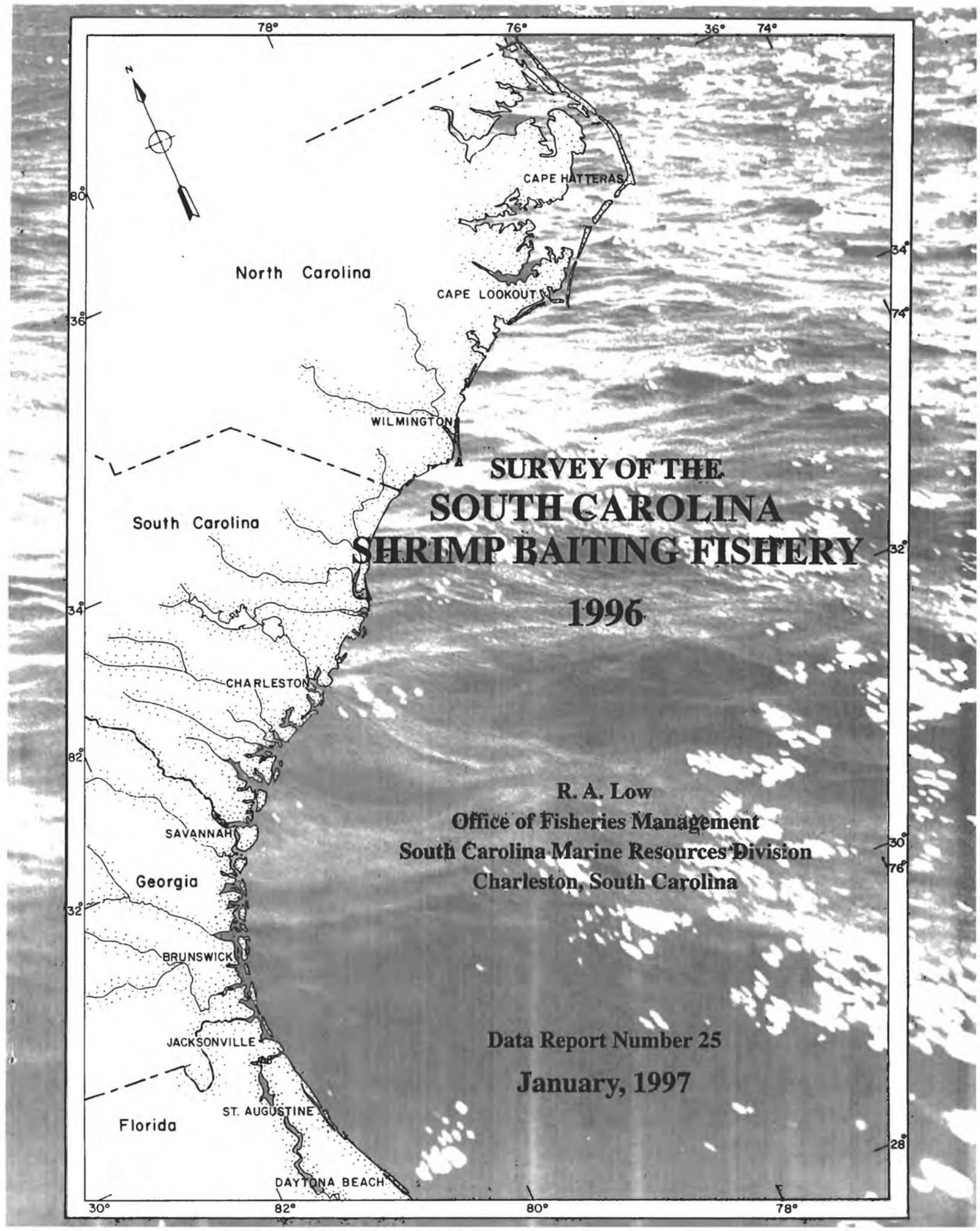

SURVEY OF THE SOUTH CAROLINA SHRIMP BAITING FISHERY

1996

R. A. Low
Office of Fisheries Management
South Carolina Marine Resources Division
Charleston, South Carolina

Data Report Number 25

January, 1997

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Mary Jo Clise and the Computer Services Section provided computer listings of permit holders and mailing labels. Printing of survey materials was done in the SCDNR Print Shop in Columbia under the supervision of B. R. Hook. Joe Moran and Nan Jenkins of the Fisheries Statistics Section provided information on commercial landings. The survey was funded with proceeds from sales of 1996 shrimp baiting permits at a cost of approximately $1,500.

INTRODUCTION

Theiling (1988) described the history of shrimp baiting in South Carolina. Surveys have been conducted annually since 1987, using various approaches to address several objectives and issues (Theiling 1988; Waltz and Hens 1989; Liao 1993; Low 1990, 1991, 1992, 1993, 1994, 1995, and 1996). These studies have obtained statistics on participation, effort, and catch for each season, in addition to information on demographics of participants and constituency opinions on management options, user group conflicts, and economic issues.

Data for the 1996 fishery were obtained from a postseason mailout survey. The objectives were to estimate 1) total participation (i.e., the numbers of active permit holders and their assistants), 2) total effort in numbers of trips, 3) total catch, and 4) effort and catch by shrimping area.

METHODS

The survey was identical to that conducted in 1994 and 1995. The survey package consisted of an introductory statement and a self-addressed business reply postcard questionnaire (Fig. 1). The package was sent by first class mail to 3,539 permit holders, 25% of the total population of 14,156. In each county, 25% of the permit holder population was randomly selected for inclusion in the sample. The mailout was approximately one week after the closing of the season on November 12. Responses received after December 16 were not included in the analysis in order to minimize problems associated with recall.

RESULTS

The effective mailout (i.e., after subtraction of nondeliverables) was 3,495 with a return rate of 43.7% by the cutoff date. Distributions of the total permit holder population and sample population by area of residence are shown in Table 1. As in previous years, the return rates from noncoastal residents were slightly higher, but the overall distribution of the sample group was reasonably comparable to that of the total permit holder population.

Participation

Nearly 15% of the respondents indicated that they had made no trips on their permit (i.e., using their gear tags). The estimated numbers of active permit holders (Table 2) were obtained by multiplying the number of permits issued in each residence category by the percentage of positive responses received per area. Assistants were the numbers of different individuals who accompanied the permit holders. Although some individuals probably

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P.O. BOX 12559
CHARLESTON, S.C. 29422-9909

1. What county do you live in? _____

2. How many trips did you make using your permit and gear?

   _____ SEP _____ OCT _____ NOV _____ All season

3. Please indicate the number of trips you made in <u>each</u> area, as indicated on the enclosed map.

   _____ BEAUFORT _____ CHARLESTON

   _____ ST. HELENA SD _____ BULLS BAY

   _____ WADMALAW/EDISTO IS. _____ GEORGETOWN

4. How many <u>different</u> people assisted you on your trips? _____

5. What was your average catch of shrimp per trip in quarts of whole shrimp? _____

6. What was your total catch for the season? _____ quarts

7. Do you have a 1996/97 marine fishing stamp? _____ YES _____ NO

Fig. 1. Survey questionnaire.

Table 1. Distribution of permit holders and sample population.

Residence category	Total population N	Total population %	Sample population N	Sample population % return	Sample population % of total
Northern Coastal					
Georgetown	825	5.8	78	38.2	5.1
Horry	339	2.4	38	46.3	2.5
Total	**1,164**	**8.2**	**116**	**40.6**	**7.6**
Central Coastal					
Berkeley	1,368	9.7	141	41.8	9.2
Charleston	3,644	25.7	387	43.2	25.3
Dorchester	779	5.5	80	41.2	5.2
Total	**5,791**	**40.9**	**608**	**42.6**	**39.8**
Southern Coastal					
Beaufort	1,423	10.1	158	45.7	10.3
Colleton	680	4.8	73	43.5	4.8
Hampton	411	2.9	34	33.0	2.2
Jasper	265	1.9	21	32.3	1.4
Total	**2,779**	**19.6**	**286**	**41.9**	**18.7**
Central Inland					
Aiken	517	3.7	57	44.5	3.7
Allendale	132	0.9	13	40.6	0.9
Bamberg	185	1.3	19	40.4	1.2
Barnwell	253	1.8	24	38.1	1.6
Lexington	705	5.0	78	44.3	5.1
Orangeburg	516	3.6	51	39.5	3.3
Richland	427	3.0	59	55.1	3.9
Total	**2,735**	**19.3**	**301**	**44.1**	**19.7**
Other	**1,687**	**11.9**	**216**	**51.6**	**14.1**
Total	**14,156**		**1,527**		

Table 2. Estimated participation by residence category.

	Northern Coastal	Central Coastal	Southern Coastal	Central Inland	Other	Total
Permits issued	1,164	5,791	2,779	2,735	1,687	14,156
% active permits	80.2	88.2	81.8	83.7	81.5	85.1
Number active	934	5,108	2,273	2,289	1,375	11,979
Average assistants	2.05	2.41	2.16	2.16	2.09	2.25
Total assistants	1,915	12,310	4,910	4,944	2,874	26,953
Total participants	2,849	17,418	7,183	7,233	4,249	38,932
% change from 1995	- < 1	- 2.5	-15.2	- 9.5	-10.9	- 7.2
% of total (1996)	7.3	44.7	18.5	18.6	10.9	

Table 3. Estimated number of trips by residence category.

	Northern Coastal	Central Coastal	Southern Coastal	Central Inland	Other	Total
Average trips/permit	5.3	6.6	6.0	4.5	4.5	5.7
% of total by month						
September	37	35	34	35	37	35
October	51	48	48	48	47	48
November	12	17	18	17	16	17
Estimated trips/month						
September	1,833	11,854	4,601	3,642	2,282	24,212
October	2,527	16,257	6,495	4,995	2,899	33,173
November	594	5,757	2,435	1,769	987	11,542
Total	**4,954**	**33,868**	**13,531**	**10,406**	**6,168**	**68,927**
% change from 1995	- 7.3	- 8.4	- 32.8	- 16.2	-8.9	- 15.6
Percent of total	7	49	20	15	9	

were counted by more than one respondent, the extent of such duplication was assumed to be negligible. The average numbers of assistants per permit holder in each residence category were multiplied by the estimated numbers of active permit holders to obtain the estimated total numbers of assistants. The total numbers of participants equalled the sums of the active permit holders and their assistants.

Effort

The average numbers of season trips per active permit holder were obtained by summing the numbers of trips reported in each residence category and dividing these figures by the numbers of respondents who reported trips. These means were then multiplied by the numbers of estimated active permit holders in the overall populations to obtain estimates of seasonal effort by residence category (Table 3). The estimated numbers of trips per month were calculated by multiplying these season totals by the appropriate percentages of trips in each month. These were determined from the data provided by respondents who broke their seasonal effort down into complete monthly components. The estimated effort figures in the **Total** column were generated by adding the categorical figures.

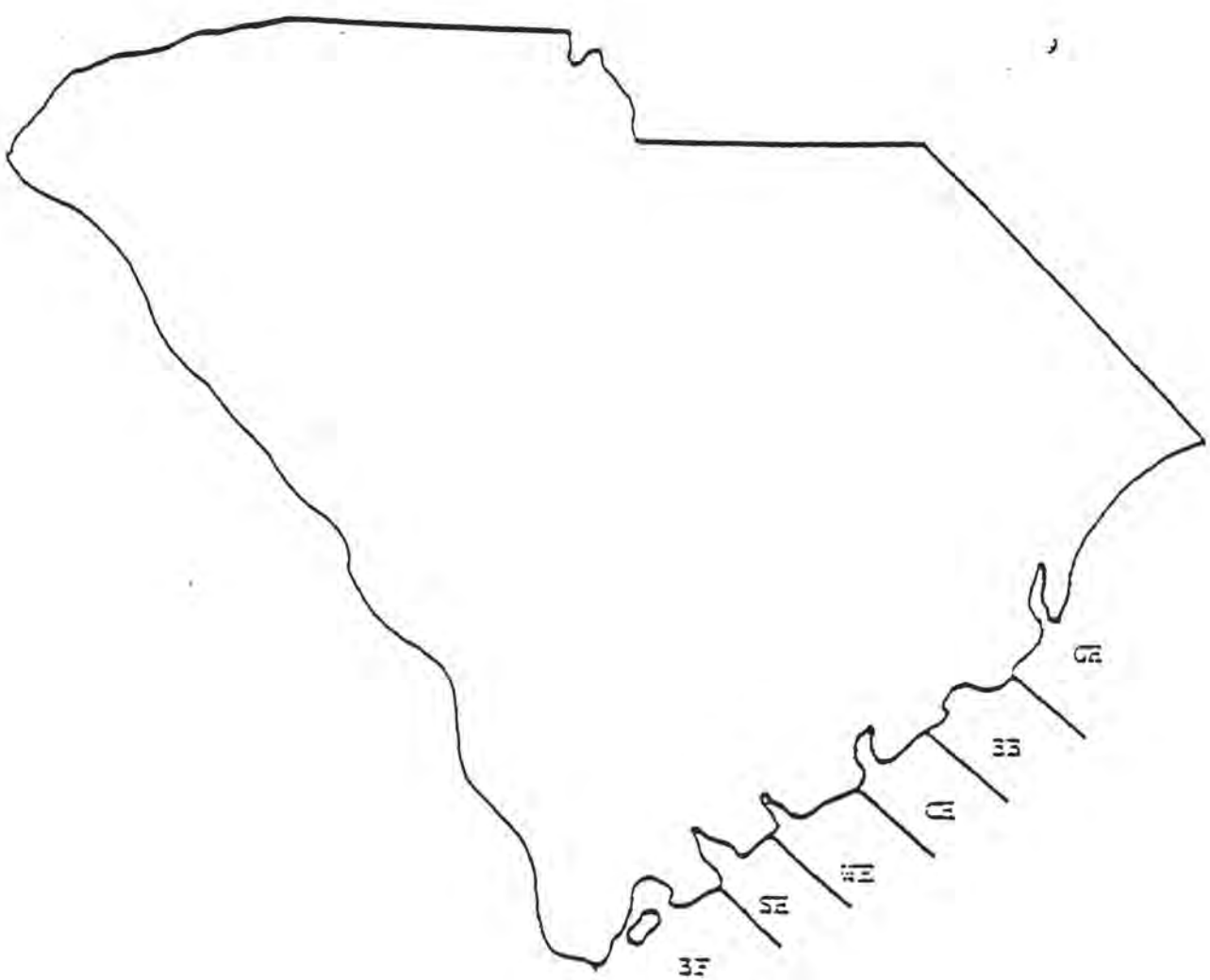
The coastal area was divided into six geographical components (Fig. 2). The relative distribution of estimated effort in each area is indicated in Table 4. These figures were obtained by multiplying the total numbers of trips in each residence category by the percentages of effort reported in each area. Percentages were determined by summing all trips reported by area within each residence category, then dividing by the numbers associated with each area.

The distribution of effort in terms of average number of trips/permit holder is shown in Fig. 3. Noncoastal residents averaged somewhat fewer trips than did coastal residents.

Catch Rates

Average seasonal catch rates are listed in Table 5. These were obtained by adding the reported catch per unit of effort (CPUE, in quarts of whole shrimp/trip) in each category and dividing by the numbers of observations. The CPUEs in Table 6 were calculated by summing the season CPUES for each area and dividing these figures by the corresponding numbers of observations. Only the data from respondents who limited their activity to one area were included, since there was no way to separate catch and effort by area for respondents who shrimped in more than one area.

The residential stratification of the sample population was comparable to that of the total permit holder population. An unbiased estimate of the average statewide CPUE can then be obtained by calculating the mean of the CPUEs reported by



BF- BEAUFORT, including Calibogue and Port Royal Sounds, Broad River
SH- St. HELENA SOUND, including Coosaw, Combahee, and Ashepoo Rivers
WE- WADMALAW/EDISTO ISLANDS, including N. and S. Edisto Rivers
CH- CHARLESTON METRO, including the harbor, Kiawah, Stono, Folly, Ashley, Cooper, and Wando Rivers
BB- BULLS BAY, including the McClellanville area
GH- GEORGETOWN, including Santee and Winyah Bays and Horry County waters

Fig. 2. Shrimp baiting areas.

Table 4. Estimated number of trips by shrimping area.

Residence category	Beaufort	St. Helena	Wadmalaw Edisto	Charleston	Bulls Bay	Georgetown
North Cst.	10	51	51	174	4,126	542
Central Cst.	483	232	4,321	22,595	6,169	68
South Cst.	8,208	4,041	1,049	223	10	0
Central Inl.	4,708	1,942	1,878	1,056	747	75
Other	2,040	643	691	715	1,798	281
Total	**15,449**	**6,909**	**7,990**	**24,763**	**12,850**	**966**
% of total	**22**	**10**	**12**	**36**	**19**	**1**

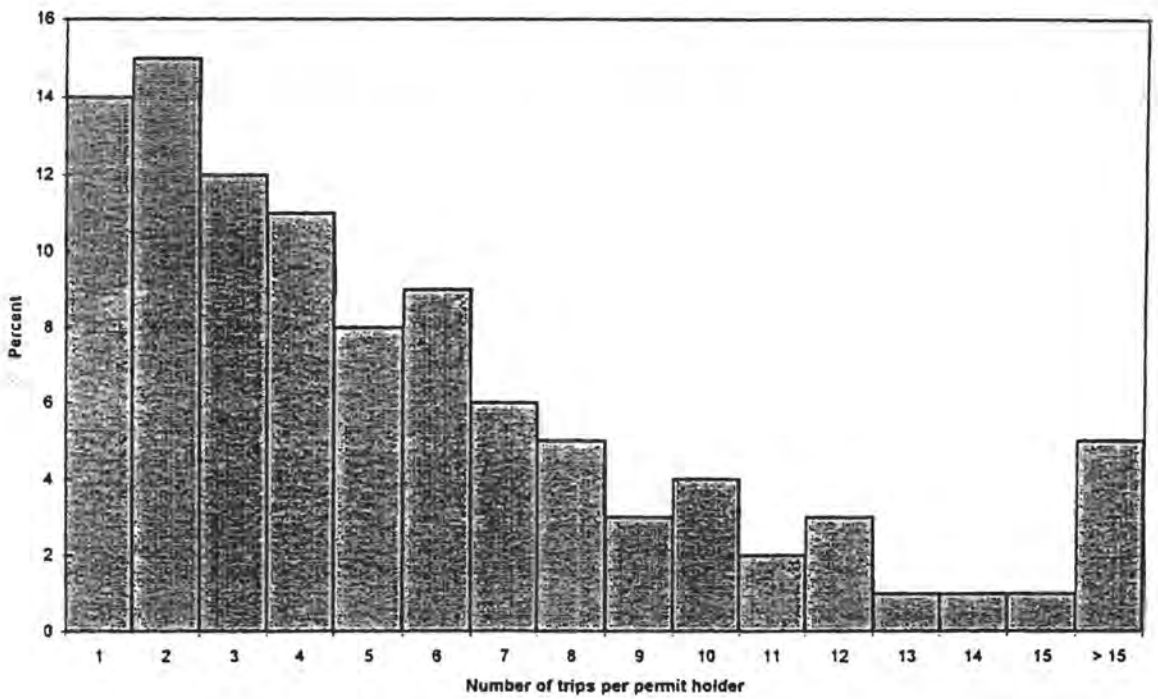


Fig. 3. Distribution of average effort per permit holder.

Table 5. CPUE by residence category.

Residence category	CPUE 1990	1991	1992	1993	1994	1995	1996
Northern Coastal	28.3	18.2	15.0	26.5	17.9	29.0	13.3
Central Coastal	24.0	17.9	24.3	22.3	21.7	27.0	18.7
Southern Coastal	28.3	24.1	26.3	24.0	12.1	28.9	14.8
Central Inland	) 23.5	24.6	30.3	24.0	16.7	32.3	16.7
Other	)	25.7	25.2	24.4	19.9	29.0	16.3

Table 6. CPUE by shrimping area.

Area	N(1996)	1990	1991	1992	1993	1994	1995	1996
Beaufort	260	28.6	24.4	28.7	22.2	13.2	30.6	15.5
St. Helena	89	23.8	25.0	29.7	23.8	16.4	27.7	18.8
Wad./Edisto	103	21.0	24.2	30.0	22.5	16.1	25.6	17.1
Charleston	287	23.2	14.1	23.4	20.4	21.6	26.1	18.2
Bulls Bay	157	23.8	22.5	20.3	26.4	23.1	28.7	15.2
Georgetown	14	26.7	10.5	14.4	26.9	13.2	19.9	9.6

respondents. For the 1996 season, this value was 16.9 quarts of whole shrimp/trip.

Catch

There are numerous ways to estimate the total catch, as described in previous reports. The examples shown here were selected to provide estimates for categories of primary interest.

The statewide average CPUE was multiplied by the estimated total number of trips to obtain a total catch estimate. This figure is 1,164,866 quarts of whole shrimp (16.9 quarts/trip x 68,927 trips).

Catches by shrimping area were obtained by multiplying the average CPUE for each area by the estimated number of trips in the area:

Area	Trips	CPUE	Catch (quarts)
Beaufort	15,449	15.5	239,460
St. Helena	6,909	18.8	129,889
Wadmalaw/Edisto	7,990	17.1	136,629
Charleston	24,763	18.2	450,687
Bulls Bay	12,850	15.2	195,320
Georgetown	966	9.6	9,274
Total	**68,927**		**1,161,259**

The catches by residence category were estimated by multiplying the effort estimates for each by the corresponding average catch rates:

Residence category	Trips	CPUE	Catch (quarts)
Northern Coastal	4,954	13.3	65,888
Central Coastal	33,868	18.7	633,332
Southern Coastal	13,531	14.8	200,259
Central Inland	10,406	16.7	173,780
Other	6,168	16.3	100,538
Total	**68,927**		**1,173,797**

There are trade-offs in probable accuracy and lack of bias associated with each approach and an intermediate value is therefore a reasonable estimate. The average of the three figures shown above is 1.167 M quarts. The conversion factor from quarts to pounds (whole weight) is 1.48. The 1996 total baiting catch was thus approximately 1.727 M pounds of heads-on shrimp. The conversion factor to heads-off weight is 0.649, giving an estimate

of 1.121 M pounds heads-off.

The distribution of catches per permit holder is listed in Table 7. The statewide average catch per permit holder (based on these data) was 98 quarts (145 pounds) of whole shrimp. Assuming that this was evenly divided between the permit holders and their assistants, the typical participant obtained about 44 pounds of whole shrimp.

The relative distribution of the fall white shrimp harvest is perceived by some parties as an allocation issue. Since 1992, a monitoring system for commercial landings has been in place that permits comparison of recreational and commercial landings for reasonably comparable area/time units. The baiting areas and corresponding commercial statistical zones are as follows:

Baiting area	Commercial zone
Beaufort (rivers, sound)	Hilton Head to Bay Point
St. Helena Sound	Bay Point to S. Edisto River
Wadmalaw/Edisto Islands	S. Edisto River to Stono Inlet
Charleston (rivers, harbor)	Stono Inlet to Dewees Inlet
Bulls Bay	Dewees Inlet to Cape Romain
Georgetown (rivers, bay)	Cape Romain to N.C. line, Winyah and Santee Bays

The comparison of baiting and commercial landings is shown in Table 8. In-season commercial landings were defined as those during week 2 of September through week 2 of November. Total commercial landings included those from week 1 of August through the closure of the 1996 season in January, 1997.

Comparisons between areas are influenced by factors such as the relative sizes of the recreational populations and trawler fleets, proximity of population centers and trawler docks, accessibility of inland waters, and extent of inland waters vs trawlable coastal waters.

DISCUSSION

The winter of 1995/1996 was considerably colder than those in recent years with an extended period of water temperatures below the 47 degree F threshhold level of significant mortality for overwintering white shrimp. The spring spawning stock was relatively low, although spawning success appeared to be fair.

The August emigration rate appeared to be comparable to that in 1993 and was not as affected by heavy rainfall as in 1991 and 1995. Hurricane Fran passed close to the South Carolina coast during the first week of September, however, with accompanying rains.

Table 7. Distribution of season catches (quarts of whole shrimp) in percentages of respondents by residence category.

Residence category	Catch/permit holder <99	100-199	200-299	300-399	400-499	>500
Northern Coastal	77	17	6	< 1		
Central Coastal	59	22	9	5	2	4
Southern Coastal	70	16	8	3	< 1	2
Central Inland	75	17	6	< 1	< 1	< 1
Other	78	11	8	2	< 1	< 1
Statewide	68	18	8	3	1	2

Table 8. Estimated shrimp baiting catches and reported commercial landings (all gears) by area, in pounds of whole shrimp.

Area	Baiting	Commercial In-season	Commercial Total	Total combined
Beaufort	354,401	63,200	146,667	501,068
St. Helena	192,236	534,012	976,927	1,169,163
Wad./Edisto	202,211	247,958	363,589	565,800
Charleston	667,017	168,581	284,946	951,963
Bulls Bay	289,074	280,071	475,184	764,258
Georgetown	13,726	448,964	1,014,878	1,028,604
Total	1,718,665	1,742,786	3,262,191	4,980,856

Area	Baiting percentage In-season 1995	In-season 1996	Total combined 1995	Total combined 1996
Beaufort	85	85	78	71
St. Helena	21	26	11	16
Wad./Edisto	37	45	27	36
Charleston	65	80	50	70
Bulls Bay	61	51	43	38
Georgetown	5	3	3	1
Total	48	50	33	35

The season opened on September 13, a week after the storm. Initial success in the Charleston area appeared to be fairly good for shrimp of variable size with less favorable reports from other areas. In recent years, Bulls Bay has been noted for its early season production, but shrimp were scarce there in 1996. Shrimping in the Beaufort area was also reported to be unusually poor during September.

Another major storm (Josephine) caused heavy rainfall in mid-October and weather thereafter tended to be more inclement than usual. Although anecdotal information continued to indicate fair success in the Charleston area, reports from other areas were negative. The shrimp in Winyah Bay were very small with very little effort evident there.

Major parameter characteristics of the 1996 season are compared to those from recent years in Table 9. Total permit sales were the highest on record, in spite of widely publicized pre-season forecasts of a relatively poor crop. The incremental rate of increase (1.7%), however, was the lowest of the last four years. Distribution of permit holders by county remained nearly identical to that in recent years.

Trends in growth of permit sales have varied considerably between residential categories during 1988-1996. The largest relative increases have occurred in the "Other" category of inland residents (859%) and northern category of coastal residents (666%). The lowest relative increase has been for the Central Coast category (83%). The greatest growth in all areas occurred during 1988-1991 (Fig. 3) with overall permit sales more than doubling.

Since 1991, the incremental annual growth rates have been much lower. Numbers of permit holders have remained virtually constant in the two most populous categories (i.e., the Central and South Coast groups). The average rate of increase for the Central Inland group has been about 7% with a declining trend. The trend in the North Coast area has been highly variable with an overall annual average increase of 12% during the last five years. Relative growth has been greatest and most consistent in "other" inland counties with an average annual rate of 14%.

The overall percentage of active permit holders in 1996 was the lowest since the hurricane year of 1989. Compared to 1995's figures, levels of participation declined in all residence categories. Participation by residents of the southern coastal area was unusually low, probably reflecting the scarcity of shrimp there.

Estimated total effort was the lowest since 1992 with the average individual effort matching that in the record low year of 1989. This was partly attributable to bad weather, but reports of poor shrimping probably also contributed. The biggest decline in

Table 9. Season comparisons of participation, effort, and catch parameters.

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Permits issued	NA	5509	6644	9703	12005	11571	12984	13366	13919	14156
% active permits	NA	92	82	94	89	87	91	86	89	85
Assistants/permit	NA	2.50	2.14	2.79	2.24	2.15	2.43	2.32	2.39	2.25
Participants	21735	17749	17171	34662	34821	31812	40620	38081	41971	38932
Trips/permit	NA	7.0	5.7	7.8	6.6	6.1	6.8	6.0	6.5	5.7
Total trips	40101	35609	31624	71153	71034	62459	80709	70429	81632	68927
Mean CPUE	28.5	22.1	26.5	25.6	21.3	25.4	23.5	18.5	28.9	16.9
M pounds whole	1.80	1.16	1.25	2.75	2.14	2.35	2.72	1.91	3.40	1.73
Lbs/participant	83	65	73	79	62	74	67	50	81	44
% of total landings	29	32	24	46	29	39	44	34	33	35

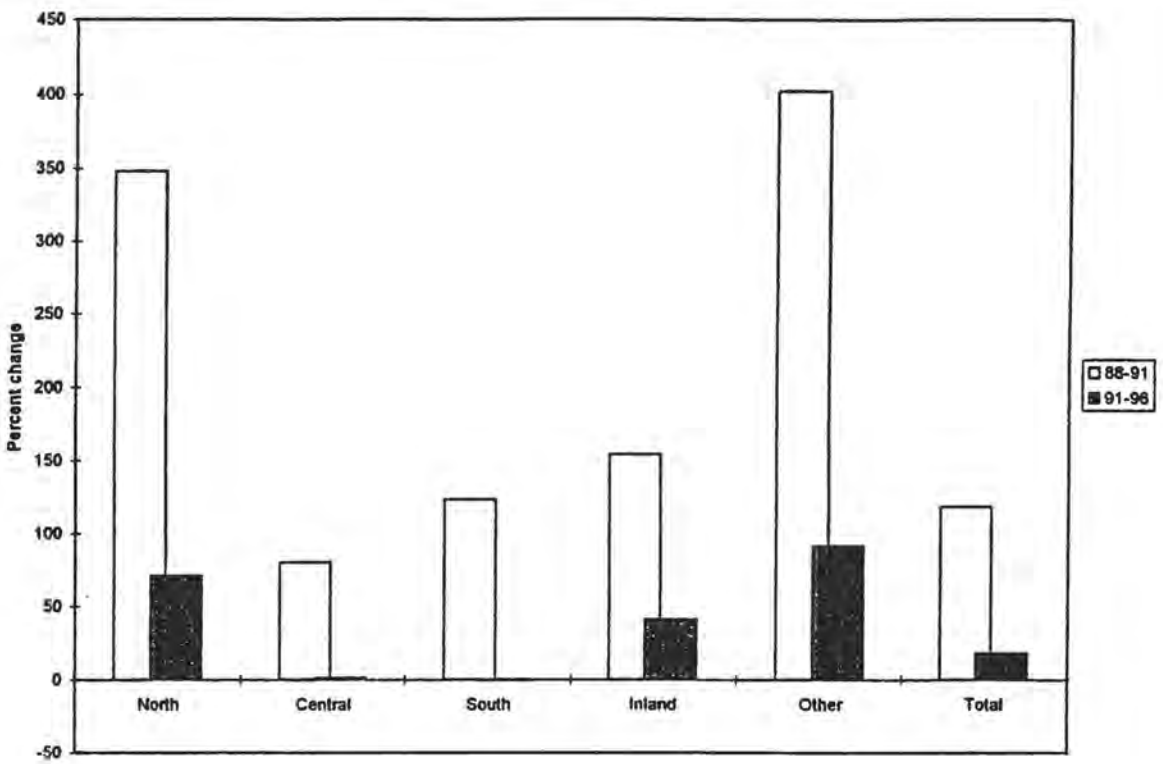


Fig. 4. Relative growth in permit sales by residential category.

average effort was by southern coastal residents. This group also registered the largest decrease in overall effort, down almost one-third from the 1995 level.

The status of effort by shrimping area is shown in Fig. 5. The largest decrease in number of trips was in the Beaufort area with the biggest percentage decline in the Georgetown region. As in 1995, the average size of shrimp in Winyah Bay was very small and this may have caused many shrimpers to relocate farther south. In recent years, much of the effort by northern coastal residents has been targeted at Bulls Bay. Although the 1996 effort in Bulls Bay was above the six-year average, it was down 31% from the 1995 level. Much of the intended effort for Bulls Bay (particularly by central coastal residents) appeared to have been redirected to Charleston, which showed a 21% increase from the 1995 figure. Another likely contributing factor was the continuing poor public accessibility to Bulls Bay.

Catch rates were down appreciably in all areas, compared to the record high levels attained in 1995, and were generally below the long-term averages as well. The south-central coastal area was the most productive as measured by this index. As in previous years, catch rates in the southern sounds area remained similar (Fig. 6), while those in the northern coastal area were much more variable (Fig. 7).

The estimated total catch was the lowest since the hurricane year of 1989, although not much lower than that in 1994. It was roughly half of the record production achieved in 1995. The largest decrease occurred in the Beaufort area (Fig. 8). Compared to the levels of recent years, the percentage decline in Charleston was the lowest of that in major shrimping areas.

The historical distribution of the fall white shrimp harvest is shown in Fig. 9 (the dark portion represents the baiting component). There has been no obvious trend in the relationship between the baiters' share and total landings. For the ten years illustrated, the baiters' share has been <33% in four with an average total harvest of 5.58 M pounds. It has been 33% or higher in six years with mean total landings of 6.55 M pounds. In the years of the largest relative baiting shares (1990 and 1993), the total landings (5.98 and 6.21 M pounds, respectively) were close to the 10-year mean of 6.16 M pounds.

In the years (1991-1996) when permit sales exceeded 10,000, the average share has been 36% compared to 33% for the earlier period (1987-1990) of lower permit issuance. In years when effort has exceeded 65,000 trips, the baiting share has averaged 37% vs 31% in years of lower effort. The abundance of shrimp (with total landings considered as a proxy) does not appear to have been a major factor. Overall landings were lowest in 1988 (3.68 M pounds) and highest in 1995 (10.31 M pounds) with baiters' shares of 32%

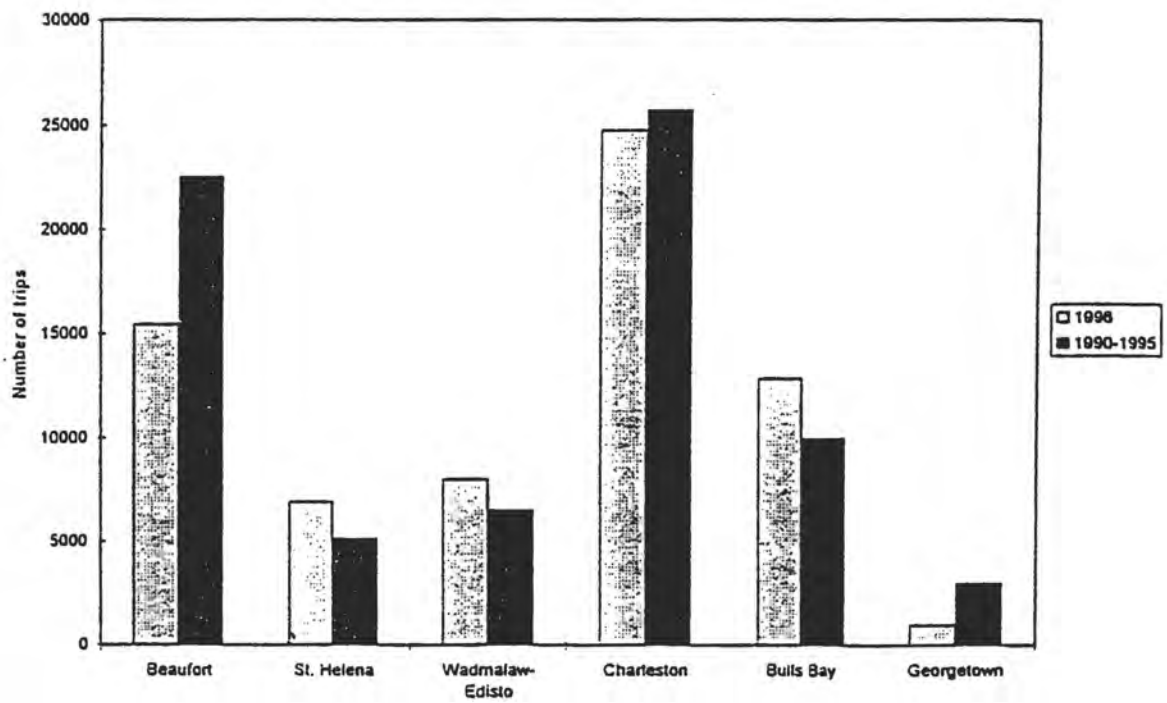


Fig. 5. Effort status by area compared to 1990-1995 averages.

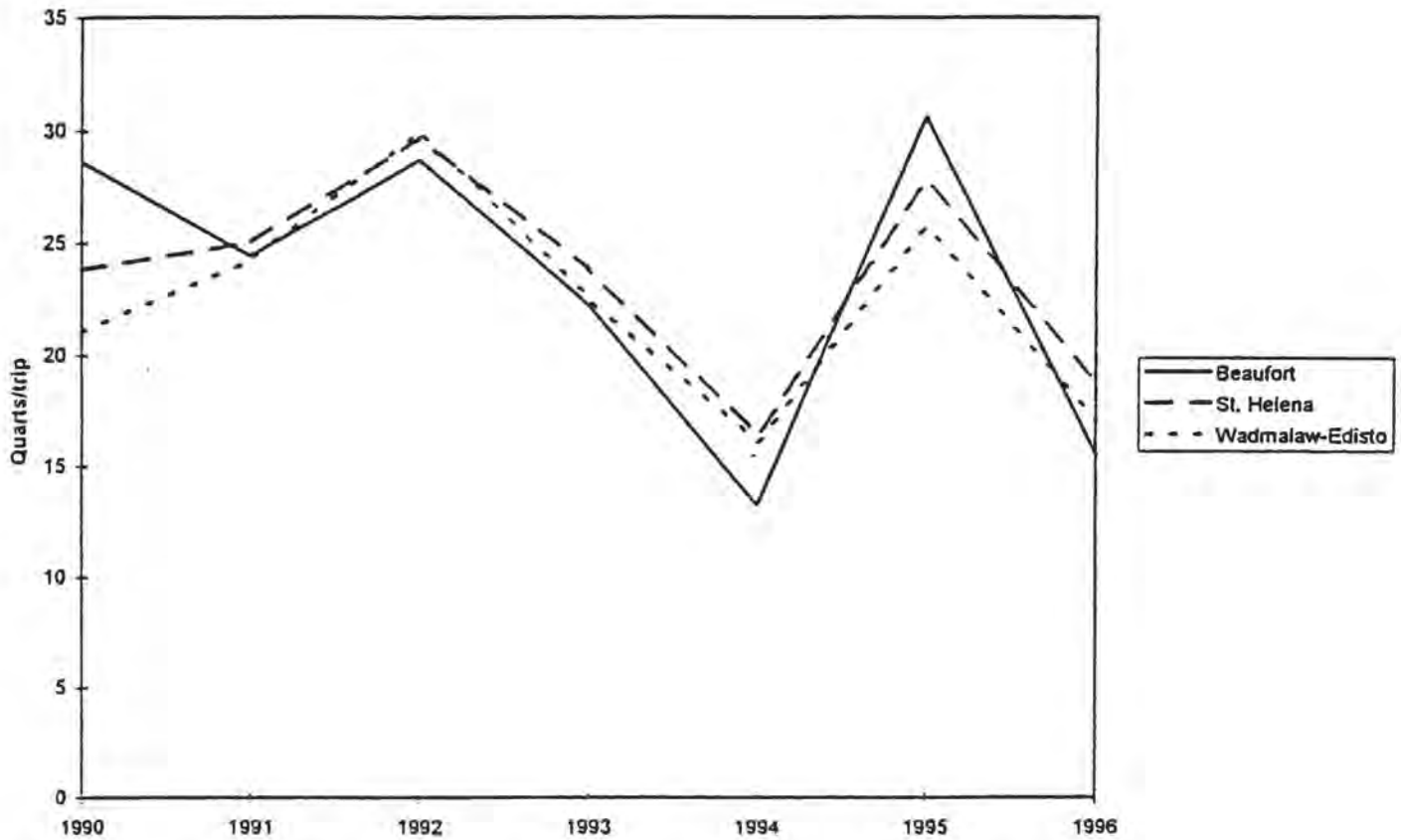


Fig. 6. Trends in CPUE in the southern sounds area.

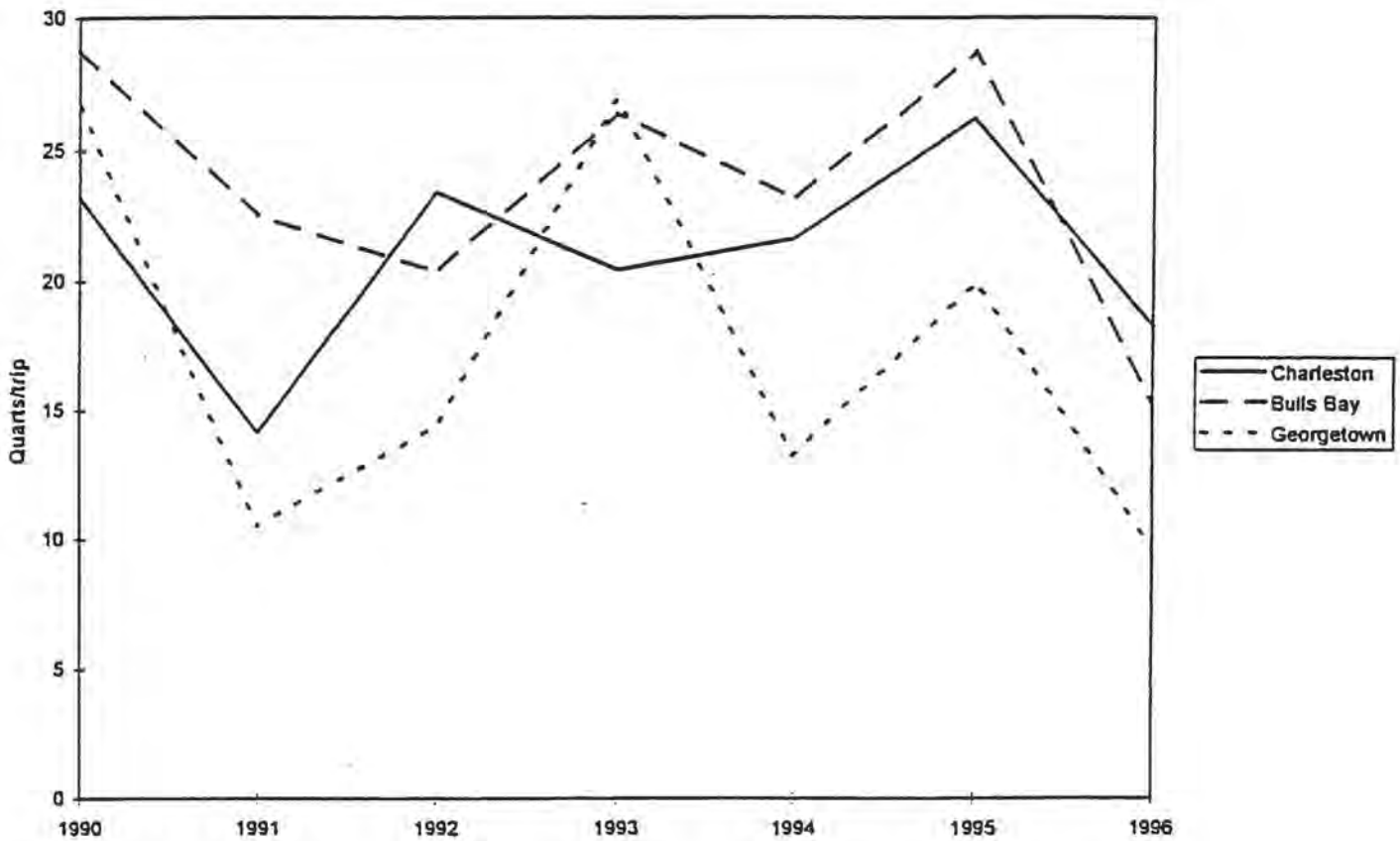


Fig. 7. Trends in CPUE in the northern coastal area.

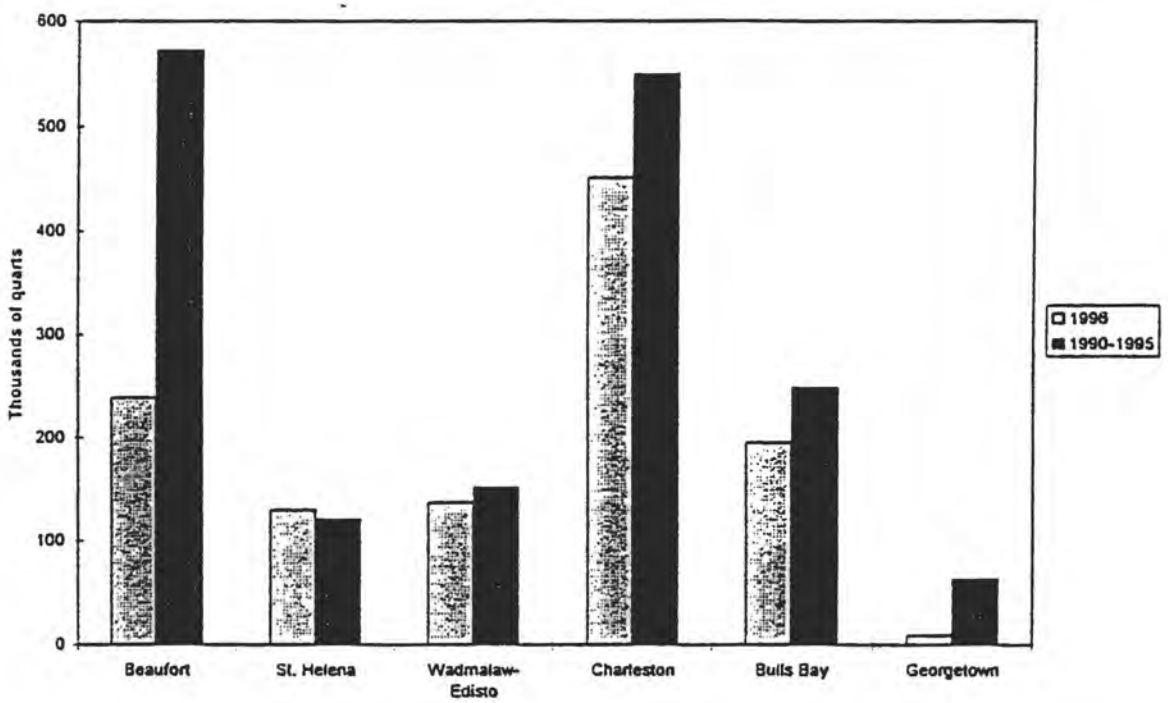


Fig. 8. Catch status by area compared to 1990-1995 averages.

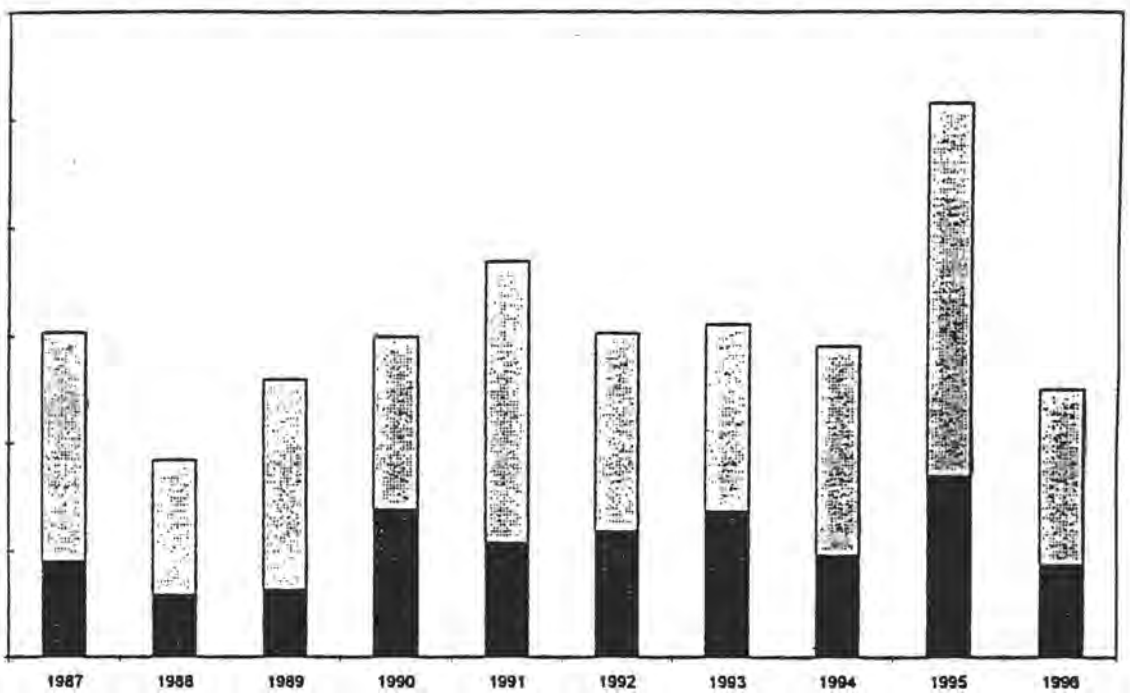


Fig. 9. Baiters' share vs total fall white shrimp landings.

and 33%, respectively. The ratios of effort (1:2.3) and landings (1:2.8)for these years, however, were roughly comparable.

Although there has been a tendency for the baiting component to be slightly larger in conjunction with relatively high levels of effort, environmental conditions appear to be the principal factor affecting the distribution of fall landings. The lowest baiting share occurred in 1989, following the landfall of Hurricane Hugo at Charleston early in the season. From Charleston northward, shrimp were flushed out to sea and baiting effort was sharply curtailed. The baiting share also was low in 1991, when heavy rains in August prompted substantial seaward movement prior to the season opening. The highest shares have occurred in years (e.g. 1993) when in-season weather was favorable and tended to delay shrimp outmigration.

Under current law, individuals harvesting shellfish or fishing for marine finfish from privately owned boats must have a Marine Recreational Fisheries Stamp. Persons baiting for shrimp are not required to have this stamp, but must possess a shrimp baiting permit. Since nearly all baiting is done from private boats and the 1989 survey (Low 1990) had shown that most shrimpers also participated in other marine resource harvesting activities, respondents were asked if they had a current marine fishing stamp. Statewide, 76.2% indicated in the affirmative and 2.2% replied that they held a gratis license, for a total of 78.4%. About 21.6% of all respondents reported that they did not have a stamp. This information agrees closely with the results of the 1989 survey, in which 76% of the respondents reported that they went marine rod and reel fishing and 20% reported that they did no type of marine harvesting other than shrimping. As would be expected, the percentage of 1996 noncoastal shrimpers who did not have a marine fishing stamp (31.8%) was appreciably higher than that of coastal residents (16.4%).

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