be kept in mind when reviewing results.

Statewide, 24% of the fishermen reported catching nothing during their trip. The success rate was progressively lower to the south. Fishing was least productive during waves 1 and 2, when half of the anglers caught no fish, and most successful during waves 4 and 5, when only 13-14% of the fishermen caught no fish.

The overall catch rate was 5.6 fish/angler trip, including trips during which nothing was caught. The catch rate was highest during waves 5 (9.6 fish/angler trip) and 6 (6.5 fish/angler trip). The average catch rate was substantially higher in the Georgetown/Horry area (8.3) than in Charleston County (4.8) and Beaufort County (2.6).

Evaluation of species-specific catch rates is complicated by the high percentage of trips targeted at "anything" and the multispecies composition of the catches. Primary interest in this mode is in catch rates for red drum and spotted seatrout. The hurricane greatly reduced sampling during waves 5 and 6, when directed effort for these species normally peaks. There is also indication that environmental conditions from Charleston north were sufficiently affected to displace fish from traditionally fished areas. Because of these constraining factors, no detailed evaluation of species-specific 1989 catch data was attempted.

Table 18. Private boat catch and effort of interviewed anglers by wave and area, MRFSS and SFS combined. Catch is in numbers of fish.

	Wave					
	1-2	3	4	5	6	Total
		Georgetown/Horry				
Hours fished	213.0	409.0	551.5	426.5	368.0	1,968.0
Mean hours/trip	3.5	4.5	5.1	5.2	4.4	4.6
Anglers	63	128	202	176	94	663
Anglers with no fish	37	33	14	6	28	118
King mackerel	0	10	38	0	1	49
Spanish mackerel	0	2	109	12	0	123
Bluefish	7	11	55	72	12	157
Other pelagics	0	6	9	4	0	19
Black sea bass	123	8	40	119	19	309
Other offshore bottomfish	55	6	20	55	4	140
Sharks	1	36	51	13	0	101
Spotted seatrout	0	2	1	23	54	80
Red drum	0	19	26	79	3	127
Summer flounder	0	15	13	4	1	33
Southern flounder	1	32	14	13	3	63
Sheepshead	0	1	5	1	1	8
Spot	92	136	118	953	663	1,962
Croaker	1	88	460	27	6	582
Miscellaneous fish	0	180	520	795	251	1,746
Total catch	280	552	1,479	2,170	1,018	5,499
		Charleston				
Hours fished	288.5	454.0	652.0	97.0	387.0	1,878.5
Mean hours/trip	3.2	4.6	4.6	4.4	4.6	4.3
Anglers	123	174	240	27	94	658
Anglers with no fish	54	28	32	5	28	147
King mackerel	2	18	2	0	0	22
Spanish mackerel	1	9	7	0	0	17
Bluefish	0	6	38	0	0	44
Other pelagics	24	67	3	0	0	94
Black sea bass	97	512	120	6	23	758
Other offshore bottomfish	96	143	15	0	0	254
Sharks	4	25	147	0	0	176
Spotted seatrout	1	14	72	44	168	299
Red drum	18	10	73	10	45	156
Summer flounder	3	6	0	0	0	9
Southern flounder	0	8	16	1	5	30
Sheepshead	13	5	17	13	22	73
Spot	1	18	130	10	11	170
Croaker	2	11	214	50	0	277
Miscellaneous fish	30	203	440	91	44	808
Total catch	292	1,058	1,294	225	318	3,187

	Wave					
	1-2	3	4	5	6	Total
			Beaufort			
Hours fished	212.0	374.5	423.0	184.5	81.5	1,275.5
Mean hours/trip	3.4	4.2	3.8	3.5	3.2	3.8
Anglers	75	112	139	70	26	422
Anglers with no fish	41	47	34	24	12	158
King mackerel	0	0	1	0	0	1
Spanish mackerel	0	2	2	4	0	8
Bluefish	1	0	6	12	5	24
Other pelagics	0	14	10	0	0	24
Black sea bass	21	1	9	10	12	53
Other offshore bottomfish	0	0	2	1	0	3
Sharks	4	57	58	5	0	124
Spotted seatrout	11	6	41	38	29	125
Red drum	4	14	25	99	0	142
Summer flounder	0	0	1	1	1	3
Southern flounder	0	14	16	7	0	37
Sheepshead	35	5	22	13	12	87
Spot	0	0	57	3	0	60
Croaker	0	1	24	2	0	27
Miscellaneous fish	40	97	202	36	3	378
Total catch	116	211	476	231	62	1,096

Length Composition

Average size of red drum retained during 1989 (Fig. 1) was 46.3 cm total length (18.25 in.), compared to 43.3 cm (17.0 in) in 1988. A June-September minimum size limit of 35.6 cm (14.0 in.) was in effect both years. About 14.9% of the total 1989 catch was below this standard. During most of the size limit window, the percentage of undersized red drum was about 16%, identical to the 1988 figure. In the fall, 21% was less than 35.6 cm, compared to 9% in 1988.

Nearly 70% of the 1988 sample was from the fall fishery, compared to only 33% in 1989, due to the hurricane. Had the 1989 sample contained a comparable percentage of fall fish, the average length would probably have been somewhat smaller because the fall red drum typically are relatively small. With the exception of the fall, however, the average seasonal size was larger in 1989, particularly during the summer (49.6 cm vs 41.6 cm in 1988). The percentage of fish greater than 50 cm was comparable in both years during winter (1988 - 71%, 1989 - 75%) and fall (1988 - 19%, 1989 - 18%), but much higher in 1989 during the spring (25% vs 9% in 1988) and summer (42% vs 18% in 1988).

Nearly all of the red drum inspected during the creel census were caught by private boat anglers fishing in inland areas. These estuarine fish were typically one and two year old immature fish and supported the directed South Carolina fishery, which was most intensive during August through November. River fish in particular tended to be quite small during this period. For example, the mean length of red drum catches inspected in the Combahee R. in 1988 (N = 101) was 41.7 cm (16.4 in.), while in 1989 (N = 102) it was 41.0 cm (16.4 in.) (D. Allen, SCWMRD, unpublished data).

The average length of spotted seatrout measured in 1989 (37.7 cm, 14.8 in.) was similar to that in 1988 (36.6 cm, 14.4 in.) and 1987 (37.0 cm, 14.6 in.). There was very little difference in average size by season in both 1988 and 1989 (Fig. 2). About 2% of the annual 1989 catch was below the 30.5 cm (12.0 in.) minimum size limit, the same figure as in 1988.

Southern flounders measured in 1989 averaged 35.0 cm (13.8 in.) (Fig. 3), virtually the same as in 1988 (34.6 cm, 13.6 in.). About 19% of the catch was below 30.5 cm (12.0 in.). Summer flounder measured in 1989 were somewhat larger than those seen in 1988, but small sample sizes in both years preclude meaningful comparisons.

The average fork length (41.2 cm, 16.2 in.) of Spanish mackerel sampled in 1989 (Fig. 4) was comparable to that in 1988 (42.2 cm, 16.6 in.). As in 1988, about 1% of the inspected catch was undersized. The mean fork length of king mackerel (Fig. 5) was 76.7 cm (30.2 in.), virtually identical to that in 1988.

Average length (25.9 cm, 10.2 in.) of black sea bass in 1989 (Fig. 6) was essentially unchanged from that in 1988 (26.5 cm, 10.4 in.). About 12% of the inspected catch was below the legal size (20.3 cm, 8.0 in.).

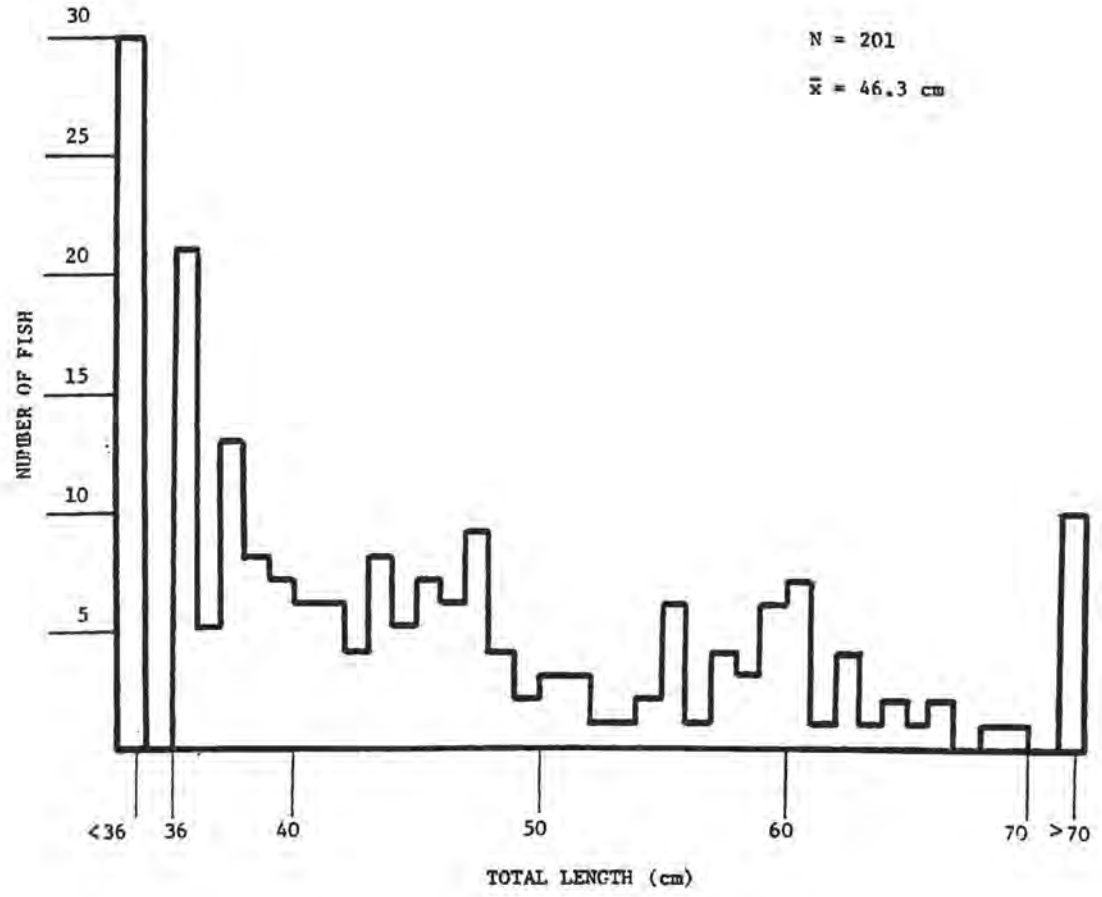

Fig. 1. Length composition of red drum.

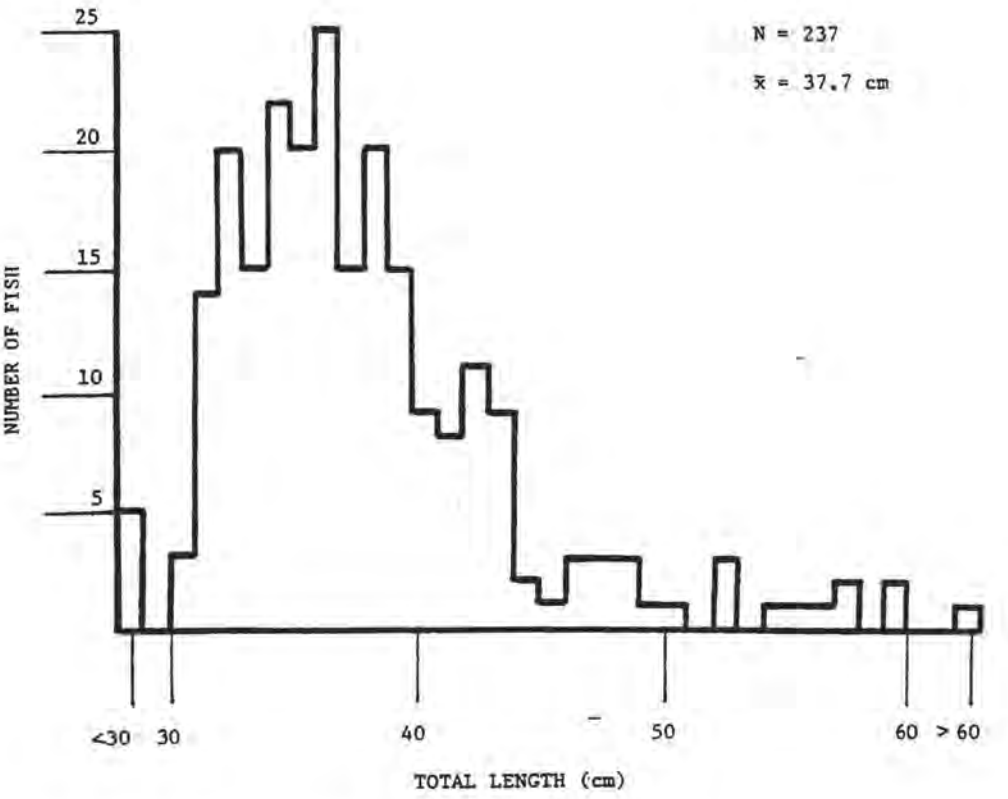

Fig. 2. Length composition of spotted seatrout.

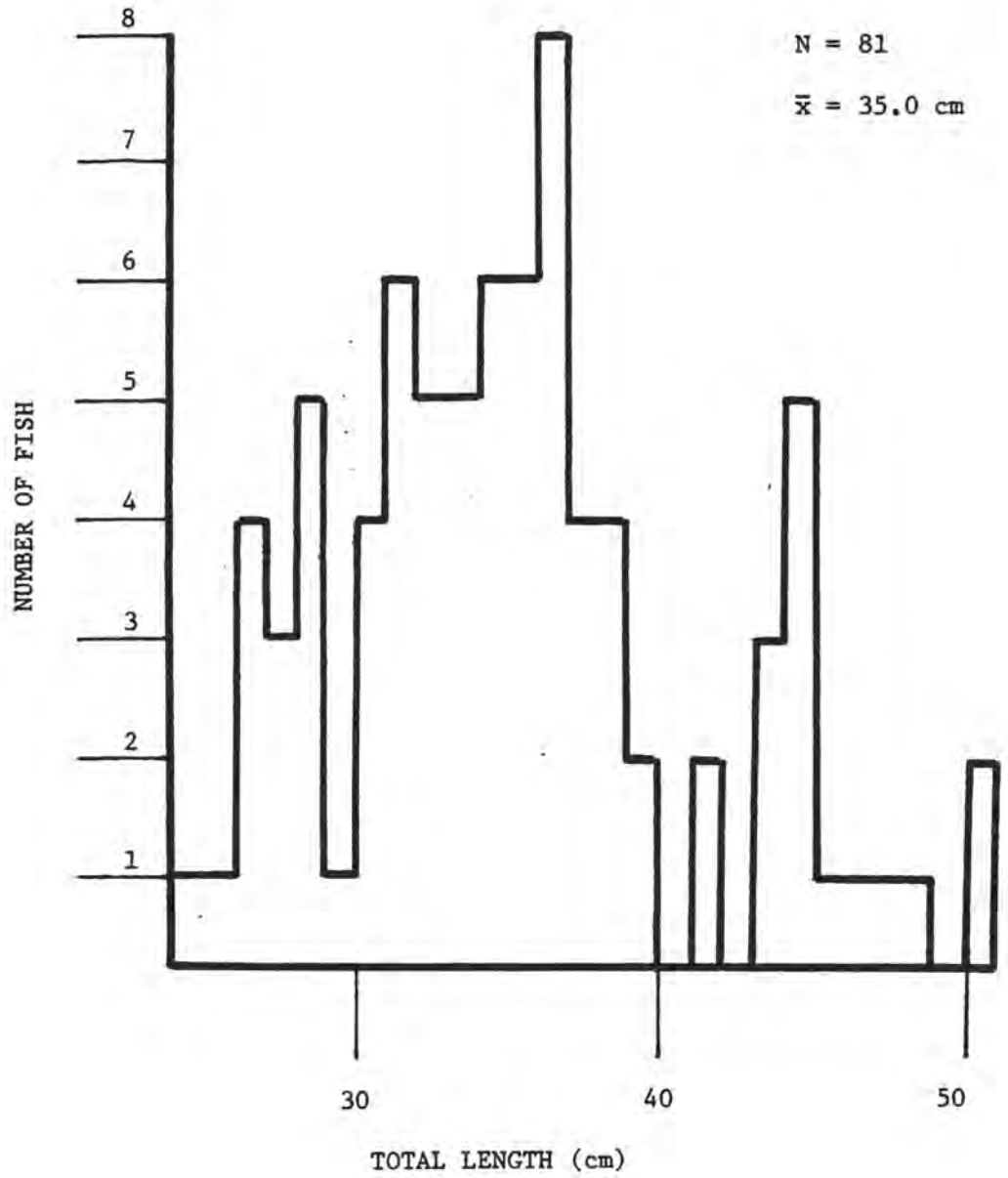

Fig. 3. Length composition of southern flounder.

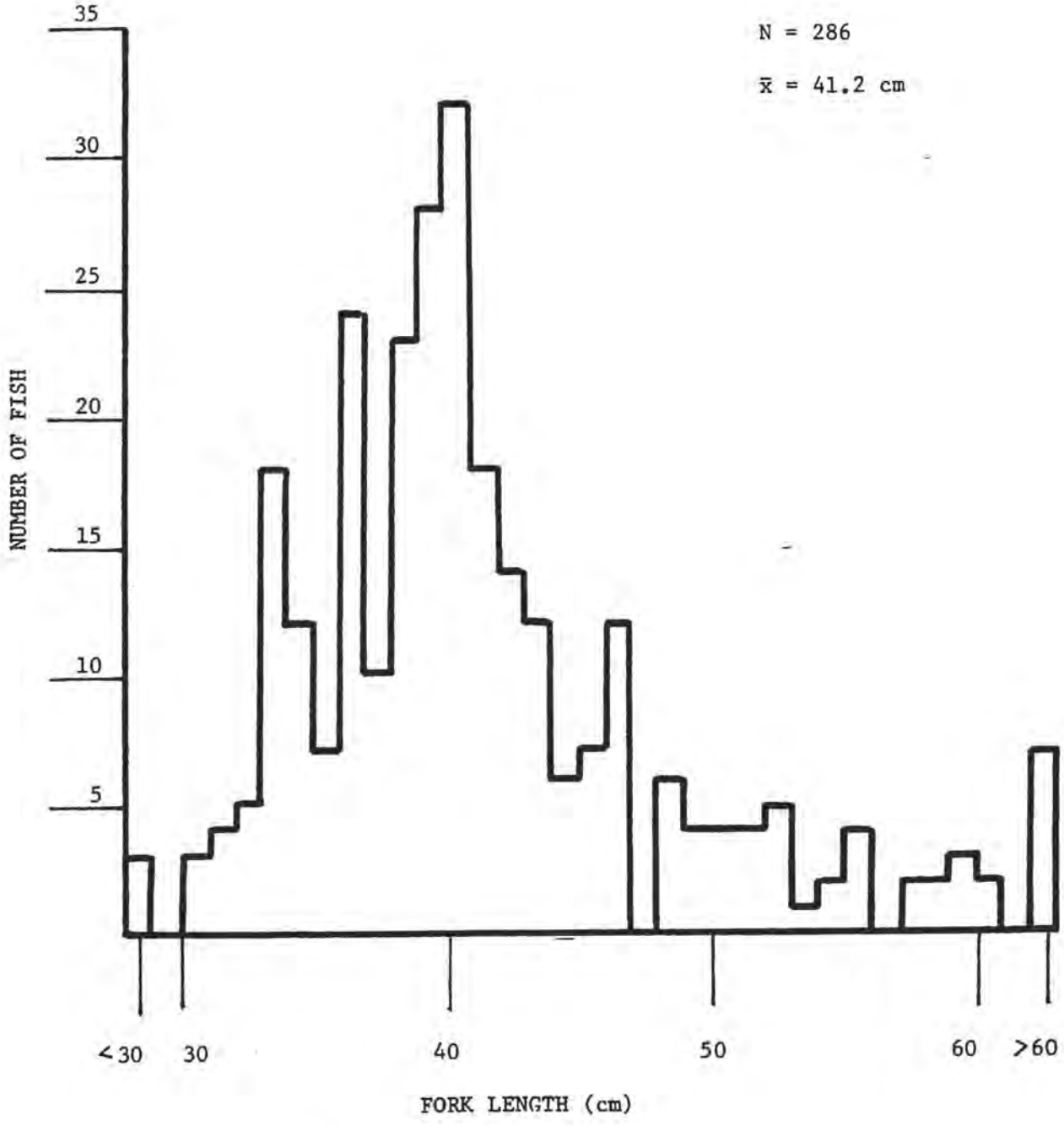

Fig. 4. Length composition of Spanish mackerel.

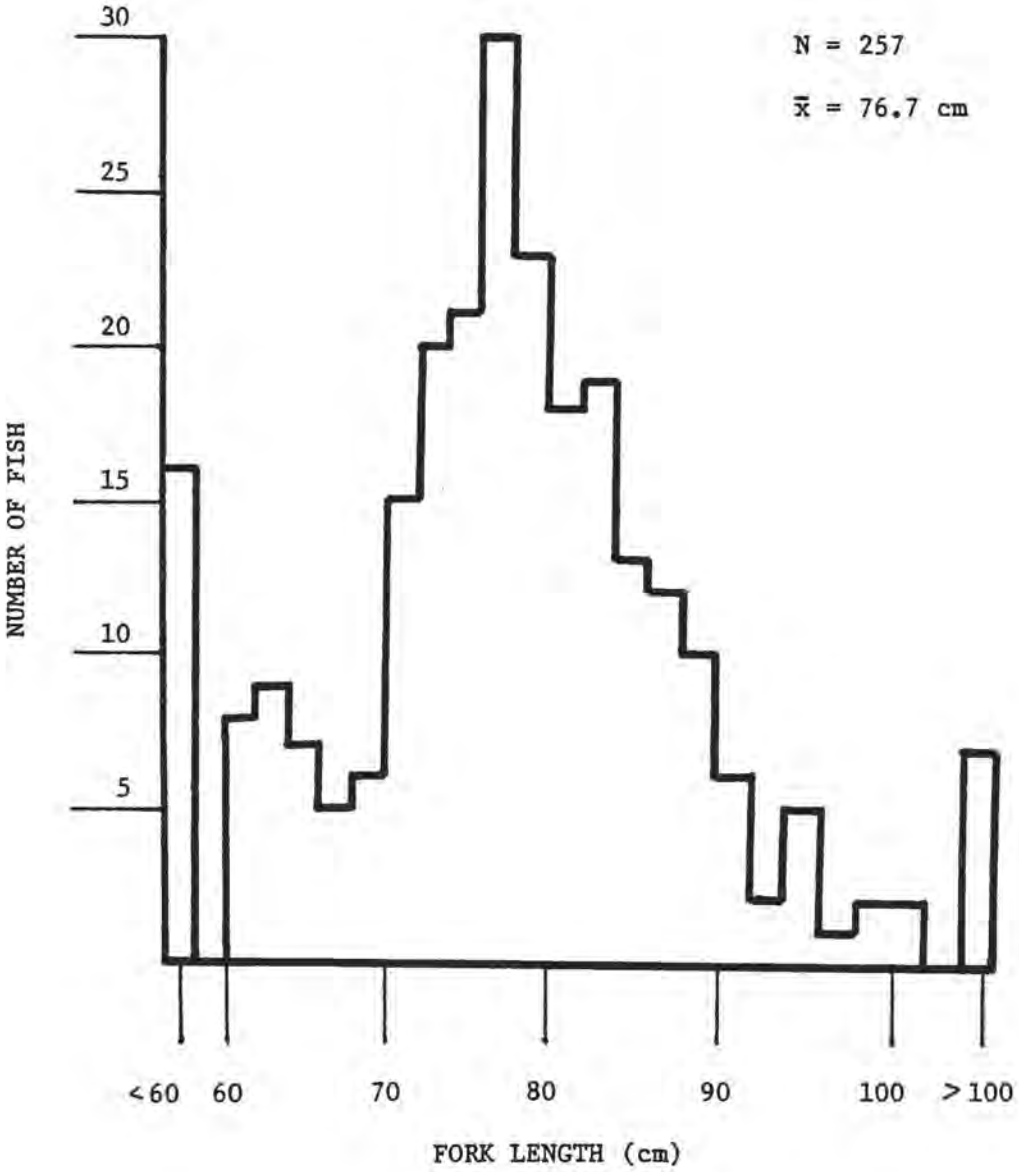

Fig. 5. Length composition of king mackerel.

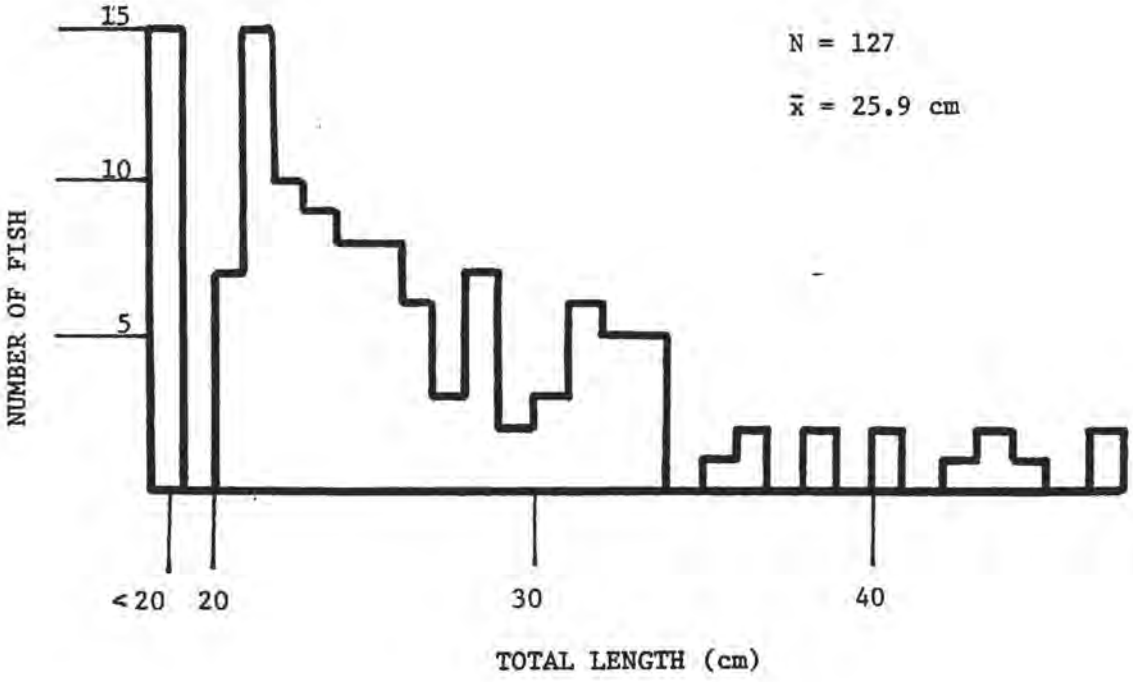

Fig. 6. Length composition of black sea bass.

DISCUSSION

Participation

The estimated percentage (5.9%) of South Carolina coastal households containing at least one person who had gone saltwater fishing in the previous two months was the lowest in three years. This participation rate ranked well below that in neighboring states (North Carolina 7.2%, Georgia 7.6%), whereas in 1988 values were comparable in the three states. Part of the decline could have been attributable to Hurricane Hugo, since the figures for post-storm waves appeared low given the typical popularity of the fall season with pier fishermen and inshore private boat anglers. Nevertheless, the 1989 state rate for waves 2-4 (6.3%) was substantially below that reported in 1988 (11.4%) and 1987 (7.8%) and suggests that the hurricane was not primarily responsible. This observation contradicts the popular assumption that population growth in coastal areas will produce a proportional increase in marine angling participation. It should be noted that regional participation in the South Atlantic area also was lower in 1989 than in 1987 and 1988.

The estimated number of coastal participants has varied widely during the years covered by the MRFSS. Only the 1982 estimate (69,000) was lower than the 1989 figure (72,000). The 1979-1988 average number of coastal residents participating in marine angling was about 145,000. The 1989 estimate was therefore only half of the long-term average. Out of state residents have consistently comprised the largest participation group. Estimates for this group have been much less variable, with a 1979-1988 (1982 and 1984 data deleted as outliers) average of 223,000 anglers. The 1989 estimate was about 67% of this figure.

Effort

Essig et al. (1991) urge caution in the serial analysis of effort data from the MRFSS. Because the telephone survey overestimates effort if an unusually high percentage of households reports large numbers of trips, an adjustment based on historical distribution of effort was initiated in 1987. The figures for recent years are therefore not directly comparable to those for earlier years, when effort may have been overestimated by 15-20%.

The estimate for total South Carolina effort in 1989 was about 57% of the 1984-1988 average, whereas South Atlantic regional effort remained about the same. Coastal residents typically contribute the bulk of the effort, particularly in the private boat mode. Some decline in effort could be expected due to reduced activity by this group after the hurricane. Inland waters in many areas from Charleston north were anoxic for several weeks following the storm. Travel in coastal areas was difficult and access at some points was restricted. All of the Grand Strand piers were destroyed, which eliminated a popular form of shore access during a major activity period. Although few charterboats sustained damage, many were forced to curtail their activity due to damaged dock facilities. Both the piers and charterboats depend primarily on tourists for

their patronage, thus reduction in effort by out of state fishermen in 1989 could have been attributable to the storm.

Examination of effort data by residential category, wave, and mode suggests, however, that the impact of the hurricane was primarily confined to the shore mode. Comparison of 1989 effort with that in 1987/1988 is shown in table 19. Regardless of residential category, post-hurricane effort was down very substantially in the shore mode, much more so than in the waves prior to the storm. This presumably reflected the loss of the piers.

Charterboat effort, in contrast, was up after the storm more so than before it. The relatively small increase by out of state fishermen could be expected given the publicity surrounding the storm's aftermath. Effort in the private boat mode was consistently lower regardless of time frame or residency of participants. There was no substantial difference between coastal residents and those from other areas. The main factor here is that the percentage declines were comparable (particularly for state residents) before and after Hugo. Thus, with the exception of the charterboat mode, there was a substantial decline in fishing effort in 1989 even before the storm and the percentage changes after the storm were not appreciably different from those before it.

Catch

MRFSS catch estimates are vulnerable to large sampling errors associated with the numbers 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. Large changes in species estimates may reflect inclusion of unusually large catches by one or a few anglers. This has been a problem with the shore mode, particularly catches of spot (Low and Waltz 1988).

When particular species are of interest, correct identification is essential. Misidentification and confusion over common names can cause gross errors in the estimated landings of similar species. Only catches inspected by the creel clerks can be reliably verified as to species identity. For species that are commonly released or discarded, the estimated total landings can be well off the mark. Catches of some species are likely underestimated because they are targeted and/or caught primarily by anglers not likely to be intercepted by the MRFSS. For example, tournaments contribute significantly to landings of offshore pelagic species (e.g. wahoo, dolphin, and tunas) but tournament anglers are not included in the sampling.

These factors should be kept in mind when evaluating results from the MRFSS. The absolute catch figures for many species or groups were probably rather meaningless. For the most frequently caught fishes, the relative rankings and long-term trends in catch were probably fairly realistic.

The estimated total catch of all species combined was the lowest since the MRFSS began. Reduced effort in the shore and private boat modes, both before and following the hurricane, appeared to be the principal causative factor. Subsequent

Table 19. Percentage changes in effort category, 1989 vs the 1987/1988 averages.

Residential category	Waves	Shore mode	Charterboat mode	Private boat mode
Coastal	2-4	-28	-15	-28
	5-6	-73	+43	-29
Non-coastal	2-4	-44	-17	-37
	5-6	-85	+23	-41
Out of state	2-4	-17	+54	-62
	5-6	-73	+6	-41

evaluation has indicated that relatively few fish were killed by the storm and displacements due to environmental conditions were temporary.

The most abundant species caught in the FCZ (3-200 miles offshore) was the black sea bass. In most years, this has been the second most numerous fish (after spot) landed by South Carolina anglers. In 1989, there was a regionwide decrease in landings of black sea bass as well as in South Carolina, although this probably did not reflect abundance. Very few anglers indicated that black sea bass was their target species. With the increasing availability of sophisticated offshore fishing equipment, growing emphasis on large species such as king mackerel and sharks, and greater abundance of nearshore sport fish such as Spanish mackerel, it is likely that directed effort for black sea bass has decreased in recent years. An obvious factor to be considered in comparing contemporary landings with catches during the early years of the MRFSS was that headboat sampling was eliminated in 1986 and annual totals since then have not included headboat catches, which account for a large percentage of the overall landings of this species.

The most popular species sought by South Carolina anglers fishing in the ocean was the king mackerel. Landings in 1989 were the second lowest in the last ten years and reflected the general decline in regional landings since the early 1980's (Essig et al. 1991). The recreational fishery was closed during March but, since there would have been mininimal directed effort in that month, the effect on annual landings was negligible. Charterboat success, particularly in the northern area, was probably the best index of the status of the state's king mackerel fishery. Anecdotal information indicated that the May/June coastal run was weaker than in 1988 and the charterboat catch rate data (fish/angler trip) support that observation.

Wave 3 catch rates of king mackerel

Area	1988	1989
Georgetown/Horry Counties	2.3	1.8
Charleston County	0.3	0.2
Beaufort County	0.1	0

September through November is also a peak period for king mackerel landings. After the hurricane, nearshore waters were turbid with abnormal temperature regimes and king mackerel were reported scarce. Charterboat catch rates in waves 5 and 6 were appreciably lower than in 1988.

Waves 5 and 6 catch rates of king mackerel

Area	1988	1989
Georgetown/Horry Counties	1.5	0.9
Charleston County	0.7	<0.1
Beaufort County	<0.1	0

In contrast, landings of Spanish mackerel and bluefish were well above average. Although the Spanish mackerel fishery was closed until April 1, this had very little impact on annual landings due to low availability in South Carolina waters early in the year. Both Spanish mackerel and bluefish were targeted primarily during spring and summer, when the bulk of the annual catch was landed, and the hurricane therefore had relatively little impact on overall landings. Contrary to popular perception, shore fishermen caught more of both species than did either charterboat or private boat anglers.

Flounder landings also peaked during the summer and should not have been materially affected by the storm. Landings of both summer and southern flounder were down significantly from the 1988 level. The reduced catch of summer flounder probably reflected the severely depressed stock status throughout its range in 1989. Landings from Massachusetts through North Carolina were down markedly and the intensive summer fishery in the New York Bight virtually collapsed. The southern flounder stock is believed to be comparatively lightly exploited, yet the catch of this species was also down with no obvious explanation.

Spot and kingfishes (whitings) are normally a major component of inshore catches. Landings of both in 1989 were well below the 1988 figures. These species are major contributors to catches on the Grand Strand piers and elimination of the pier fishery by the hurricane probably contributed significantly to the decline.

In 1989, charterboat fishermen generally did not do as well as in the previous year, although trends remained similar. The overall catch rate (5.1 fish/angler trip) was slightly below the regional average (5.5). Results are summarized below for comparative purposes. "Pelagics" includes king mackerel. Catch rates were calculated as the total number of fish divided by the total number of anglers.

	1988			1989		
Catch/angler	North	Central	South	North	Central	South
Pelagics	2.3	0.9	1.5	1.3	0.7	1.6
Bottomfish	4.5	1.9	0.9	8.0	1.0	0.4
Anglers with no fish	6%	33%	32%	28%	40%	31%

Perhaps the most obvious difference was in the percentage of anglers in the northern counties who caught no fish. The high figure for 1989 was attributable to the large percentage of unsuccessful anglers during wave 6. This may have partly reflected differences in the availability of king mackerel due to the hurricane. Those few anglers who did catch kings did very well. This is not unusual with a schooling species; catch rates once fish are located tend to be similarly high and it is the differential availability of the schools that is reflected in the overall catch per effort.

Private boat anglers generally fared somewhat better in 1989 than in 1988, despite the effects of the hurricane. The overall catch rate (5.6 fish/angler trip) was higher than the regional

average (4.6). Catch rates, calculated as the total number of fish divided by the total number of trips, were as follows.

	Waves 1-4					
	1988			1989		
Catch/angler	North	Central	South	North	Central	South
Red drum and spotted seatrout	0.2	0.7	0.3	0.1	0.4	0.3
All species	4.2	2.5	3.3	5.9	4.9	2.5
Anglers with no fish	42%	50%	43%	21%	21%	37%

	Waves 5-6					
	1988			1989		
Catch/angler	North	Central	South	North	Central	South
Red drum and spotted seatrout	0.4	1.6	2.2	0.6	2.2	1.7
All species	7.2	4.6	3.9	11.8	4.5	3.1
Anglers with no fish	30%	30%	40%	13%	27%	38%

In 1989 prior to the hurricane, private boat fishermen generally had lower catch rates of red drum and spotted seatrout than in 1988, but fared somewhat better on other species and a higher percentage of anglers was successful. After the hurricane, the catch rate of red drum and spotted seatrout was appreciably higher than in 1988 in the areas most impacted by the storm. The percentage of anglers catching no fish was also somewhat lower. The annual CPUE index for red drum was slightly below the 1979-1988 average, which does suggest that lower abundance as well as reduced effort contributed to the reduced landings. Regional landings of spotted seatrout were above average in 1987 and 1988, but decreased in 1989. The same trend was evident in South Carolina, despite a very mild preceding winter. The catch rate index was a little below the long-term average, which implies that abundance was also slightly below normal.

Length composition

The catch of red drum was dominated by fish barely over the legal size limit of 35.6 cm (14.0 in.). This was particularly true in the rivers and inner estuarine areas. Any substantial increase in the minimum size limit (for example, to 45.7 cm or 18.0 in.) would greatly reduce the retainable catch, with questionable biological benefit. The fishery depends heavily on new recruitment, with most of the incoming cohort reaching legal size in September through November in typical years. If a substantially larger size limit was in place, the legally retainable portion of the fall catch in a normal year would be relatively minor until very late in the season. For whatever reason, the remaining component of the cohort is not a prominent contributor to catches in subsequent years. Extension of the 35.6 cm (14.0 in.) limit to year round would conserve small fish without excessively restricting the fall landings and this action was taken in the 1990 legislative session.

The year round 30.5 cm (12.0 in.) minimum size limit on spotted

seatrout appeared to be observed by most anglers with only 2% of the inspected catch being undersized. One trend that is similar to that elsewhere has been the year-to-year consistency in average size, regardless of regulations or abundance. In most of the southeast, the annual mean size of spotted seatrout landed by recreational anglers has been slightly over one pound, equivalent to a 35.6 - 38.1 cm (14.0 - 15.0 in.) fish, with very little geographic variation. Annual landings have fluctuated similarly in most of the region, being high after mild winters and depressed following severe freezes. This suggests that stock status in South Carolina is primarily determined by regional climatic conditions rather than localized fishery-dependent factors.

Average length of other species subject to size limits showed very little change from recent years and remained at least 20% above the legal minimum. This indicates that growth overfishing is not an imminent problem.

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