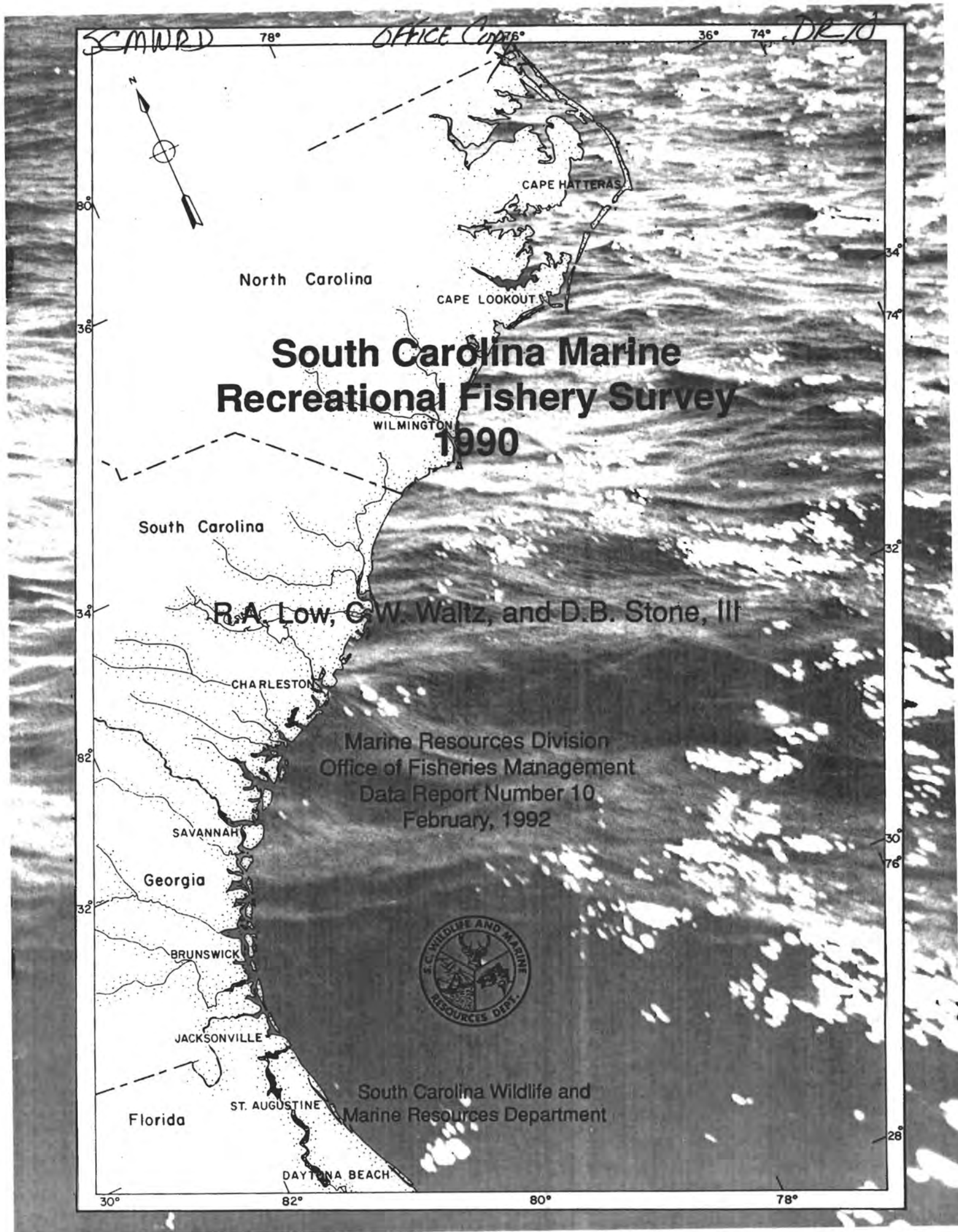
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CHARLESTON
Marine Resources Division
Office of Fisheries Management
Data Report Number 10
February, 1992
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Georgia
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South Carolina Wildlife and
Marine Resources Department
ST. AUGUSTINE
Florida
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DAYTONA BEACH
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SOUTH CAROLINA MARINE RECREATIONAL FISHERY SURVEY, 1990

R.A. Low, C.W. Waltz, and D.B. Stone, III

Office of Fisheries Management

Marine Resources Division

South Carolina Wildlife and Marine Resources Department

February, 1992

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ACKNOWLEDGMENTS

Urbie West, Harvey Atwater, and Billy Glenn devoted many tedious hours to the creel census. Mary Jo Clise rendered valuable assistance in producing summary data tables from computerized files. Joanna Walling typed the report. We gratefully acknowledge assistance from the staffs at KCA and NMFS Washington office in various aspects of the project. This project (F-29) was conducted in cooperation with the Department of the Interior, U.S. Fish and Wildlife Service and funded in part (75% of total costs) by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777 - 777K).

INTRODUCTION

Recreational fishing is a popular marine activity in coastal South Carolina. One of the principal responsibilities of the Marine Resources Division (MRD) is management of recreational fisheries. Effective management requires an extensive data base on both the resources and their usage. MRD's Fisheries Statistics Program is primarily responsible for the collection, compilation, analysis, and distribution of fishery-dependent information for the marine recreational fisheries.

The principal instrument used to obtain such information is the Marine Recreational Fishery Statistics Survey (MRFSS), conducted annually in cooperation with the National Marine Fisheries Service (NMFS). This regional survey was initiated in 1979 and has two components. A telephone poll of coastal households is used to obtain information on participation and effort with an on-site intercept survey (creel census) employed 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. Headboat fishermen are not interviewed because catch and effort data for the headboat fishery are collected during an independent NMFS survey. Fishermen using gear other than hook and line are seldom encountered. MRFSS results therefore do not pertain to activities such as gill netting, gigging, and spearfishing.

MRD has performed the South Carolina creel census since July, 1987. Additional catch and effort data are collected in a State Finfish Survey (SFS) using procedures similar to those of the MRFSS. During 1990, most SFS effort was targeted at private boat fishermen fishing in estuarine waters. This report describes procedures and results of these surveys for 1990. Information for 1985-1989 is contained in a series of similar reports listed in the References section. There are no comprehensive sources of such data for earlier years.

METHODOLOGY

MRFSS procedures for the telephone and intercept surveys are described in Essig et al. (1991) and Low and Waltz (1988). Other than minor changes to questions on the survey forms, these procedures have remained the same since 1987. MRD personnel conducted the 1990 MRFSS creel census at 19 sites utilized by shore-based anglers, 15 charterboat docks, and 37 public boat ramps or landings (Table 1). The sampling schedule, provided by the NMFS subcontractor (KCA Research, Inc.), was based on historical usage 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. The private boat assignments were divided approximately equally between Beaufort County, Charleston County, and the Georgetown/Horry County area. About 60% of the sampling effort was assigned to weekend days

Table 1. Site list for the 1990 MRFSS by county and mode.

County	Shore	Charterboat	Private boat
Beaufort	Battery Creek, Port Royal	Blue Water Marina, Hilton Head	All Joy Landing, Bluffton
	Harbor River bridge Hunting Is.	Harbor Town Marina, Calibogue Sound	Harbor Town Marina, Calibogue Sound
	C.C. Haigh, Jr. recreational area Pinckney Is.	Beaufort Marina, Beaufort	E.C. Glenn Landing, Chechessee River
	Paradise Pier, Hunting Is.	Factory Creek Marina, Factory Creek	Battery Creek Landing, Port Royal
		Shelter Cove Marina, Hilton Head	Station Royal, Battery Creek
		Hudson Seafood Dock, Hilton Head	Sam's Point, Lucy Creek
			Gray's Hill Intracoastal Wwy.
			Bush Island Landing, Harbor River
			Fripp Is. Marina, Fripp Island
			C.C. Haigh Landing, Pinckney Island
			Shelter Cove Marina, Hilton Head
			Broad R. Landing, Broad R. bridge
			Russ Pt. Landing, Hunting Island
			Fort Frederick, Port Royal
			Hudson Seafood Dock, Hilton Head
Colleton			Bennett's Point, Ashepoo River
Charleston	Limehouse Pier, Johns Island	Charleston Marina, Charleston	R. Hendricks Ldg., N. Charleston

County	Shore	Charterboat	Private boat
	Wappoo Cut Ldg., Charleston	Wild Dunes Yacht Club, Isle of Palms	Shem Cr. Ldg., Mt. Pleasant
	Riverland Ldg., James Island	Bohicket Marina Seabrook Is.	Remley Pt. Ldg., Mt. Pleasant
	Church Cr. bridge, Johns Island		Charleston Marina, Charleston
	County Park, Folly Beach		Paradise Is. Ldg., Wando R.
	Battery Park, Charleston		Sol Legare Ldg., Battery Island
	Breach Inlet, Isle of Palms		Folly R. Ldg., Folly Beach
	Pitt St. bridge, Mt. Pleasant		Wappoo Cut Ldg., Charleston
	Bowens Id. Dock, Bowens Island		Dawhoo R. Ldg., Edisto Island
	Crosby Pier, Folly Beach		Wild Dunes Marina, Isle of Palms
			Bohicket Marina, Seabrook Is.
			Steamboat Ldg., Edisto Island
			County Farm Ldg., N. Charleston
			Live Oak Ldg., Edisto Island
			Bowens Island, Bowens Island
			Folly Marina, Folly Beach
Georgetown	Pawleys Id. Midway Inlet	Capt. Dick's Marina, Murrells Inlet	Marlin Quay, Garden City
	Murrells Inl. jetties	Georgetown Marina, Georgetown	South Is. Ferry, Georgetown

and 40% to weekdays. There was no nighttime sampling and most interview periods were 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, he proceeded to the nearest alternative location for that mode. The clerk usually remained at the site until the day's MRFSS interview quota was obtained or further effort appeared unwarranted. SFS sampling followed similar procedures, the principal exception being that site assignments were determined by MRD. SFS sampling was targeted at private boat anglers fishing in estuarine waters for red drum and spotted seatrout, therefore most of the SFS interviewing was conducted at sites frequented by such fishermen. SFS interviews were collected at locations listed in Table 2.

Interviews were conducted in accordance with procedures and guidelines described in KCA's Intercept Interviewer Training Manual (1990 edition), using the appropriate survey forms. Except for beach/bank fishermen, those interviewed had completed their fishing. To be eligible for an incomplete trip interview the beach/bank fishermen must have completed at least one third of his or her fishing trip. An MRFSS interview pertained to an individual fisherman, with all members of a fishing party usually being interviewed (there were some exceptions with charterboat groups). An SFS interview generally applied to a group of anglers and constituted a trip interview rather than an individual one. Responses in both surveys were voluntary and all information was confidential as to personal identity.

Routinely obtained information included the number of anglers in the party, 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, released alive, given away, or used for bait). 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 fishing party (e.g. on charterboats) and anglers didn't recall how many fish they had caught individually, the group catch was divided by the number of fishermen to obtain catch rates. It should be emphasized that the numbers and kinds of fish not inspected by the creel clerks (e.g. released and discarded catches) could not be verified.

MRD coded and edited MRFSS interview forms and forwarded them to KCA for processing. Information for this survey was subsequently provided by KCA and NMFS Washington, D.C. office and its accuracy is therefore their responsibility. This applies to estimates of total catch, participation, and effort and wave/mode estimates (i.e., those based on expanded data). Summaries of sampling data were provided by KCA or compiled locally. All data from the SFS were processed by MRD.

RESULTS

Essig et al. (1991) described considerations pertinent to interpretation of results from the MRFSS, e.g. sources of variation and their implications, potential elements of bias, and possible effects of data adjustments. Most of these apply to the South

Table 2. Site list for the 1990 State Finfish Survey (SFS) by county and mode.

County	Shore	Charterboat	Private boat
Beaufort		Shelter Cove Marina, Hilton Head	C.C. Haigh landing, Pinckney Island
		Harbor Town Marina, Calibogue Sound	Port Royal landing, Battery Creek
			Russ Point landing, Hunting Island
			Broad River landing
Colleton			Bennetts Point
Charleston	Breach Inlet, Sullivan's Island		Remleys Point landing, Mt. Pleasant
	Remleys Point pier, Mt. Pleasant		Wild Dunes Yacht Club, Isle of Palms
	Folly Beach, Folly Island		Wappoo Cut landing, Charleston
	Capt. Sam's, Kiawah Island		Shem Creek landing, Mt. Pleasant
	Church Creek bridge, Johns Island		City Marina, Charleston
	Limehouse pier, Johns Island		Folly River landing, Folly Beach
	Crosby's pier, Charleston		Limehouse landing, Johns Island
	Riverland Terrace landing, James Island		Folly Marina, Folly Beach
Georgetown	South Island Ferry landing, Georgetown		South Island Ferry landing, Georgetown
			Murrells Inlet landing, Murrells Inlet
Horry	Surfside pier, Surfside Beach		

Carolina survey results and are mentioned where appropriate.

Survey Logistics

A total of 1,615 interviews were collected during the MRFSS, distributed by wave and mode as indicated in Table 3. Almost half of the field work time was expended in travel. Shore mode interviews required the greatest average amount of census effort, particularly during waves 2 and 6. The average amount of effort required to obtain charterboat interviews was substantially higher after October, when seasonal activity declined.

About 61% of the MRFSS interviews were obtained on weekends (Table 4). Most charterboat interviews (64%) were collected on weekdays. In the other modes, the majority was obtained from weekend sampling, particularly in waves 2 and 3. Most of the fishermen interviewed had completed their trips in the afternoon (Table 5), with 1500-1800 being the most productive time interval for obtaining interviews.

An additional 244 interviews were collected during the SFS (Table 6). About 82% of these were attributable to private boat fishermen, with Charleston County sites accounting for the majority.

Annual Overview

One of the questions asked during the phone survey was used to determine the percentage of coastal households that contained a member who went saltwater fishing during the wave. Table 7 contains the results for 1987-1990. In 1990, fishing households had an average of 1.47 marine anglers (Kubota et al. 1991).

About 61% of all fishermen interviewed in the MRFSS were coastal county (South Carolina) residents, 11% were from noncoastal counties, and 28% were from out of state (Table 8). The charterboat mode accounted for most of the latter category; 71% of the charterboat fishermen interviewed were non-residents of South Carolina. A substantial portion (30%) of the shore anglers, particularly those interviewed on the piers, was also from out of state. Coastal residents predominated among private boat anglers (78% of those interviewed). Based on expansion of these data with results from the phone survey, total estimated participation for the year was 408,000 anglers, including 189,000 coastal residents, 52,000 non-coastal residents, and 166,000 out of state fishermen (Table 9).

Estimated total effort for the year was 900,420 trips, distributed by wave, mode, and residential category as shown in Table 10. Coastal residents accounted for 580,177 trips, about 64% of the total effort. About 11% (94,534 trips) was contributed by non-coastal state residents. Anglers from out of state made an estimated 225,706 trips, 25% of the total effort.

About 54% of the estimated total effort was expended in the private boat mode, with coastal residents accounting for 78% of this mode's activity. Out of state fishermen contributed 13% of the private boat trips and non-coastal residents 9%. Shore fishing trips accounted for 36% of all effort. Coastal residents were the major contributors, making 59% of the trips. Out of state anglers

Table 3. MRFSS creel census logistics. Source: KCA final wave reports.

Wave	Mode	Sites	Interviews	Total effort hours	Travel miles
2	Shore	8	38	21.8	-
(Mar/Apr)	Charterboat	10	98	32.2	-
	Private boat	23	250	108.3	-
	Total		386	162.3	4,248
3	Shore	8	68	29.0	-
(May/Jun)	Charterboat	5	126	25.5	-
	Private boat	18	408	120.5	-
	Total		602	175.0	4,071
4	Shore	4	55	17.0	-
(Jul/Aug)	Charterboat	4	46	7.5	-
	Private boat	33	137	123.0	-
	Total		238	147.5	4,678
5	Shore	6	57	16.8	-
(Sep/Oct)	Charterboat	4	46	8.2	-
	Private boat	10	94	37.2	-
	Total		197	62.2	2,219
6	Shore	10	48	39.5	-
(Nov/Dec)	Charterboat	9	41	20.0	-
	Private boat	14	103	53.8	-
	Total		192	113.3	4,214
Annual	Shore	19	266	124.0	-
	Charterboat	15	357	93.5	-
	Private boat	37	992	442.8	-
	Total		1,615	660.3	19,430

Table 4. Distribution of MRFSS interviews by wave, mode, and time of week. Source: KCA final wave reports.

	Number of interviews obtained					
	Shore		Charterboat		Private boat	
Wave	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday
2	32	6	58	40	187	63
3	56	12	36	90	338	70
4	22	33	12	34	64	73
5	26	31	7	39	60	34
6	23	25	17	24	53	50
Total	159	107	130	227	702	290

Table 5. Distribution of MRFSS interviews by wave, mode, and time of day. Source: KCA final wave reports. NA - not available.

		Number of interviews obtained			
Mode	Wave	0900-1200	1200-1500	1500-1800	1800-2100
Shore	2	NA	NA	NA	NA
	3	0	15	51	2
	4	8	20	27	0
	5	0	31	26	0
	6	2	43	3	0
Charterboat	2	NA	NA	NA	NA
	3	1	52	52	21
	4	1	30	15	0
	5	1	29	16	0
	6	0	23	18	0
Private boat	2	NA	NA	NA	NA
	3	0	115	273	20
	4	1	73	63	0
	5	6	33	55	0
	6	4	60	39	0

Table 6. SFS effort by wave, mode, and county.

Wave	Mode	County	Interviews
MAR/APR	Shore	Charleston	3
	Charterboat	Beaufort	5
	Private boat	Charleston	3
MAY/JUN	Private boat	Charleston	22
		Georgetown	1
JUL/AUG	Shore	Charleston	16
		Horry	6
	Charterboat	Beaufort	2
	Private boat	Beaufort	19
		Charleston	58
		Georgetown	4
SEP/OCT	Shore	Georgetown	1
	Private boat	Beaufort	1
		Colleton	1
		Charleston	8
		Georgetown	27
NOV/DEC	Shore	Charleston	18
	Private boat	Colleton	1
		Charleston	44
		Georgetown	10

Table 7. Percentage of households containing a member who went fishing in the last two months (i.e., during the indicated wave). Source: Kubota et al (1991)

Year	Wave 2	3	4	5	6
1987	5.9	9.4	6.8	9.1	8.4
1988	7.0	6.7	10.2	NA	NA
1989	7.5	5.5	7.1	5.7	5.1
1990	5.6	7.6	5.6	6.7	5.7

Table 8. Residency of anglers interviewed in the MRFSS, by wave and mode. C - coastal S.C., NC - noncoastal S.C., OOS - out of state resident. Figures are numbers of fishermen.
Source: KCA final wave reports.

	Shore			Charter boat			Private boat		
Wave	C	NC	OOS	C	NC	OOS	C	NC	OOS
2	23	4	11	4	22	73	209	18	25
3	45	7	16	6	15	103	315	39	54
4	32	7	16	4	12	30	105	13	19
5	35	4	16	13	4	23	69	10	15
6	25	3	19	14	9	16	75	20	8
Total	161	25	80	43	62	252	773	99	121

Table 9. Estimated participation in the South Carolina marine recreational fishery in 1990 (from preliminary data provided by NMFS).

Wave	Coastal residents	Non-coastal residents	Out-of-state residents	Total
1	----------	No estimate	----------	----------
2	35,000	12,000	47,000	94,000
3	25,000	6,000	29,000	61,000
4	60,000	19,000	43,000	122,000
5	47,000	10,000	28,000	85,000
6	22,000	5,000	19,000	46,000
Total	189,000	52,000	166,000	408,000

Table 10. Estimated effort (number of trips) by wave, mode, and residential category Source: NMFS.

Mode	Coastal residents	Non-coastal residents	Out of state residents
	Wave 2		
Shore	56,868	9,890	27,198
Charterboat	940	5,172	16,926
Private boat	90,748	6,947	10,855
	Wave 3		
Shore	23,667	3,682	8,415
Charterboat	1,839	3,449	23,682
Private boat	42,226	5,228	7,239
	Wave 4		
Shore	39,070	8,547	19,535
Charterboat	2,270	6,811	17,027
Private boat	130,454	16,151	23,606
	Wave 5		
Shore	30,636	3,501	15,756
Charterboat	2,024	623	4,516
Private boat	72,494	10,506	15,760
	Wave 6		
Shore	39,606	4,570	28,943
Charterboat	1,277	821	1,642
Private boat	46,058	8,636	4,606

made 31% of the shore trips and non-coastal residents 10%. Most (72%) of the charterboat effort was by out of state fishermen. About 19% was attributable to non-coastal residents and 9% of the trips were made by coastal residents.

Seasonal distribution of effort varied according to mode. Overall, wave 4 (July-August) was the peak activity period, with 29% of all estimated effort in this interval. Private boat effort was substantially greater in wave 4 than in other intervals. Wave 2 (March-April) was the next most popular interval (25% of total effort). The least active interval was wave 3 (May-June), when there was the least amount of shore and private boat effort. This was, however, the most popular period for charterboat fishing, with 33% of the total charterboat effort expended in wave 3.

Compared to the 1987-1989 period, the relative distribution of shore effort was substantially greater in waves 2 and 6 with a pronounced decrease in wave 5. In the charterboat mode, there also was a very substantial decline in the percentage of effort expended in wave 5. Private boat effort was relatively lower in waves 3 and 6 and higher in wave 2. Coastal residents expended a much higher percentage of their effort during wave 2 than in previous years and less in wave 3; the same pattern was also true for non-coastal anglers. The relative distribution of effort by out of state residents was also much higher in wave 2 and appreciably down in wave 5.

Three-quarters of the fishermen interviewed during the MRFSS had fished in state waters (i.e., inland and out to three miles offshore) (Table 11). Of the 25% who had fished in the FCZ (3-200 miles offshore), 79% were charterboat fishermen. Only 11% of the charterboat fishermen had fished in state waters (89% in the FCZ). The vast majority (86%) of the private boat fishermen interviewed had fished in inland (estuarine) areas and only 9% had been in the FCZ.

Table 12 shows the average duration of fishing trips by wave and mode and the average number of days fished per angler during the previous 12 months. Figures in the latter category varied greatly depending on season but those indicated for wave 6 could be considered a proxy for the calendar year. These values appear high (particularly in the charterboat mode, where sampling error or an artifact due to small sample size is suspected) when compared to results from the SFS. For example, in response to the same question, those private boat fishermen interviewed during 1990's SFS (all waves combined) who had fished in state waters (N = 188) averaged about 33 days of fishing. Anglers (N = 16) who had fished in the FCZ reported an average of about 25 days of effort in the previous 12 months.

A total of 2,176 fishermen from both surveys provided information on the species targeted. Forty one percent indicated that they were fishing for "anything." Preferences of those anglers who named a species are listed in Table 13 for fish sought by at least 1% of this group.

Red drum and spotted seatrout (both officially designated by state law as gamefish) were the primary targets of private boat fishermen in estuarine areas. King mackerel was the principal species sought by ocean charterboat and private boat anglers.

Table 11. Numbers of fishermen interviewed in the MRFSS who had fished in inland (estuarine), nearshore ocean (0-3 miles offshore), and offshore ocean (FCZ, 3-200 miles offshore) areas, by wave and mode. Source: KCA final wave reports.

	Inland			Nearshore ocean			Offshore ocean	
Wave	Shore	Charter boat	Private boat	Shore	Charter boat	Private boat	Charter boat	Private boat
2	24	2	222	14	5	8	91	20
3	45	0	337	23	5	29	121	42
4	27	2	108	28	4	11	40	18
5	36	6	93	21	0	0	40	1
6	21	16	95	27	1	3	24	5
Total	153	26	855	113	15	51	316	86

Table 12. Duration of fishing trips and average numbers of trips fished in the last 12 months, by wave and mode. Source: KCA final wave reports.

	Hours fished						Days in last 12 months					
	Shore		Charter boat		Private boat		Shore		Charter boat		Private boat	
Wave	N	$\bar{x}$	N	$\bar{x}$	N	$\bar{x}$	N	$\bar{x}$	N	$\bar{x}$	N	$\bar{x}$
2	38	2.7	98	4.2	250	3.4	24	6.1	88	0.1	118	28.9
3	68	3.0	126	4.1	408	4.0	50	8.1	109	0.1	296	13.1
4	55	2.4	46	2.9	137	3.5	51	4.5	46	0.2	119	15.6
5	57	3.4	46	3.5	94	4.1	51	14.3	39	0.1	75	8.2
6	48	3.7	41	5.7	103	4.6	45	43.6	35	8.7	94	69.1

Table 13. Targeted species, all modes combined, of those anglers who designated a particular species.

Species	Percentage of 1990 anglers	Rank	1989 rank	1988 rank
Red drum	25	1	3	2
Spotted seatrout	17	(tie) 2	2	3
King mackerel	17	(tie) 2	1	1
Flounders	12	4	5	5
Spanish mackerel	8	5	6	7
Sheepshead	6	6	8	8
Cobia	6	7	10	10
Spot	4	8	4	4
Sharks	4	9	7	6
Croaker	2	10	14	-
Kingfishes	1	11	12	-
Black sea bass	1	12	11	9

Flounders were popular with both private boat anglers and shore-based fishermen. Spot were the major attraction for pier patrons as well as being popular with private boat fishermen in the Grand Strand area. These species have consistently been the most frequently targeted by the recreational fishery over the last ten years.

Spanish mackerel have been increasingly targeted in the last few years by nearshore ocean fishermen as their stock status improves. Several other species warrant mention because of seasonal and/or geographic popularity. Sheepshead were a favorite of private boat fishermen during the spring and early summer, particularly in the southern part of the state. Cobia attracted a large following in Beaufort County during the spring. It should also be noted that the black sea bass, although rarely the primary objective on an ocean trip, was frequently turned to as a reliable alternative when fishing for pelagic species was unsatisfactory.

The total catch in 1990 was estimated at 2,133,000 fish. Landings by category and their disposition are listed in Table 14. Table 15 compares annual catches for the last five years. Landings by wave in 1990 are shown in Table 16 and those by fishing area in Table 17.

Offshore pelagic species comprised 1% of the estimated overall landings. These catches were probably underestimated because anglers participating in offshore tournaments were rarely intercepted in MRFSS sampling, yet tournament effort accounted for a substantial amount of the catch of offshore pelagics. An independent survey conducted by MRD's Finfish Management Program provides more reliable catch and effort information for this category.

Offshore bottomfish represented 10% of the total numerical catch. Landings were greatest during March/April, a peak season of catchability for these species. Black sea bass predominated, accounting for about 7% of the total state landings. About 46% of the sea bass catch was released. While landings were rather evenly distributed throughout the year, the retention rate was much lower (17%) during May through September, when small fish taken in inland and nearshore waters dominated the landings. About 43% of the overall catch was caught in state waters. The next most important contributor was red porgy. Landings of other offshore demersal species were limited in both frequency and overall volume.

Coastal pelagic species, particularly mackerels, were the principal targets of most ocean anglers and accounted for 14% of the overall state catch. Spanish mackerel and bluefish dominated the landings, with nearly the entire catch of both being taken during the May through September peak period of ocean angling activity. About 22% of the Spanish mackerel catch and 44% of the bluefish catch were released. About 46% of the Spanish mackerel catch was made in state waters (primarily the nearshore ocean area) and nearly all of the bluefish catch.

Inshore sportfish is an arbitrary classification for the most frequently targeted estuarine species. In aggregate, this group represented 18% of the total 1990 landings. About 46% of the red drum and 23% of the spotted seatrout were released. Landings of both species were largely limited to the second half of the calendar

Table 14. Estimated total catch (in thousands of fish) by South Carolina marine recreational anglers in 1990. Source: NMFS.

Species	Retained/discarded dead	Released	Total
Offshore pelagics			
Dolphin	13	1	14
Little tunny	4	0	4
Tunas/other	1	0	1
Offshore bottomfish			
Black sea bass	80	68	148
Other sea basses	1	0	1
Groupers	9	5	14
Vermilion snapper	10	0	10
Other snappers	1	0	1
Red porgy	23	0	23
Other porgies	4	<1	4
Grunts	3	1	4
Triggerfish	2	0	2
Coastal pelagics			
King mackerel	51	<1	51
Spanish mackerel	89	25	114
Bluefish	70	56	126
Jack crevalle	0	1	1
Blue runner	2	2	4
Amberjacks	6	1	7
Barracuda	1	<1	1
Inshore sportfish			
Red drum	99	84	183
Spotted seatrout	96	29	126
Weakfish	7	0	7
Summer flounder	7	6	13
Southern flounder	53	2	55
Inshore bottomfish			
Kingfishes	57	24	82
Spot	136	11	148
Croaker	289	96	385
Black drum	16	1	17
Sheepshead	79	14	93
Pompano	16	9	24
Miscellaneous			
Sharks	26	30	56
Skates/rays	4	20	23
Eels	0	3	3
Catfish	30	62	92
Toadfish	3	34	36
Searobins	5	5	10
Pigfish	5	0	5
Pinfish	71	120	191
Mullet	18	1	19
Puffers	8	3	10
Other	4	21	25

Table 15. Total catches of South Carolina anglers during 1986-1990, in thousands of fish. NR indicates none reported.
Source: NMFS.

Category	1986	1987	1988	1989	1990
Offshore Pelagics					
Dolphin	72	<30	26	11	14
Little tunny/bonitos	34	<30	18	9	4
Tunas/other	65	<30	1	3	1
Offshore Bottomfish					
Black sea bass	531	732	798	444	148
Groupers	<30	<30	4	7	14
Red porgy	<30	<30	27	70	23
Other porgies	NR	47	17	3	4
Snappers	<30	<30	26	34	11
Grunts	NR	<30	55	49	4
Coastal Pelagics					
King mackerel	254	71	118	74	51
Spanish mackerel	163	69	103	170	114
Bluefish	159	177	147	297	126
Barracuda	62	<30	25	9	1
Inshore Sportfish					
Red drum	196	509	542	150	183
Spotted seatrout	576	444	345	203	126
Summer flounder	NR	45	47	17	13
Southern flounder	206	65	103	51	55
Weakfish	78	<30	1	7	7
Inshore Bottomfish					
Kingfishes	1,049	474	424	169	82
Spot	1,863	757	1,810	1,125	148
Croaker	616	227	254	287	385
Sheepshead	70	<30	75	54	93
Other					
Sharks	207	391	168	111	56
Miscellaneous	1,228	2,161	1,624	1,096	446

Table 16. Estimated 1990 total landings by species category and sampling wave, in thousands of fish. NR indicates none reported or less than 1,000 fish. Source: Preliminary NMFS data, totals do not match those in Table 14 in all cases.

Species category	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
Offshore Pelagics					
Dolphin	NR	13	1	NR	NR
Little tunny	1	2	1	NR	NR
Tunas/other	NR	1	NR	NR	NR
Offshore Bottomfish					
Black sea bass	39	20	21	31	32
Groupers	4	3	5	1	NR
Vermilion snapper	9	NR	NR	NR	1
Other snapper	1	NR	NR	NR	NR
Red porgy	22	NR	NR	NR	3
Grunts	3	NR	NR	NR	NR
Triggerfish	1	NR	NR	NR	NR
Coastal Pelagics					
King mackerel	13	8	13	2	12
Spanish mackerel	NR	39	51	33	NR
Bluefish	18	25	44	24	NR
Jack crevalle	NR	NR	NR	1	NR
Blue runner	NR	2	NR	2	NR
Amberjacks	1	NR	5	NR	NR
Barracuda	NR	1	2	NR	NR
Inshore Sportfish					
Red drum	4	3	71	47	51
Spotted seatrout	4	4	39	36	38
Weakfish	NR	NR	NR	2	5
Summer flounder	2	2	5	1	NR
Southern flounder	13	6	11	8	3
Inshore Bottomfish					
Kingfishes	NR	6	24	38	9
Spot	6	14	21	53	53
Croaker	13	34	176	135	3
Black drum	6	1	3	NR	1
Sheepshead	15	2	1	50	18
Pompano	NR	NR	19	1	NR
Other					
Sharks	18	10	21	9	NR
Miscellaneous	31	28	101	238	6
Total	229	225	633	713	231

Table 17. Estimated catch by fishing area, in thousands of fish. Source: NMFS.

Category	Inland	Nearshore ocean	Offshore ocean
Offshore Pelagics			
Dolphin	0	0	14
Little tunny/bonitos	0	0	4
Tunas/other	0	0	1
Offshore Bottomfish			
Black sea bass	45	19	84
Other sea basses	0	0	1
Groupers	2	4	8
Vermilion snapper	0	0	10
Other snappers	0	0	1
Red porgy	0	0	23
Other porgies	0	0	4
Grunts	0	0	4
Triggerfish	0	0	2
Coastal Pelagics			
King mackerel	<1	1	50
Spanish mackerel	5	47	62
Bluefish	83	39	3
Jack crevalle	1	0	<1
Blue runner	2	2	0
Amberjacks	0	0	7
Barracuda	0	0	13
Inshore Sportfish			
Red drum	181	2	0
Spotted seatrout	124	2	0
Weakfish	6	1	<1
Summer flounder	10	4	0
Southern flounder	54	1	0
Inshore Bottomfish			
Kingfishes	57	25	0
Spot	138	10	0
Croaker	372	13	0
Black drum	5	0	12
Sheepshead	75	1	17
Pompano	4	20	0
Miscellaneous			
Sharks	32	13	10
Skates/rays	17	6	0
Eels	3	0	0
Catfish	92	0	0
Toadfish	36	<1	<1
Searobins	8	2	0
Pigfish	5	0	0
Pinfish	141	37	13
Mullet	19	0	0
Puffers	10	0	0
Others	16	7	2

year. Flounder landings were more evenly distributed seasonally than usual and were dominated by southern flounder (80%). About 12% of the combined (summer and southern) flounder catch was released. Practically all landings in this category occurred inland.

As is normally the case, inshore bottomfish comprised the largest component (35%) of annual landings in numbers of fish. Atlantic croaker was the dominant species, representing nearly 18% of the total state catch and replaced spot as the most numerous fish caught by South Carolina marine anglers. About 75% of those caught were kept despite the predominately small individual size. In most years, a sizeable percentage of the spot catch occurs in the nearshore ocean area, however, only about 7% of the 1990 landings were from there.

Sharks have traditionally been popular warm weather targets of coastal fishermen, with smaller species (particularly the Atlantic sharpnose) dominating the landings. About 54% of the 1990 catch was released.

Catches in inland areas typically contain numerous species of little socioeconomic value. This is particularly true in summer and early fall, when pinfish, catfishes, and toadfish torment legions of anglers targeting inshore bottom species with bottom rigs and cut shrimp. About 22% of the 1990 annual landings consisted of such miscellaneous species.

About 84% of the total catch in all modes was taken in state waters (72% inland, 12% nearshore ocean). The principal species in inland landings, in order of numerical abundance, were Atlantic croaker (24%), red drum (12%), pinfish (9%), spot (9%), and spotted seatrout (8%). Catches in nearshore ocean waters were dominated by Spanish mackerel (18%), bluefish (15%), pinfish (14%), and kingfishes (10%). Sixteen percent of the total catch was taken in the FCZ, where the major contributors were black sea bass (24%), Spanish mackerel (18%), and king mackerel (14%).

Shore Mode

A total of 315 anglers were interviewed during the two surveys, distributed by wave and area as indicated in Table 18. About 59% were intercepted in Charleston County, 37% in Georgetown/Horry Counties, and 4% in Beaufort County. Most were fishing from manmade structures (piers, bridges, docks) rather than from the bank or in the surf. Coastal residents comprised 47%, 23% were noncoastal residents, and 30% were from out of state.

Most shore fishermen (71%) indicated that they were fishing for "anything." About 15% were seeking inshore sportfish (red drum, trout, flounders) and 12% targeted inshore bottomfish (spot, croaker, kingfishes). The most popular species were spot and red drum, each targeted by 7% of all shore anglers.

Interviewed shore fishermen caught 1.34 fish per angler, 35% of which were released. Table 19 lists the estimated total shore catch by wave, which represented 17% of the overall landings. Inshore bottomfish represented 41%, miscellaneous species 30%, coastal pelagics (bluefish and Spanish mackerel) 25%, and inshore sportfish 4%. The most numerous species were spot (17%), bluefish (15%), and kingfishes (13%). Half of all fishermen interviewed had caught no

Table 18. Distribution of shore fishermen interviewed during the MRFSS and SFS by wave and area.

	Wave 2	Wave 3	Wave 4
Total anglers	44	68	78
Beaufort County	8	0	0
Charleston County	22	38	45
Georgetown/Horry Counties	14	30	33
	Wave 5	**Wave 6**	**Annual Total**
Total anglers	53	72	315
Beaufort County	0	4	12
Charleston County	37	43	185
Georgetown/Horry Counties	16	25	118

Table 19. Estimated catch by wave in the shore mode, in thousands of fish. Source: NMFS.

Category	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Total
Offshore Bottomfish						
Black sea bass	0	0	1	0	0	1
Coastal Pelagics						
Spanish mackerel	0	2	0	32	0	34
Bluefish	10	15	17	12	0	54
Blue runner	0	2	0	0	0	2
Inshore Sportfish						
Red drum	0	1	0	1	0	2
Spotted seatrout	0	2	0	0	2	4
Weakfish	0	0	0	1	0	1
Summer flounder	0	0	4	1	0	5
Southern flounder	0	1	1	1	2	4
Inshore Bottomfish						
Kingfishes	0	6	16	18	8	47
Spot	0	0	10	2	50	62
Croaker	0	0	2	12	3	17
Sheepshead	0	0	1	0	0	1
Pompano	0	0	20	1	0	21
Miscellaneous						
Sharks	12	1	1	2	0	16
Skates/rays	5	0	2	6	0	13
Eels	2	0	0	0	0	2
Catfish	0	0	4	3	0	7
Toadfish	2	0	0	3	0	5
Searobins	0	0	6	3	0	9
Pigfish	0	0	0	1	0	1
Pinfish	0	0	2	38	0	40
Mullet	0	1	0	0	0	1
Puffers	0	1	0	0	5	6
Others	0	4	2	4	0	10

fish. Catch rates were highest during September/October (2.77 fish per angler) and lowest in March/April (0.41 fish per angler). The Beaufort County sample was too small to justify calculation of catch rates. The annual average catch rate in Charleston County was 1.29 fish per angler, while in the Georgetown/Horry area it was 1.50.

Charterboat Mode

During March through December, 431 anglers were interviewed, distributed by wave and area as shown in Table 20. Half of the interviews were obtained in Beaufort County, 38% in the Georgetown/Horry area, and 12% in Charleston County. Most of the anglers (73%) were from out of state. Residents of noncoastal counties comprised 18% of the sample and coastal residents 9%.

Ninety percent of the anglers interviewed indicated that they had fished in the FCZ (more than three miles offshore). All of the charter activity originating from Charleston, Georgetown, and Horry Counties occurred there. Ten percent of the fishermen interviewed in Beaufort County had fished in inland waters and 10% in nearshore ocean (0-3 miles offshore) waters.

About 88% of the ocean effort was directed at pelagic species and 43% was targeted specifically at king mackerel. In Beaufort County, 11% of the total ocean fishing time was accounted for by anglers identifying kings as the target species. For Charleston and Georgetown/Horry fishermen, the figures were 51% and 60%, respectively. More actual effort contributed to the landings of king mackerel because it was a frequent catch of those anglers who identified "anything" as their target. Surface trolling was the principal activity of this group, with mackerels by far the dominant catch.

Five percent of the interviewed fishermen targeted inshore sportfish (red drum and/or spotted seatrout) (Table 21). All of these fishermen were in Beaufort County. Of the remaining group (i.e., ocean fishermen), 44% had fished for "anything" and 47% for mackerels. About 28% of the ocean anglers identified king mackerel as the specific target, by far the largest preference rating for an individual species. Offshore bottom species were identified as a target by only 7% of all ocean fishermen.

The estimated total catch by wave of charterboat fishermen is listed in Table 22; it represented 13% of the overall state landings. Coastal pelagic species, principally mackerels, represented 42% of the charterboat landings. Spanish mackerel was the most numerous species landed (about 24% of the total mode catch), while king mackerel comprised nearly 16% of all charterboat landings. Black sea bass was the second most abundant catch (23% of total mode landings) and offshore bottomfish in aggregate contributed 41% of the overall catch. The amount of other fish landed by charterboats was relatively insignificant.

About 26% of the estuarine anglers were unsuccessful, while 36% of the ocean fishermen caught no fish. Almost 60% of the Beaufort County ocean anglers caught nothing. In Charleston County, the failure rate was 35%. In the Georgetown/Horry area, only 7% of the fishermen had no catch.

Catch and effort data by wave and area are summarized in Table

Table 20. Distribution of charterboat fishermen interviewed during the MRFSS and SFS by wave and area.

	Wave 2	Wave 3	Wave 4
Total anglers	125	128	74
Beaufort County	73	50	46
Charleston County	4	35	6
Georgetown/Horry Counties	48	43	22
	Wave 5	**Wave 6**	**Annual total**
Total anglers	56	48	431
Beaufort County	33	15	217
Charleston County	4	0	49
Georgetown/Horry Counties	19	33	165

Table 21. Target species of charterboat anglers by wave and area, in numbers of anglers designating each species.

Species	Beaufort County	Charleston County	Georgetown/Horry	Total
		Wave 2		
Anything	70	0	21	91
Bottomfish	0	4	21	25
King mackerel	0	0	6	6
Black sea bass	3	0	0	3
		Wave 3		
King mackerel	6	9	32	47
Anything	10	12	11	33
Spanish mackerel	29	0	0	29
Mackerels	0	14	0	14
Cobia	5	0	0	5
		Wave 4		
Anything	24	0	2	26
Mackerels	0	0	19	19
King mackerel	14	2	1	17
Spanish mackerel	8	0	0	8
Sharks	0	4	0	4
		Wave 5		
Anything	23	0	6	29
King mackerel	0	4	6	10
Mackerels	0	0	7	7
Spotted seatrout	7	0	0	7
Sharks	3	0	0	3
		Wave 6		
King mackerel	0	0	33	33
Red drum/spotted seatrout	15	0	0	15

Table 22. Estimated catch in the charterboat mode by wave, in thousands of fish. Source: NMFS.

Category	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Total
Offshore Pelagics						
Dolphin	0	10	<1	0	0	10
Little tunny/bonitos	1	2	<1	0	0	4
Tunas/other	<1	<1	0	0	0	<1
Offshore Bottomfish						
Black sea bass	36	5	0	3	19	64
Other sea basses	1	0	0	1	0	1
Groupers	4	3	0	<1	0	8
Vermilion snapper	9	0	0	0	1	10
Other snappers	1	0	0	0	0	1
Red porgy	22	<1	0	0	0	23
Other porgies	2	0	0	0	0	2
Grunts	3	<1	0	1	0	4
Triggerfish	1	0	0	<1	<1	2
Coastal Pelagics						
King mackerel	11	8	9	6	10	44
Spanish mackerel	<1	34	32	1	0	67
Bluefish	1	<1	3	0	<1	5
Jack crevalle	0	<1	0	0	0	<1
Amberjacks	1	<1	1	<1	0	2
Barracuda	0	1	0	1	0	1
Inshore Sportfish						
Red drum	<1	0	0	0	11	12
Spotted seatrout	0	0	0	0	4	4
Weakfish	0	0	0	<1	0	<1
Inshore Bottomfish						
Kingfishes	0	0	0	0	<1	<1
Miscellaneous						
Sharks	<1	1	10	0	0	11
Toadfish	0	<1	0	0	0	<1
Pinfish	2	0	0	<1	0	2
Other	0	0	0	<1	0	<1

23. Few anglers targeted bottomfish and their catches included many species, therefore catch rates for this group were rather meaningless. For ocean anglers who targeted "anything" or mackerels, the overall average catch of pelagic species was 1.4 fish per angler. In Beaufort County, the pelagic catch rate was 0.9 fish per angler, with most of the landings attributable to Spanish mackerel. For Charleston County fishermen, the pelagic catch rate was 1.1 fish per angler, consisting primarily of dolphin (although this was a sampling artifact). In the Georgetown/Horry area, the catch rate was 1.8 pelagics per fisherman, with king mackerel the principal component.

Success for the most popular species, king mackerel, varied greatly with season and area (Table 24). The overall statewide catch rate was 0.6 kings per angler and 66% of the fishermen were unsuccessful. The other most popular and commonly caught pelagic was the Spanish mackerel. This species was primarily targeted by anglers in Beaufort County, with landings peaking during waves 3 and 4. In 1990, the average catch rate there in that period was 1.5 fish per angler for ocean fishermen fishing for "anything" or mackerels.

Table 25 indicates the extent of artificial reef usage (percent of anglers who had fished on reefs or non-reef sites) during the various waves. About 21% of the ocean fishermen interviewed in both surveys had fished on artificial reefs. This represented 14% of the reporting total ocean fishing effort (in hours fished). Most of the reef usage occurred in Beaufort County, where 37% of the interviewed ocean anglers utilized reefs (accounting for 34% of the total time fished). In Charleston County, about 22% of the interviewed anglers fished reefs, while virtually none (2%) of the fishermen from northern ports reported reef fishing. Table 26 summarizes data for specific sites (MRFSS and SFS data combined). The overall average catch rate was 0.72 pelagic fish per angler, compared to a nonreef average of 1.66. It should be noted that most of the reef usage was in Beaufort County, where the reef and nonreef pelagic catch rates were 0.70 and 1.15 fish per angler, respectively.

Private Boat Mode

A total of 1,430 anglers were interviewed during the MRFSS and SFS, distributed as indicated in Table 27. In Beaufort County, 68% of the fishermen were coastal residents, 20% noncoastal, and 12% from out of state. Charleston/Colleton Counties had the largest proportion of coastal resident anglers (84%), with 12% from noncoastal counties and only 4% from out of state. Out of state fishermen were best represented in the Georgetown/Horry area (17% of the anglers), where participation by coastal residents was lowest (51%). About 32% of the fishermen there were from inland counties.

The majority (78%) of the private boat anglers interviewed had fished in estuarine waters. Inland water usage was highest in Beaufort County (90% of the fishermen) and lowest in the Georgetown/Horry area (70%). About 76% of the fishermen interviewed in Charleston and Colleton Counties had fished in estuarine areas. Statewide, 12% of the anglers interviewed had fished in nearshore (0-3 miles offshore) ocean waters and 10% in the FCZ. In both the

Table 23. Charterboat catch and effort data for interviewed anglers by wave and area, MRFSS and SFS combined. Catch is in numbers of fish.

Category	Wave 2	3	4	5	6	Total
			Georgetown/Horry Counties			
No. of anglers	48	43	22	19	33	165
Total hours fished	288.5	257.5	69.0	86.5	202.0	903.5
Anglers w/no catch	5	7	0	0	0	12
King mackerel	45	50	15	36	64	210
Spanish mackerel	1	6	50	6	0	63
Other pelagics	4	14	3	1	0	22
Black sea bass	140	21	0	20	148	329
Other bottomfish	177	15	0	2	11	205
Sharks	2	0	0	0	0	2
Total catch	381	106	68	67	223	845
			Charleston County			
No. of anglers	4	35	6	4	0	49
Total hours fished	8.0	134.0	26.0	16.0	0	184.0
Anglers w/no catch	0	14	0	3	0	17
King mackerel	0	0	2	1	0	3
Spanish mackerel	0	9	0	0	0	9
Other pelagics	0	42	1	0	0	43
Black sea bass	9	0	0	0	0	9
Other bottomfish	0	0	0	0	0	0
Sharks	0	0	23	0	0	23
Total catch	9	51	26	1	0	87
			Beaufort County			
No. of anglers	73	50	46	33	15	217
Total hours fished	193.5	115.5	119.5	91.0	56.5	576.0
Anglers w/no catch	63	19	17	23	0	122
King mackerel	1	3	3	0	0	7
Spanish mackerel	0	116	29	0	0	145
Other pelagics	7	7	9	9	2	34
Black sea bass	5	3	0	0	0	8
Other bottomfish	0	0	0	0	0	0
Sharks	0	5	21	0	0	26
Red drum	2	0	0	0	110	112
Spotted seatrout	0	0	0	0	41	41
Total catch	15	135	62	10	155	377

Table 24. Charterboat fishing success for king mackerel, MRFSS and SFS data pooled. Anglers include ocean fishermen indicating "anything" or mackerels as target species.

Wave	Total anglers	Total hours	Total kings	Anglers with no catch	Kings per angler
Beaufort County					
2	63	169.0	1	62	0.02
3	43	103.0	3	40	0.07
4	43	112.0	3	40	0.07
5	23	71.5	0	23	0
6	0	0	0	0	0
Total	172	455.5	7	165	0.04
Charleston County					
2	0	0	0	0	0
3	35	134.0	0	35	0
4	2	16.0	2	1	1.00
5	4	16.0	1	3	0.25
6	0	0	0	0	0
Total	41	166.0	3	39	0.07
Georgetown/Horry Counties					
2	27	165.5	39	8	1.44
3	43	257.5	50	15	1.16
4	22	69.0	15	9	0.68
5	19	86.5	46	0	2.42
6	33	202.0	64	0	1.94
Total	144	780.5	214	32	1.49
Statewide					
2	90	334.5	40	70	0.44
3	121	494.5	53	90	0.44
4	67	197.0	20	50	0.30
5	46	174.0	47	26	1.02
6	33	202.0	64	0	1.94
Total	357	1,402.0	224	236	0.63

Table 25. Artificial reef usage by charterboat anglers by wave (MRFSS data only). Source: KCA final wave reports.

Usage Group	Wave 2	3	4	5	6	Total
% Reef users	27	31	37	15	0	25
% Non-reef users	73	69	63	85	100	75

Table 26. Sites fished by charterboat anglers interviewed in the MRFSS and SFS.

Reef site	No. of anglers	Hours fished	Target	No. anglers	Total catch
FishAmerica	17	42.5	Any	7	8 Spanish mackerel
			Spotted seatrout	7	3 Sharpnose sharks
			Cobia	3	1 Bluefish
					1 Weakfish
Hunting Is.	8	14.0	Any	8	0
Fripp Is. (Tire Reef)	41	103.0	Spanish mackerel	20	31 Spanish mackerel
			Any	15	1 King mackerel
			King mackerel	6	1 Little tunny
					1 Amberjack
					1 Barracuda
Gaskins Bank Wreck	5	11.5	Any	3	5 Spanish mackerel
			Cobia	2	3 Black sea bass
					2 Sharks
					1 Amberjack
					1 Toadfish
Edisto Trolling Alley	3	7.5	King mackerel	3	0
Kiawah	8	27.5	Mackerel	8	4 Spanish mackerel
Ten-Mile	3	19.5	King mackerel	3	1 Spanish mackerel
					1 Bonito

Table 27. Distribution of private boat fishermen interviewed during the MRFSS and SFS by wave and area.

	Wave 2	Wave 3	Wave 4
Total anglers	259	460	332
Beaufort County	74	138	97
Charleston/Colleton Counties	92	182	184
Georgetown/Horry Counties	93	140	51
	Wave 5	Wave 6	Annual total
Total anglers	182	197	1,430
Beaufort County	32	19	360
Charleston/Colleton Counties	50	128	636
Georgetown/Horry Counties	100	50	434

Charleston/Colleton and Georgetown/Horry areas, 16% fished in nearshore ocean waters, while the figure for Beaufort County was 2%. Offshore fishing was pursued by 8% of the fishermen in Beaufort County and the Charleston/Colleton area and by 14% of the Georgetown/Horry anglers.

Nearly all of the ocean artificial reefs are located more than three miles offshore, i.e., in the FCZ. Statewide, about 46% of the interviewed private boat fishermen who fished in the FCZ reported using an artificial reef. The relative usage rate was highest in Beaufort County (70%) and lowest in Charleston County (19%). About 61% of the offshore anglers in the Georgetown/Horry area reported fishing on reefs. Site-specific information is summarized in Table 28 where the reef identity was known. Mackerels were the most popular target, sought by 43% of the anglers. About 28% indicated "anything" as their preference. Few anglers (8%) fished the reefs specifically for bottomfish, although these species represented 75% of the total catch. Black sea bass was the most numerous species, comprising 47% of the total landings and 64% of the bottomfish catch. Coastal pelagics represented 20% of the overall landings and sharks 4%. The catch rate of king mackerel was 0.26 fish per angler compared to 0.12 for fishermen not fishing on the reefs.

Species preferences were rather variable from area to area. Table 29 summarizes results for the most frequently named fishes. Preferences were generally very similar to those expressed in recent years, with substantial numbers of anglers in every area indicating no particular target species. The red drum retained its status as the most popular estuarine target species. Spotted seatrout were primarily targeted in Charleston County, while flounders were the most popular species group in the Georgetown/Horry area. Sheepshead and cobia attracted large seasonal followings in Beaufort County, while king mackerel was universally the most popular species sought by ocean anglers. Inshore bottomfish (spot, croaker, kingfishes, black drum), although often caught throughout the coastal area, were commonly targeted only by fishermen in the northern counties.

Private boat mode landings (Table 30) represented 70% of the estimated total catch. Atlantic croaker was the most numerous species and represented 25% of the mode catch. Two-thirds of the statewide annual landings of this species were in the Georgetown/Horry area, where it comprised 33% of the reported catch. Landings here and in Charleston County were primarily during waves 4, and 5 and, despite the generally small average size, about 73% of the catch was retained.

Red drum was the next most numerous fish in the statewide landings. Its relative contribution to area landings decreased from south to north and statewide catches were greatest during wave 4. Spotted seatrout represented 8% of the annual catch, with the vast majority of the landings in Charleston County. The other popular inshore sportfishes were flounders, particularly in the Georgetown/Horry area. Southern flounder comprised 86% of the estimated statewide flounder catch, with virtually all of the summer flounder landings limited to the Georgetown/Horry area.

Inshore bottomfish normally are the largest group contributor to South Carolina landings and 1990 was no exception. Perhaps the most notable aspect was a relatively weak showing by spot, which had

Table 28. Artificial reef usage by private boat anglers interviewed in the MRFSS and SFS.

Reef site	No. of anglers	Hours fished	Target	No. anglers	Total catch
Cape Romain	7	35.5	King mackerel	5	6 Sharks
			Any	2	0
Capers (R8)	3	15.0	Spadefish	3	10 Spadefish
Georgetown	2	14.0	Spadefish	2	12 Spadefish
					2 Black sea bass
					4 Pinfish
					2 Sand perch
Paradise	7	38.0	Sharks	2	5 Spanish mackerel
			Spanish mackerel	3	1 Red drum
			Any	2	1 Unidentified
					11 Black sea bass
City of Richmond	11	38.0	Bottomfish	3	3 Whitebone porgy
			King mackerel	8	25 Spotted pinfish
					5 Black sea bass
					1 King mackerel
					1 Spanish mackerel
					4 Amberjack
General Sherman	6	25.5	Any	3	1 Porgy
Pawleys Island	7	29.0	Bottomfish	2	20 Bluefish
			Mackerels	5	1 Hake
					56 Black sea bass
Ten-Mile	3	30.0	Any	3	1 Cobia
					1 Amberjack
					2 Spadefish
					34 Black sea bass
Fripp Island	4	14.0	King mackerel	4	0
FishAmerica	4	18.0	Any	2	1 Shark
			Cobia	2	
Betsy Ross	8	46.0	Shark	5	1 Cobia
			Any	3	2 Spadefish
					2 Spanish mackerel
					1 King mackerel
					3 Sharks
Navy Tower (Star Wars)	3	9.0	King mackerel	3	9 King mackerel

Table 29. Target species of private boat anglers by area, in percentages of interviewed fishermen who designated the species.

Species category	Beaufort Cty.	Charleston Cty.	Georgetown/Horry Cty.	Total
Anything	40%	30%	33%	33%
Red drum	14%	21%	17%	18%
Spotted seatrout	4%	22%	5%	13%
Flounders	2%	6%	18%	9%
Sheepshead	10%	5%	1%	5%
King mackerel	4%	4%	7%	4%
Cobia	19%	-	-	4%
Inshore bottomfish	-	2%	12%	4%
Sharks	8%	2%	1%	3%

Table 30. Estimated catch in the private boat mode by wave, in thousands of fish. Source: NMFS.

Category	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Total
Offshore Pelagics						
Dolphin	0	4	0	0	0	4
Tunas/other	0	<1	0	0	0	<1
Offshore Bottomfish						
Black sea bass	7	19	20	25	12	83
Other sea basses	0	<1	0	0	0	<1
Groupers	0	0	5	1	0	6
Other porgies	1	<1	0	0	0	1
Grunts	0	<1	0	0	0	<1
Coastal Pelagics						
King mackerel	4	1	0	0	2	7
Spanish mackerel	0	6	6	1	0	13
Bluefish	9	18	31	10	0	68
Jack crevalle	0	0	0	1	0	1
Blue runner	0	<1	0	2	0	2
Amberjacks	0	<1	5	0	0	5
Inshore Sportfish						
Red drum	8	2	81	38	39	169
Spotted seatrout	8	4	44	30	32	118
Weakfish	0	0	0	1	5	6
Summer flounder	4	2	2	0	0	8
Southern flounder	25	7	11	6	1	51
Inshore Bottomfish						
Kingfishes	<1	2	14	18	1	34
Spot	12	16	15	43	0	86
Croaker	25	41	198	103	0	368
Black drum	11	1	4	0	1	17
Sheepshead	30	2	0	42	18	92
Pompano	0	0	4	0	0	4
Miscellaneous						
Sharks	4	11	7	6	0	28
Skates/rays	3	1	2	3	0	10
Eels	<1	<1	0	0	0	1
Catfish	11	19	25	31	0	86
Toadfish	4	6	12	8	1	31
Searobins	0	0	0	1	0	1
Pigfish	0	0	0	4	0	4
Pinfish	11	3	37	98	0	148
Mullet	0	<1	18	0	0	19
Puffers	1	1	0	3	0	5
Other	2	2	6	5	0	15

consistently been the most numerous fish in the state's total marine recreational catch. It was replaced by Atlantic croaker in 1990. Inshore bottomfish were most important to northern area anglers, particularly during waves 4 and 5. Although both spot and croaker are usually small in South Carolina, anglers retained the vast majority of those caught.

Black sea bass was the only offshore ocean species prominently represented in the private boat landings. Most of the catch was landed in Charleston, Georgetown, and Horry Counties. Mackerel landings were more dispersed seasonally and geographically than is usually the case. Bluefish was the most numerous component of the coastal pelagic catch, with roughly equal landings in Charleston County and the Georgetown/Horry area among those anglers interviewed. Very few were reported in Beaufort County. Shark landings were largely confined to Charleston and Beaufort Counties. The miscellaneous group consisted largely of catfishes and pinfish. Its contribution to geographic landings was rather consistent.

Catch and effort data for fishermen interviewed in both surveys are listed in Table 31. Statewide, 40% of the interviewed private boat fishermen reported catching no fish during their trip. The success rate was progressively lower to the south. Georgetown/Horry area anglers were usually the most successful with 27% of the annual total failing to catch anything. In contrast, about 62% of the fishermen in Beaufort County caught nothing and the failure rate here was consistently highest during each wave. Fishing statewide was least productive during waves 2 and 6, when 51% caught nothing, and most successful during wave 5, when only 13% failed to catch anything.

With all anglers included, the annual statewide catch rate was 3.4 fish per angler trip. The catch rate was highest during wave 5 (7.2) and lowest in wave 2 (1.7). Average annual catch rates by area wave were 1.5 in Beaufort County, 2.9 in Charleston/Colleton, and 5.6 in the Georgetown/Horry area.

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 management interest at the state level is directed at red drum and spotted seatrout, most of which are caught by private boat fishermen. Table 32 summarizes directed effort and catch data for these species. "Directed effort" was defined as a trip in which the angler either specifically indicated the species as a target or caught at least one of it.

The overall average catch rate for red drum was 1.4 fish per angler trip. Nearly half of the fishermen caught no red drum on their trip. Fishing was best during waves 4 and 6, when anglers averaged 2.1 fish per trip. Success in waves 2 and 3 was much lower (0.3-0.4 fish per trip). The annual catch rate was highest in Beaufort County, but this may have been attributable to sample distribution. Few anglers per wave were interviewed and the catch rates between waves were highly variable; most of the sample was obtained during wave 4 when success was greatest. The catch rates between waves were also highly variable in the Georgetown/Horry area, with the highest rate occurring also in wave 4. The catch rate was lowest but most consistent in Charleston County, where the

Table 31. Catch and effort of interviewed private boat anglers by wave and area, MRFSS and SFS combined. Catch is in numbers of fish.

	Wave 2	3	4	5	6	Total
		Georgetown/Horry				
Anglers	93	140	51	100	50	434
Total hours fished	396.5	595.0	200.5	421.0	269.5	1,882.5
Anglers with no fish	37	35	19	6	21	118
King mackerel	0	4	0	1	0	5
Spanish mackerel	0	25	1	1	0	27
Bluefish	15	72	10	4	6	107
Other pelagics	0	6	4	3	0	13
Black sea bass	13	126	2	50	0	191
Other offshore bottomfish	28	5	13	0	0	46
Sharks	2	1	0	2	0	5
Red drum	11	11	31	56	48	157
Spotted seatrout	5	2	1	5	4	17
Flounders	65	74	12	13	0	164
Sheepshead	0	7	0	30	0	37
Spot	23	114	7	41	112	297
Croaker	10	165	148	481	0	804
Kingfishes	0	8	3	48	0	59
Miscellaneous	13	62	65	309	62	511
Total catch	185	682	297	1,044	232	2,440
		Charleston/Colleton				
Anglers	92	182	184	50	128	636
Total hours fished	302.5	683.0	665.0	159.5	602.0	2,412.0
Anglers with no fish	54	56	53	6	61	230
King mackerel	0	1	5	0	3	9
Spanish mackerel	0	15	5	0	0	20
Bluefish	2	73	36	6	0	117
Other pelagics	0	49	16	1	1	67
Black sea bass	1	20	43	0	109	173
Other offshore bottomfish	0	0	18	1	5	24
Sharks	5	38	21	0	0	64
Red drum	5	6	78	24	91	204
Spotted seatrout	20	32	72	58	110	242
Flounders	1	21	5	2	1	30
Sheepshead	16	19	1	7	51	94
Spot	0	6	15	0	40	61
Croaker	2	151	118	59	1	331
Kingfishes	1	19	30	20	1	71
Miscellaneous	23	131	68	45	1	268
Total catch	76	581	531	223	434	1,845
		Beaufort				
Anglers	74	138	97	32	19	380
Total hours fished	218.5	547.5	282.5	137.5	95.5	1,281.5
Anglers with no fish	50	84	65	12	11	222
King mackerel	9	1	0	0	4	14
Spanish mackerel	0	2	0	0	0	2
Bluefish	1	2	3	2	0	8
Other pelagics	0	4	0	0	0	4
Black sea bass	2	12	0	1	2	17
Other offshore bottomfish	0	2	0	0	0	2
Sharks	0	28	4	3	0	35
Red drum	2	1	88	10	8	109
Spotted seatrout	0	1	6	13	0	20
Flounders	0	5	0	3	1	9
Sheepshead	83	6	3	11	0	103
Spot	5	0	0	0	0	5
Croaker	49	14	10	0	0	73
Kingfishes	0	4	2	0	0	6
Miscellaneous	37	56	21	7	1	122
Total catch	188	138	137	50	16	529

Table 32. Catch and effort data by wave and area for red drum and spotted seatrout in the private boat mode. Anglers are those who targeted a species and/or caught at least one on their trip.

Area	Wave	Anglers	Fish	Anglers with no catch	Fish per angler
			RED DRUM		
Beaufort County	2	2	2	1	2.0
	3	4	1	3	0.3
	4	28	88	18	3.1
	5	13	10	7	0.8
	6	6	8	1	1.3
	Total	53	109	30	2.1
Charleston/Colleton Counties	2	30	5	25	0.2
	3	32	6	26	0.2
	4	48	78	18	1.6
	5	15	24	5	1.6
	6	52	91	28	1.8
	Total	177	204	102	1.2
Georgetown/Horry Counties	2	13	10	5	0.8
	3	18	11	7	0.6
	4	8	31	1	3.9
	5	39	56	4	1.4
	6	17	48	10	2.8
	Total	95	156	27	1.6
			SPOTTED SEATROUT		
Beaufort County	2	2	0	2	0
	3	1	1	1	1.0
	4	4	6	2	1.5
	5	9	13	0	1.4
	6	4	0	4	0
	Total	20	20	9	1.0
Charleston/Colleton Counties	2	26	20	18	0.8
	3	34	32	22	0.9
	4	30	72	8	2.4
	5	21	58	0	2.8
	6	66	110	37	1.7
	Total	177	292	85	1.6
Georgetown/Horry Counties	2	7	5	2	0.7
	3	6	2	4	0.3
	4	1	1	1	1.0
	5	8	5	3	0.6
	6	15	4	11	0.3
	Total	37	17	21	0.5

wave sample sizes were largest and most uniform. In both Beaufort and Charleston Counties, about 58% of the anglers failed to catch a red drum, whereas only 28% were unsuccessful in the Georgetown/Horry area.

Geographic and wave comparisons in fishing success for spotted seatrout are restricted by small sample sizes in areas other than Charleston County, reflective of the comparatively low level of interest in this species at either end of the state. Statewide, about half of the anglers targeting trout also failed to catch one during their trip and the catch rate was the same as for red drum (1.4 fish per trip). Success was highest during waves 4 and 5 (2.1 fish per trip). Nearly all of the catch was made in Charleston County.

Ocean anglers represented a relatively small group, with king mackerel their most important target species. Few fishermen seeking this species were successful and the overall annual catch rate was only 0.17 kings per angler.

Length Composition

The total number of red drum measured was 186, with sample sizes by wave and area as shown in Table 33. With the means and standard deviations typically observed, a sample size of about 20 is required to obtain an estimate within + - 10% of the true mean. Since this standard was achieved in only two sampling cells, valid comparisons between areas within waves were not possible.

Nearly half of the total sample was obtained in wave 6. About 47% of the total measured catch came from Charleston/Colleton Counties and 41% from the Georgetown/Horry area. The average size of red drum retained statewide during the entire year was 45.7 cm (18.0 in). distributed as shown in Fig. 1. On 6 June, 1990, the 14.0 in (35.6 cm) minimum size limit became effective year round, replacing the previous window (June-September) limit. During waves 4, 5, and 6, about 10% of the fish inspected were undersized (all 30-35 cm).

The average size of retained spotted seatrout was 37.1 cm (14.7 in) total length, distributed as indicated in Fig. 2. No fish below the 12.0 in (30.5 cm) minimum size limit were observed. Since nearly all of the inspected catch came from Charleston County, area comparisons were not practical. There was little difference in average size between waves (wave 2 = 36.8 cm, wave 3 = 40.3 cm, wave 4 = 36.0 cm, wave 5 = 36.2 cm, wave 6 = 38.0 cm).

Only 11 summer flounder were measured, precluding any meaningful evaluation of their average size. Length frequency distribution of southern flounder is illustrated in Fig. 3, with a mean size of 35.6 cm (14.0 in).

The average fork length of Spanish mackerel was 42.0 cm (16.5 in), with a length distribution as indicated in Fig. 4. About 2% of the inspected catch was below the minimum legal size of 12.0 in (30.5 cm) fork length. The mean fork length of king mackerel (Fig. 5) was 76.2 cm (30.0 in).

Large enough sample sizes for sheepshead (N = 75) and bluefish (N = 50) were obtained to permit reasonably reliable estimates of average size. For sheepshead, the mean total length was 34.2 cm

Table 33. Distribution of length samples and mean lengths for red drum (MRFSS and SFS data combined). Lengths are cm total length.

Area	Wave 2	3	4	5	6	Total
Beaufort County	N = 4	N = 1	N = 0	N = 2	N = 15	N = 22 $\bar{x}$ = 46.8 sd = 11.5
Charleston/ Colleton Counties	N = 4	N = 2	N = 2	N = 13	N = 67	N = 88 $\bar{x}$ = 43.2 sd= 9.0
Georgetown/ Horry Counties	N = 11	N = 10	N = 18	N = 28	N = 9	N = 76 $\bar{x}$ = 49.0 sd = 10.8
Total	N = 19	N = 13	N = 20	N = 43	N = 91	N = 186
$\bar{x}$	42.3	48.6	50.4	47.7	43.3	45.7
sd	19.4	14.4	12.3	12.8	7.0	10.4

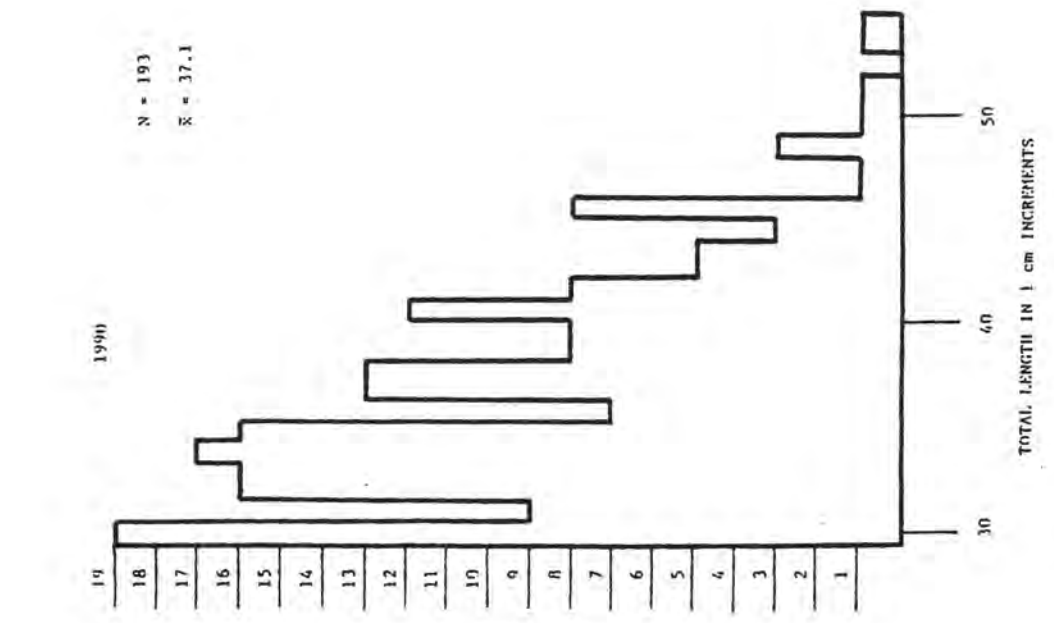

Fig. 2. Length composition of spotted seatrout.

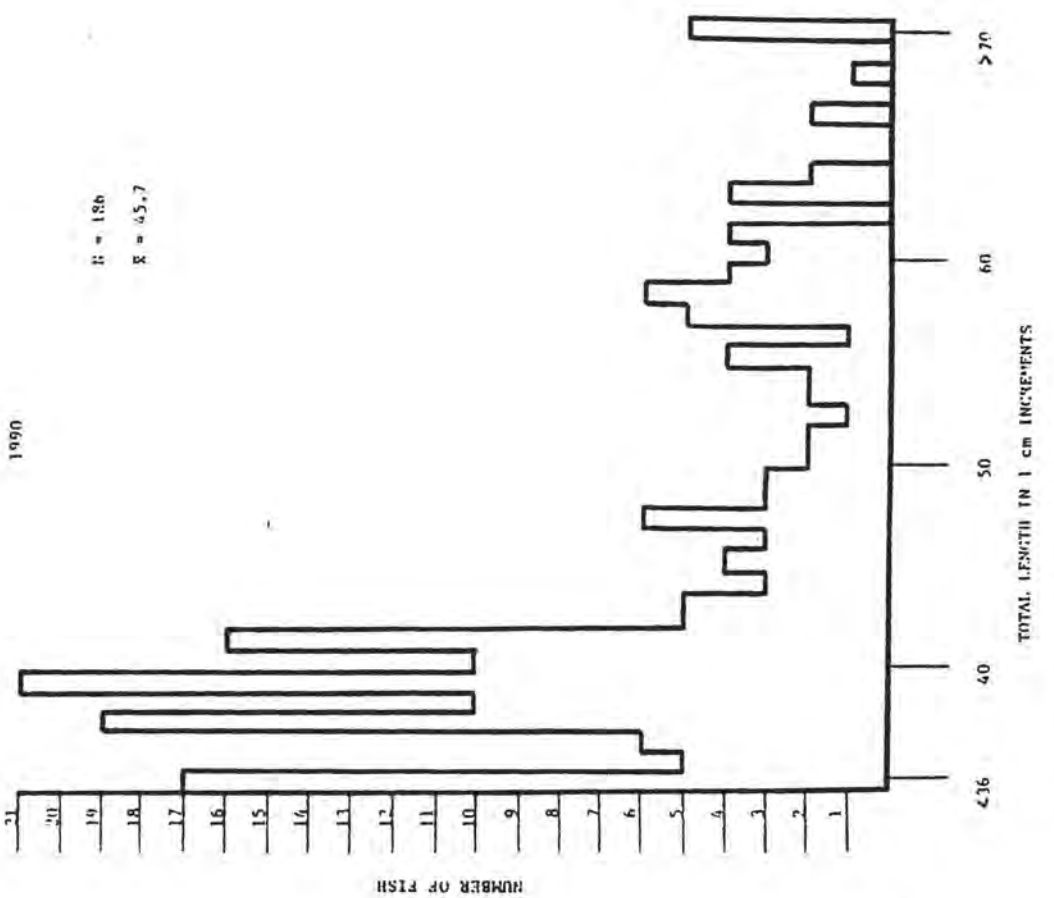

Fig. 1. Length composition of red drum

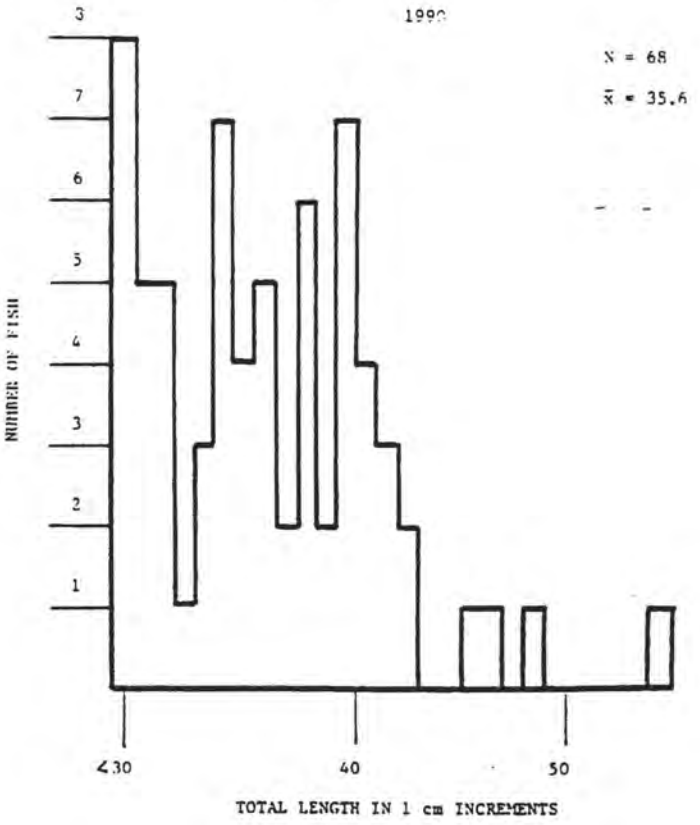

Fig. 3. Length composition of southern flounder.

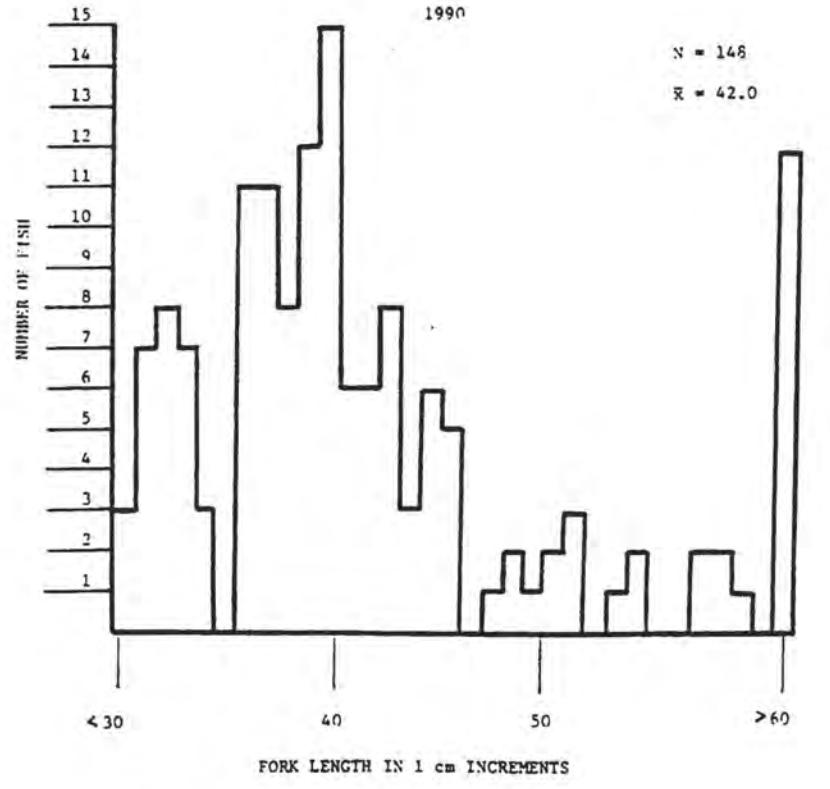

Fig. 4. Length composition of Spanish mackerel.

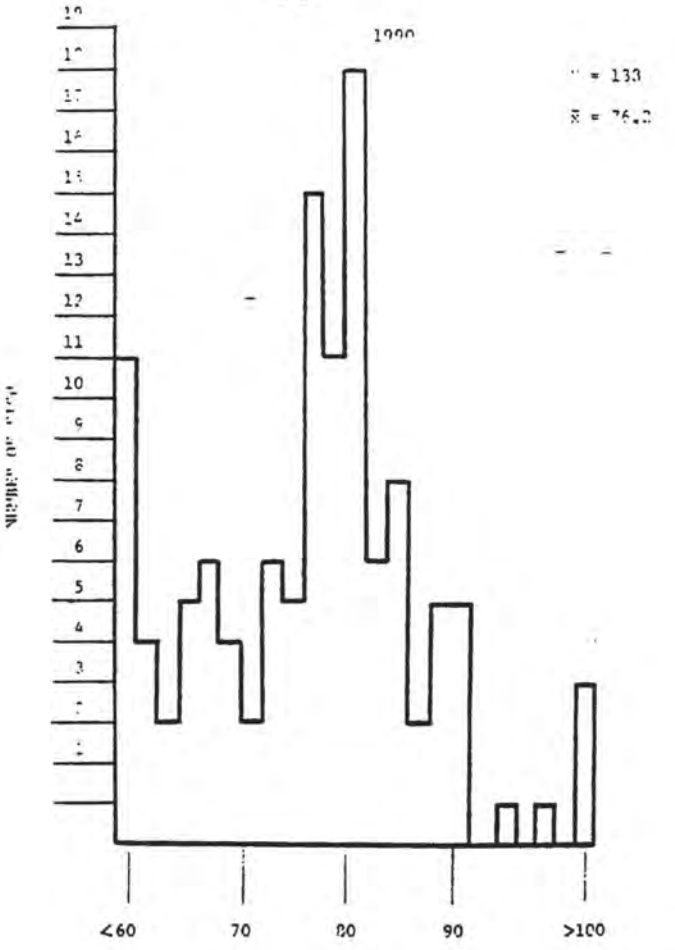

Fig. 5. Length composition of king mackerel.

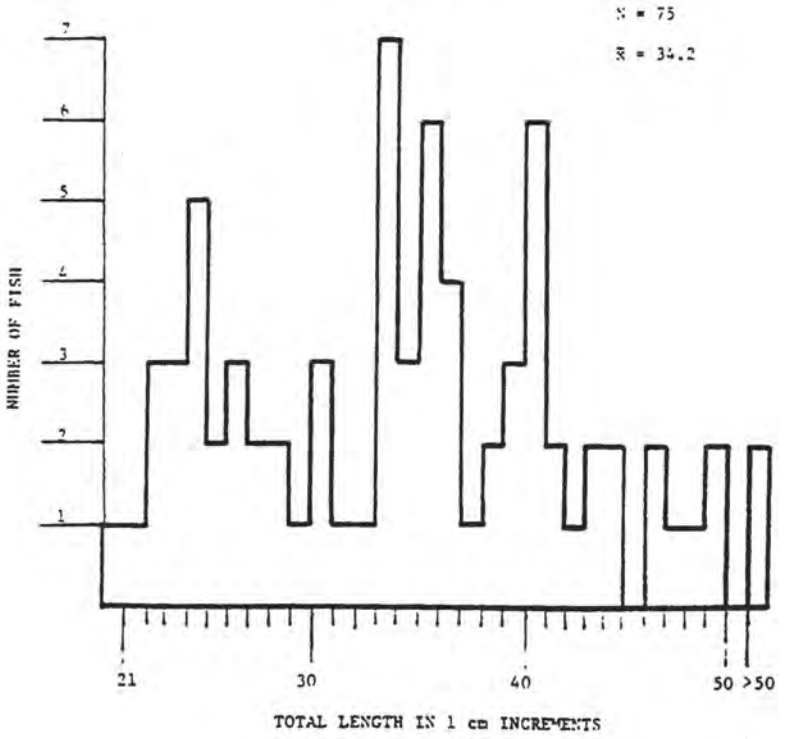

Fig. 6. Length composition of sheepshead.

(13.4 in), with a wide size range (Fig. 6). The average size of bluefish was 31.5 cm (12.4 in) total length, distributed as shown in Fig. 7.

DISCUSSION

Survey Logistics

The principal difference between the 1990 and 1989 MRFSS was a 37% reduction in the total number of interviews obtained. Sampling was reduced because MRD did not consider the relatively insignificant improvement in statistical reliability associated with the larger sample sufficient justification for the greater expense. MRD's major interest was in trends in private boat catch and catch per unit of effort for red drum and spotted seatrout. Simple expansion of the MRFSS wave quotas was not the most direct or effective way to address these aspects. We believed that targeting SFS coverage at specific areas with high levels of inshore private boat fishing activity was a more practical approach. The total number of SFS interviews was therefore doubled in 1990. We did not, however, succeed in obtaining all of the intended area-specific goals, as was evident in the length frequency data for red drum, for example.

The average cost per (MRFSS) interview increased appreciably in 1990. With all expenses calculated in terms of 1990 costs, the average cost per 1989 interview (personnel time for travel and on-site plus mileage expense) was $9.10, compared to $11.41 in 1990. These figures do not include personnel time for editing, processing, or meal allowances. Both average travel and on-site times per interview in 1990 were higher, as was the average mileage.

Participation and Effort

The estimated total number of anglers in 1990 was nearly identical to the 1979-1989 average (with 1982 and 1984 data omitted as outliers). With the hurricane year (1989) not included, however, only 1981 and 1986 had lower estimates (Fig. 8). If 1989 is also dropped (as an atypical year) from calculation of the average, then the 1990 estimate was about 5% below the long-term mean. Most of the apparent decline reflected a drop in the number of fishermen from out of state, with the 1990 estimate identical to that in the hurricane year and about 33% below the 1979-1988 average. Since South Carolina consistently has had the lowest percentage of resident marine anglers (i.e., residents/total anglers) in the southeast (Essig et al. 1991), the effect of a decline in out of state participation would be especially obvious.

The Grand Strand piers were mostly destroyed by Hurricane Hugo and only one was operational in 1990. A 1977 study of this pier fishery reported that 57% of the anglers were from out of state and that the majority of pier fishermen traveled to the coast strictly to fish (Hammond and Cupka 1977). About 39% of the out of state anglers reported coming to the area solely because of the availability of pier fishing. The absence of the piers therefore presumably had a significant impact on the number of out of state fishermen frequenting the northern coastal area, where much of the

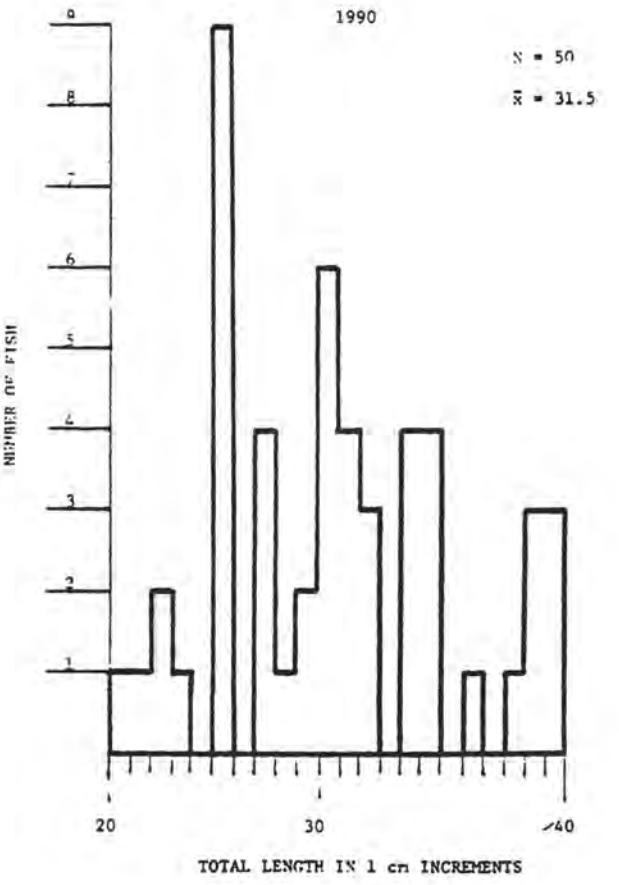

Fig. 7. Length composition of bluefish.

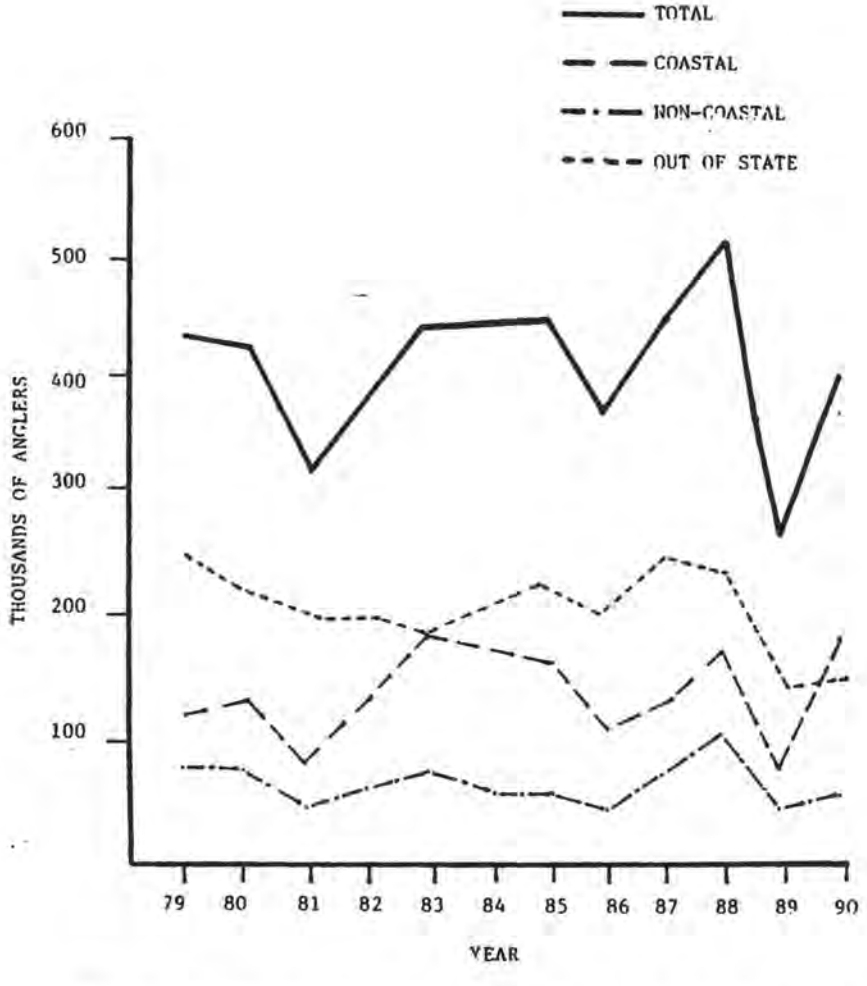

Fig. 8. Trends in estimated participation in the South Carolina marine recreational hook and line fishery.

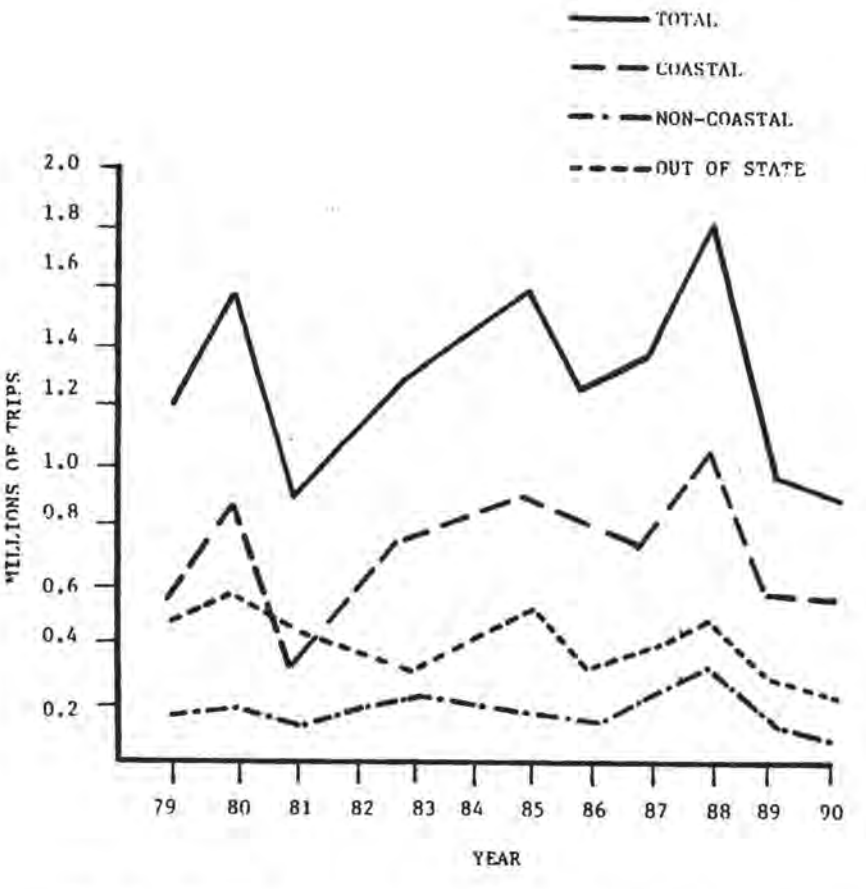

Fig. 9. Trends in estimated effort in the South Carolina marine recreational hook and line fishery.

out of state fishing participation occurs.

From a management perspective, trends in levels of effort are more important than those in participation because of the relationship between fishing pressure and fishing mortality. Although the popular perception is that fishing effort has steadily increased, results from recent MRFSS activities clearly attest to the contrary. Table 34 lists the percentage changes in estimated 1990 effort levels by time interval, mode, and residential category from those in 1) 1989 and 2) the average of 1987 and 1988 estimates.

Shore-based fishing is popular with all categories of residents. In 1990, shore effort during waves 2-4 was down appreciably from the pre-hurricane period in 1989 in all residential categories. As expected, effort during waves 5-6 in 1990 was appreciably greater than in 1989, reflecting some recovery of the pier fishery. Annual shore effort in 1990, however, was down 53% from the 1987/1988 average, with far less effort by anglers in all residential categories. Effort in this mode will probably continue to recover to pre-hurricane levels as more piers become active.

Annual charterboat effort in 1990 was about the same (+1%) as the 1987/1988 average, but well below (- 20%) the 1989 level. This decline was primarily attributable to much lower 1990 effort in waves 5-6 by out of state residents. Prior to 1989, charterboat effort by all categories of residents had been trending sharply upward. In 1989 prior to the storm, effort by out of state residents continued to increase (compared to 1988) while that of state residents declined. The storm resulted in a decrease in waves 5-6 as could be expected due to disruption of operations and poor post-hurricane fishing for pelagic species. In 1990, the increasing trend continued during waves 2-4 but wave 5-6 effort was down 72% compared to that in 1989 and 76% vs 1988. There was no obvious explanation for the fall decline.

Private boat effort accounted for the majority of overall fishing in the state and is of the greatest interest to management because it was primarily expended in state waters and targeted at species (e.g. red drum, spotted seatrout, and flounders) currently managed at the state level. In 1990, private boat effort by coastal residents in waves 2-4 was up somewhat (+ 8%) compared to the 1989 level, but down 22% from the 1987/1988 average. In waves 5-6, it was down 26% from 1989 and 47% from the previous two years' average. Out of state effort also increased during waves 2-4 compared to 1989 (+ 35%), but was down appreciably (-49%) from the 1987/1988 level. In waves 5-6, out of state private boat effort in 1990 was well below that in both the hurricane year (-27%) and 1987/1988 (-57%). Private boat effort by non-coastal residents declined substantially across the board. Overall, private boat effort in 1990 was down 39% from the 1987/1988 average. One plausible explanation for the decrease during waves 5-6 could be the increased level of effort in the shrimp baiting fishery. In other surveys, shrimpers have indicated that they are also anglers and it is likely that many devoted the majority of their activity to shrimping rather than fishing during the baiting season.

Annual effort by coastal residents in all modes combined was up slightly (+1%) from that in 1989, but down 35% from the 1987/1988 average. Effort by non-coastal residents declined relative to both

Table 34. Percentage changes in 1990 effort by residential category, mode, and time interval compared to 1989 and the 1987/1988 averages.

Residential category	Mode	Vs 1989	Vs 1987/1988 avg.
	Waves 2 - 4	-	-
Coastal	Shore	- 4%	- 31%
	Charterboat	- 6%	- 20%
	Private boat	+ 8%	- 22%
	Total	+ 4%	- 25%
Non-coastal	Shore	- 35%	- 64%
	Charterboat	+ 131%	+ 93%
	Private boat	- 35%	- 59%
	Total	- 22%	- 53%
Out of state	Shore	- 47%	- 56%
	Charterboat	- 4%	+ 48%
	Private boat	+ 35%	- 49%
	Total	- 21%	- 37%
	Waves 5 - 6		
Coastal	Shore	+ 83%	- 51%
	Charterboat	+ 1%	+ 44%
	Private boat	- 26%	- 47%
	Total	- 4%	- 48%
Non-coastal	Shore	- 10%	- 86%
	Charterboat	- 74%	- 66%
	Private boat	- 34%	- 61%
	Total	- 34%	- 74%
Out of state	Shore	+ 36%	- 63%
	Charterboat	- 80%	- 78%
	Private boat	- 27%	- 57%
	Total	- 22%	- 64%

the 1989 (-26%) and 1987/1988 (-62%) levels. Out of state effort was also down in comparison to both the 1989 (-21%) and 1987/1988 (-49%) figures.

Several indicators suggested that these were real declines rather than due to sampling artifacts. The percentage of South Carolina coastal households interviewed during the phone survey that contained a member who had fished in salt water during the previous two months declined and was the lowest in the South Atlantic region in 1990. The average number of marine fishermen per fishing household was also lower than in recent years. Finally, although difficult to assign to precise time periods, it appeared that the average number of days fished per angler per 12-month interval also decreased.

There are several possible explanations for this apparent trend, which is consistent with that reported nationally by the Sport Fishing Institute. Although the coastal populations are steadily increasing, assumption of a proportional increase in recreational angling effort is unwarranted due to a "saturation effect." This occurs when the density of fishermen exceeds a threshold level and dissatisfaction attributable to the effects of crowding contribute to related declines in both participation and effort. Another contributing factor could be the generally unfavorable recent economic climate in the state, which has impacted working class residents that comprise the majority of the marine recreational fishing population. A 1989 survey of shrimp baiters (75% of whom indicated that they were marine sportsfishermen as well) found that 85% were actively employed (mainly in professional/technical and tradesman/manufacturing occupations) and 70% had gross annual household incomes below $50,000 (Low 1990). Presumably, many in this group could have increased their worktime and have had less time and discretionary funds available for fishing.

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 in catch estimates for the shore mode and some species of offshore fish.

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, e.g. offshore pelagics, are underestimated because they are targeted and/or caught primarily by anglers not likely to be intercepted during the MRFSS.

These factors should be considered when evaluating results from the MRFSS. The absolute catch estimates for many species or groups

are probably rather meaningless. For the most frequently caught fishes, the relative rankings and long-term trends in catch appear to be reasonably reliable when considered in conjunction with anecdotal information and results from other sources.

Species preferences were generally similar to those in recent years except for minor changes in relative ranking. Perhaps the most notable change was a drop in the ranking of spot (from fourth in 1988 and 1989 to eighth). This decline was probably attributable to the reduced number of pier anglers interviewed. The percentage of anglers targeting Spanish mackerel has increased considerably since the mid-1980's as its abundance has steadily improved. Sheepshead also appear to be becoming more popular with private boat anglers, particularly during the first half of the year.

The estimated total catch in 1990 was the lowest since the MRFSS began and followed the second poorest year (1989). While the principal causative factor in both years appeared to be reduced effort, there were several instances where species-specific catch rates also showed appreciable declines. Overall, however, there were no substantial changes in species composition by group, with declines more or less evenly spread across all groups. This characteristic suggests that reduced effort was the main reason for the lower landings.

There was relatively little change in the overall species composition of the annual landings. In 1990, offshore pelagics comprised 1%, compared to 2% the previous year. Offshore bottomfish represented 10% of the 1990 catch vs 12% in 1989, although landings of the principal species - black sea bass - were down nearly 68%. Regional sea bass landings have also been declining. The retention rate was somewhat lower also, suggesting a higher percentage of small fish (the length frequency sample was too small to evaluate). One possible explanation was that most of the 1989 catch was made during the cooler weather when the average size was larger, while a larger portion of the 1990 landings occurred during the warmer months.

Coastal pelagics accounted for 14% of the 1990 landings compared to 12% in the previous year. Mackerel catches registered a substantial decline despite apparently healthy stock status.

Inshore sportfish comprised a somewhat larger portion of overall landings in 1990 (18% vs 10% in 1989). MRD biologists were seriously concerned about the effects of the hurricane and December freeze in 1989 which would be manifested primarily in landings of red drum and spotted seatrout in 1990 (one year old fish contribute significantly to the catches of both species). Prior to the hurricane, young red drum were abundant but the numbers observed in spring of 1990 were abnormally low. Landings for the year were above those in 1989 but well below those of other recent years.

Spotted seatrout are particularly vulnerable to winter kills and catches historically have been low in years following cold winters. Immediately after the December cold spell, MRD staff received reports of fish kills (primarily spotted seatrout) in the Charleston area and observed dead fish at several locations. As expected, landings in 1990 were well below average and probably reflected significant mortality associated with the low December water temperatures.

Summer flounder landings continued to be depressed, reflecting the uniformly poor condition of the stock throughout its range. Those of southern flounder were also well below average, despite an apparently healthy population.

As in 1989, inshore bottomfish represented the largest component of the landings; the percentages were very similar in both years. Atlantic croaker was the dominant species, with landings continuing the upward trend observed in the last three years. Landings of spot showed the opposite pattern and were down 87% from 1989's, the absence of a large pier fishery probably being a significant factor.

Shark landings also continued a steep rate of decline since the peak year of 1987, although most of the catch appeared to consist of Atlantic sharpnose, considered to be in relatively healthy condition. The retention rate continued to increase, which may be a contributing factor if abundance is on the decline.

Landings of miscellaneous species were relatively a little lower in 1990 (22% of the total vs 25% in 1989). As has been normally the case, pinfish and catfish dominated this group.

Shore based fishing success followed the usual pattern, being highest in the early fall and in the northern counties. Average catch per angler was low and the failure rate high. Species composition was somewhat atypical due to low landings of spot, normally one of the most abundant species.

Charterboat fishing characteristics were generally consistent with those observed in recent years in terms of species preferences by area and season and species composition of the catches. The overall failure rate in 1990 (35%) was slightly higher than in 1989 (32%). Pelagic species, as usual, were the principal target, often of surface trolling for "anything." The average catch rate (1.2 fish per angler) was identical to that in 1989, although there were area-specific differences:

	Pelagic catch rate			Angler failure rate		
	1988	1989	1990	1988	1989	1990
Beaufort County	1.5	1.6	0.9	32%	31%	56%
Charleston County	0.9	0.7	1.1	33%	40%	35%
Georgetown/Horry Counties	2.3	1.3	1.8	6%	28%	7%

Mackerels were the principal species targeted by charterboat fishermen. Comparative catch rates for king mackerel in recent years have been as follows:

	1988	1989	1990
		Wave 3	
Beaufort County	0.1	0	0.1
Charleston County	0.3	0.2	0
Georgetown/Horry Counties	2.3	1.8	1.2

		Waves 5 and 6	
Beaufort County	0.1	0	0
Charleston County	0.7	0.1	0.3
Georgetown/Horry Counties	1.5	0.9	2.1

In 1988 and 1989, fishing success was generally better during the spring run, while in 1990 the fall fishing excelled. With the overall index of catch rate calculated simply as the total number of fish caught divided by the total numbers of anglers (regardless of species targeted), there was little difference between the two years: 0.51 in 1990 and 0.48 in 1989. Most of the catch was landed in the Georgetown/Horry area. There the annual indices were 1.27 in 1990 and 0.96 in 1989, with the higher 1990 value being primarily attributable to substantially higher fall landings. The hurricane eliminated most of the fall fishery in 1989.

For Spanish mackerel, the overall annual statewide averages obtained by dividing the catch by number of anglers regardless of species targeted were 0.50 in 1990 and 0.47 in 1989. Most of the charterboat catch is usually made by Beaufort County boats during waves 3 and 4. Catch rates for that area/wave cell were 1.51 in 1990 and 1.91 in 1989. Since these indices would have been unaffected by the hurricane, a reasonable conclusion is that the angling for this species was somewhat better during (most of) 1989.

Private boat anglers generally were not as successful in 1990 as in recent years (Table 35). In the table, parameter values were calculated as the total numbers of fish divided by the total numbers of anglers. The obvious assumption is that the relative proportions of ocean anglers/inshore anglers by area have remained similar, which appears warranted given the survey design. The 1990 statewide catch rate (3.4 fish per angler) was considerably lower than in 1989 (5.6). Since the private boat mode accounts for most of the estimated total catch after expansion of the creel census data, the decline in overall landings was mostly attributable to the decline in success in this mode.

In Beaufort County, the all-species private boat catch rate has steadily declined in recent years. Success for the popular inshore gamefish (red drum and spotted seatrout) during the most productive period (waves 5 and 6) has also dropped sharply. The percentage of unsuccessful anglers has increased, particularly during the spring and summer.

In Charleston County, changes have been less pronounced. The overall catch rate has declined slightly, while there has been relatively little change in fishing success for the inshore game species. The percentage of unsuccessful anglers has been variable with no pronounced directional trend.

The situation appears to be most favorable in the northern counties, where the overall catch rate has remained comparatively high throughout the year. This should be considered in the context that inshore bottomfish (spot, croaker, etc.) comprise a larger percentage of inshore landings here than in the other counties with the contribution of inshore gamefish correspondingly lower. The catch rate of the latter group appears to have trended upward, due

Table 35. Fishing success parameters for private boat fishermen.

Parameter	Area	1988	1989	1990
Catch per angler of all species combined			Waves 1-4	
	Beaufort County	3.3	2.5	1.5
	Charleston/Colleton Counties	2.5	4.9	2.6
	Georgetown/Horry Counties	4.2	5.9	4.1
			Waves 5-6	
	Beaufort County	3.9	3.1	1.3
	Charleston/Colleton Counties	4.6	4.5	3.7
	Georgetown/Horry Counties	7.2	11.8	8.5
Catch per angler of red drum and spotted seatrout			Waves 1-4	
	Beaufort County	0.3	0.3	0.3
	Charleston/Colleton Counties	0.7	0.4	0.5
	Georgetown/Horry Counties	0.2	0.1	0.2
			Waves 5-6	
	Beaufort County	2.2	1.7	0.6
	Charleston/Colleton Counties	1.6	2.2	1.6
	Georgetown/Horry Counties	0.4	0.6	0.8
Percentage of anglers catching no fish			Waves 1-4	
	Beaufort County	43	37	64
	Charleston/Colleton Counties	50	21	36
	Georgetown/Horry Counties	42	21	32
			Waves 5-6	
	Beaufort County	40	38	45
	Charleston/Colleton Counties	30	27	38
	Georgetown/Horry Counties	30	13	18

primarily to landings of red drum. The failure rate, consistently lower than elsewhere in the state, also seems to have decreased.

Length Composition

The 14 in minimum size limit for red drum was in effect during waves 4, 5, and 6 of 1990. During this time frame, the percentage of undersized fish (10%) observed was lower than during the size limit periods in 1988 and 1989 (16% in both years). This suggested that public awareness and compliance with the regulation improved. The statewide annual average size (45.7 cm, 18.0 in) of retained fish was comparable to than seen in 1989 (46.3 cm, 18.25 in) and 1988 (43.3 cm, 17.0 in). Although it may be that the higher 1989 and 1990 averages were solely attributable to regulatory changes, there is some evidence to suggest that the fish available were larger. The percentages of fish observed during waves 5 and 6 that were over 50 cm were virtually identical in all three years (1988 - 19%, 1989 - 18%, 1990 - 19%), but the percentages of retained red drum over 50 cm during spring and summer have been increasing. During waves 2 and 3, the figures were: 1988 - 9%, 1989 - 25%, 1990 - 41%. In wave 4, they were: 1988 18%, 1989 - 42%, 1990 - 55%.

Statewide in 1990 46% of the total red drum catch was reported released, compared to 23% in 1989 and 50% in 1988. The highest release rate (73%) was in wave 4 (July/August). In an average year, most of the incoming year class attains 14 in during September (i.e., in wave 5). In 1990, 36% of the reported wave 5 catch was released and 15% of the wave 6 catch.

If 27.0 in (69 cm) is considered the average size at first maturity, then the South Carolina catch consisted almost entirely of immature fish. Only 3% exceeded this benchmark. Nearly all of the red drum seen were caught by private boat anglers fishing in inshore waters. These estuarine fish are typically one and two year olds and support the directed fishery. There is substantial concern that the escapement rate to the regional offshore brood stock is insufficient at present levels of fishing mortality of immature fish. One of the corrective options proposed by the Atlantic States Marine Fisheries Commission (ASMFC) management plan is an 18.0 in (45.7 cm) minimum size limit, equivalent to the average size observed in South Carolina in 1990. About 54% of the total retained catch was between this measure and the current legal size, while 34% fell between 18 in and 27 in. The imposition of the higher minimum size limit would therefore reduce the retained catch by at least half of the present level.

Another proposed option would be adjustment of the maximum size limit and associated bag limit. The current state regulation permits retention of one red drum per day in excess of 32 in (81 cm). Only one fish of this size was seen in the 1990 surveys and only 3% were between 27 and 32 in. The ASMFC plan proposes a zero retention level for fish over 27 in as an alternative to the 18 in minimum size limit (with a five fish bag limit). It appears that any modification in the upper size/bag limit provision would have a minimal impact on the South Carolina fishery.

The average size of retained spotted seatrout in 1990 (37.1 cm) was very similar to that seen in recent years (e.g. 37.7 cm in 1989,

36.6 cm in 1988, and 37.0 cm in 1987). Compliance with the minimum size limit appeared to be very good, with no undersized fish seen in 1990 and only 2% in both 1989 and 1988. Several other states in the southeast have a 14 in minimum size limit. About 48% of the 1990 observed catch was between 12 and 14 in, so adoption of the larger measure would nearly halve the catch from its present level.

A 12 in minimum size limit for flounders was enacted in 1990 effective at the beginning of wave 4. In 1988, about 39% of the inspected catch was below this size, while in 1989 the figure was 18%. The retained flounder catch in 1990 therefore was probably down at least 20% because of the new regulation.

The average sizes of both Spanish and king mackerel in 1990 were virtually identical to those observed in 1989 and 1988. Sample size of the other commonly caught ocean species subject to size limits, black sea bass, was too small to permit any meaningful evaluation.

Stock Status

The main species commonly caught by South Carolina anglers that are currently of significant management interest are red drum, spotted seatrout, flounders (particularly the fluke or summer flounder), Spanish mackerel, king mackerel, and black sea bass. Numerous offshore snapper-grouper species have shown signs of overexploitation and are being increasingly regulated; however, these fish are seldom targeted or caught by the modes covered in these surveys (the headboats account for most of the recreational landings). While extensive discussion of the apparent stock status of each exceeds the scope of this report, some comments based on the survey data are relevant.

All of the above-named species had year round minimum size limits in place as of June, 1990. The size limit for king mackerel has no biological basis and is intended to avoid enforcement problems attributable to confusion with Spanish mackerel. The red drum minimum size limit is an arbitrary figure selected to permit a reasonable level of retainable catch while preventing excessive harvest of immature fish, although it is not based on maturity characteristics (the maximum size limit is). For the other species, the size limits are roughly equivalent to typical average sizes at first maturity.

In 1990, the average sizes of retained fish observed vs the minimum size limits were as follows: spotted seatrout + 22%, southern flounder + 14%, and Spanish mackerel + 38%. The sample size of summer flounder (N = 11 in 1990) in recent years has been too small for reliable evaluations, but it appears that the vast majority of the fish landed in South Carolina are immature (i.e., below 13 in total length). Small sample size in 1990 also applied to black sea bass, although the means in 1989 and 1988 were about 25% above the minimum size limit. These observations suggest that the average size of retained fish of all species except summer flounder is comfortably above the acceptable biological threshold. Also important is that these annual means have remained practically constant since 1987 (the first year of MRD's involvement in comprehensive surveys).

The other stock-related factor generated by the survey data is CPUE or catch rate, believed to be roughly indicative of abundance, at least for the age groups that provide the vast majority of the catch. Table 36 summarizes 1990 area catch rate data for the inshore sportfishes, combined from both surveys over all waves and modes. Anglers include fishermen who targeted the species and/or caught it. Catch rates are based on total landings, i.e., both retained and released fish.

The red drum catch rate for Beaufort County included one very large charterboat catch; with this omitted, the catch rate was 2.2 fish per angler. These red drum CPUE's are comparable to those observed in recent years. The release rates are higher because of regulatory changes. Fishing has tended to be somewhat less successful in Charleston County (mainly the Charleston metro area) where directed effort is probably the highest in the state (the average size has also been slightly lower).

The bulk of the directed effort for spotted seatrout also occurs in Charleston County, as do most of the landings. Statewide success for this species has roughly paralleled that for red drum in overall order of magnitude in recent years, both as measured in catch and CPUE, although there have been substantial area differences. Catch rates have been consistently lower in the northern counties, where this species is not particularly popular. The Charleston County CPUE has not shown any pronounced directional trend in the last few years.

Most of the directed fishery for flounders occurs in the northern counties, particularly in the Murrells Inlet area. Catch rates have been typically low except in this area because most of the fish elsewhere represent incidental catches. The release rate has been low because of the high food esteem and local preference for pan-dressed fish.

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Table 36. Catch rates by area for popular inshore sport fishes, combined over all waves and modes, MRFSS and SFS data combined.

Species	Area	No. anglers	% with fish	% of catch released	Fish/angler
Red drum	Beaufort County	77	49	45	3.0
	Charleston County	193	40	40	1.0
	Georgetown/Horry Counties	102	67	23	1.5
Spotted seatrout	Beaufort County	42	60	42	1.5
	Charleston County	185	51	29	1.7
	Georgetown/Horry Counties	37	46	24	0.5
Flounders	Beaufort County	14	57	0	0.6
	Charleston County	71	38	17	0.6
	Georgetown/Horry Counties	106	67	10	1.6

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