The South Carolina Shrimp Baiting Fishery 1988-2002: A review of trends and issues

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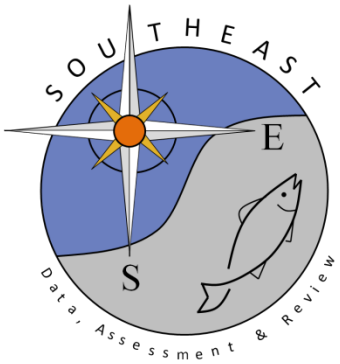

THE SOUTH CAROLINA SHRIMP BAITING FISHERY

1988 – 2002

A Review of Trends and Issues

Public Information Document

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Introduction

The 2002 shrimp baiting season marked the 15th year of this unique noncommercial fishery managed under a permit system by the Marine Resources Division. In view of recent developments in the state's shrimp fisheries, such as the effects of a persistent drought, increasing occurrence of black gill syndrome, and sharp reductions in prices for locally harvested shrimp, it is appropriate to review the historical trends and current status of this popular activity. With the continued development of the coastal area and its associated population increase, it is certain that several issues relevant to the shrimp resource will attract further attention. Those that apply to the baiting fishery have been addressed previously, but history has shown clearly that they will revisited. The objectives of this report are to 1) document the trends in characteristics of this fishery, 2) provide an overview of the issues that have been associated with it, and 3) offer some brief analytical perspectives relevant to both the fishery and these issues.

Background

Shrimping has long been a popular recreational activity in the Lowcountry of South Carolina, as well as a subsistence fishery for low-income residents. Prior to 1980, noncommercial shrimping was practiced with three principal gears. Baited drop nets were used from docks, bridges, piers, and, rarely, from boats. Cast nets were employed from the same platforms. Seine nets were also fished, principally for brown shrimp in the summer. The magnitude of noncommercial shrimping activity was basically unknown. Cupka and McKenzie (1974) reported that one-third of the recreational shrimpers used gear other than cast nets and two-thirds did not employ boats. It was estimated that their annual harvest approximated 10% of the commercial (mainly trawl) landings.

Some cast netters spread animal feed (e.g. chicken mash) in shallow areas shortly before throwing cast nets in order to concentrate the shrimp. This technique was especially effective for white shrimp in the fall. A refinement was introduced in Beaufort and Jasper Counties about 1980, reputedly by fishermen from Florida. The modified method involved the use of stakes to precisely mark the location of the bait, which was combined with mud or another binder into balls or patties. This improved the efficiency of cast netting by both concentrating the shrimp and pinpointing their location.

White shrimp were relatively abundant in 1982 and 1983 and the modified baiting technique became increasingly popular. This drew opposition from the commercial sector. Trawlers viewed the practice as unfair competition , since most baiting occurred in areas closed to trawling. Seafood dealers also reacted to what they perceived as unjust competition for sales of shrimp. They argued that baiters did not have to purchase licenses and conform to reporting requirements and health regulations. As a result of these complaints, the General Assembly in June, 1983 prohibited the sale of shrimp taken over bait (by cast net). This was followed in April, 1985 by legislation limiting the catch by seine or cast net to 50 quarts of heads-on shrimp (or 30 quarts heads-off) per boat.

Abnormally cold winters drastically reduced the abundance of white shrimp in 1984 and 1985 with little growth observed in the new baiting practice. White shrimp were unusually abundant in 1986, which contributed to a large increase in noncommercial shrimping, including the new version of baiting. This generated more pressure on the General Assembly for additional restrictions. The Marine Resources Division (MRD) reviewed the situation with the Director asking the Marine Advisory Board (MAB) to pursue legislative action; the MRD recommended a prohibition on the use of bait and marking poles. The MAB approved in October, 1986 with the Wildlife and Marine Resources Commission concurring in February, 1987. No action was taken during the 1987 legislative session, in part because of little quantitative information about the extent of the baiting fishery and its landings.

During the fall white shrimp season that year, the MRD conducted a study to generate such information (Theiling 1988). A creel census was used to obtain details on fishing practices, measure catches and size of shrimp, and document the extent of conflicts between shrimpers. A postseason mailout survey of owners of 12-20 ft boats requested information on baiting effort. Data from these activities were used to generate estimates of participation, number of trips made, average catch rates, and total harvest.

Provided with this essential information for details of legislation, the General Assembly passed the Shrimp Baiting Act of 1988. This established a 60-day season, to be set by the MRD between 1 September and 15 November, with a maximum of ten tagged poles per boat set over not more than 100 yds. A 48-quart limit of heads-on shrimp per boat per 24-hr period was prescribed. A $25 permit was required and at least one permit holder with pole tags had to be in the boat. Additional persons in the boat were not required to have permits (this provision was clarified in subsequent legislation). These requirements in effect made the baiting fishery strictly a boat-based activity.

The 1988 season was therefore the first in which the participants could be reliably identified, because of the permit required. A total of 5,509 individuals purchased permits. A postseason mailout questionnaire, coded to allow identification of individual respondents, was sent to each permit holder. Respondents were asked to provide estimates of their number of trips, average catch per trip, comments on any problems experienced, and suggestions as to changes in management. A follow-up survey was sent two months later to all nonrespondents to the initial mailout (Waltz and Hens 1989).

The information obtained from the 1987 (Theiling 1988) and 1988 (Waltz and Hens 1989) studies established the basis for such efforts in the following years. The 1987 creel census visited a large number (N = 33) of access points and defined relative usage rates for them, which facilitated the planning of future on-site activity (as did data on site usage and areas shrimped from the 1988 survey). Based on the observations of catches, conversion factors for measuring volume were established. Technical aspects associated with the reliability and efficiency of mailout surveys were evaluated in the 1988 study. User conflicts and management concerns were identified for additional consideration.

Survey Methods

Waltz and Hens (1989) made the practical observation that "future efforts (need) to be thoroughly coordinated in terms of methodologies and procedures to make valid comparisons possible in the years to come." Since the postseason mailout survey was an essential part of the first two studies, this approach has been maintained throughout the fishery's existence as the principal source of data for determining participation, effort, and landings. Gotie et al. (1984) found that a *post facto* survey is applicable for short-term, special seasons where one inquiry supplies the data, no written records are needed by the respondent, and the activity is discreet and well-remembered; the shrimp baiting season conforms to these criteria.

There are two basic limitations to the use of this methodology. One is the ability of the respondent to recall events accurately, the other is his willingness to provide the information.

The recall factor has been thoroughly studied, particularly in conjunction with the design of the Marine Recreational Fishery Statistics Survey (MRFSS), used by the National Marine Fisheries Service (see Brown 1977 for a comprehensive review of this general subject; also Deuel 1980). Over a two-month period, it has been established that a person can accurately recall and report the type, number, and location of fishing trips, but not the number or size of fish caught. Because of this, the MRFSS employs two-month intervals in its telephone component. Waltz and Hens (1989) recommended that

> "future surveys should be planned in a way that will reduce the duration for which shrimpers are required to recall information. A time limit or deadline for the submission of survey returns should also be considered. On-site survey methods, as a means of verifying catch rates and obtaining length frequency information should also be employed."

Beginning with the 1989 study, the postseason mailout survey has been sent as soon after the close of the baiting season as possible (usually within two weeks). Analytical procedures are facilitated if the distribution (by residence) of the respondents approximates that of the entire permit holder population, even though "biases associated with a disproportionate response rate from a given sector of the state appear to be small" (Waltz and Hens 1989). After evaluating this aspect in the 1989 and 1990 surveys, (Low 1991b) concluded that a satisfactory response distribution was achieved within four weeks of the mailout date. It has since been standard procedure for the postseason mailout survey to specify a submission deadline of mid- December (the 15th in most years).

The cooperation of respondents is the other potential weak point of the mailout procedure: "the failure of some shrimpers to return survey forms may introduce a bias into the sample if respondents do not adequately represent the total population of shrimp baiters" (Waltz and Hens 1989). This "nonresponse bias" was examined in the 1988

survey through the use of multiple mailouts and statistical comparison of the response data. There was no significant difference in the average number of trips per respondent reported. Although the average catches rates were statistically different, the actual magnitude of the discrepancy was rather minor (6% lower for the nonrespondents to the first mailout).

What is less clear is the extent of any "response bias." The principal concern with the shrimp baiting surveys has been the possibility of overestimating effort and catch, as a result of "nonresponse bias" that presumes a nonrespondent has likely made fewer trips and/or caught less than the typical respondent. The associated risk pertaining to management, however, is usually higher if such parameters are underestimated. Thompson and Hubert (1990) found that anglers who fished often were the most reluctant to participate in a survey or devote effort to responding to questions. The individuals who participated less often were the most cooperative in recalling trip data. This bias would lead to underestimation of the actual levels of effort and catch. The results of the 1988 survey were therefore somewhat inconclusive on the extent of response vs nonresponse bias.

The accuracy of the individual data provided is problematic, as verification of same is virtually impossible; it has been assumed that voluntarily provided information has been accurate, in the absence of any incentive to falsify it. The widely alleged propensity of fishermen to exaggerate not withstanding, the catch data provided appear to be fairly reliable in an aggregate sense. In 1989, catches were measured volumetrically by creel clerks and these figures compared to the shrimpers' estimates; the shrimpers' average was 1.75% less than the average of the volumetric figures. The statewide mean CPUE (26.8 quarts/trip) estimated from the creel census data was in excellent agreement with that derived from the postseason survey data (26.5 quarts/trip).

The early surveys solicited comments from the respondents on a variety of topics, such as user conflicts and problems with the fishery. Resource user opinion polls are useful to determine 1) success of a program and 2) management policy for increased use enjoyment (Duttweiler 1976, Smith 1983). Given the newness of the permit program (as well as the relatively short history of the fishery itself), the MRD had an obvious interest in participants' perception of both. The responses received contributed greatly to subsequent assessment of issues pertaining to the fishery and its management with polls being periodically used to address specific concerns.

Table 1 shows the types of survey methods and sample sizes employed annually since the permit program was initiated. The total mailout has approximated 25% of the total number of permits sold. Typical return rates (within the designated response period) have been around 40% with the usable responses averaging about 10% of the total permit holder populations.

The following briefly describes the survey activities in each year. Each postseason mailout survey consisted of a standard set of questions on participation, effort, CPUE, and season catch, referred to as the basic survey. In some years, additional questions were included as indicated.

Table 1. Types of survey employed and sample sizes.

	On-site/creel census	Postseason mailout survey		
Year	interviews	Mailout N	Usable returns	Return % of total popn.
1988		5,509	3,472	63.3
1989	348	2,968	1,009	15.2
1990		3,100	1,263	13.0
1991		2,980	1,106	9.2
1992		3,078	1,291	11.2
1993		3,500	1,269	9.8
1994		3,500	1,418	10.6
1995		3,479	1,528	11.0
1996		3,539	1,527	10.8
1997		3,994	1,521	9.8
1998		4,000	1,688	9.6
1999	1,055	3,925	1,445	9.1
2000		3,984	1,487	9.3
2001		4,000	1,558	11.4
2002		4,000	1,324	9.5

1988- Two-part postseason mailout survey to test response-related bias. Respondents were asked to comment on problems with the fishery and need for management changes. (Waltz and Hens 1989)

1989- On-site creel census to obtain information on CPUE during specific intervals, gear and areas fished, retained bycatch, shrimp size, and trip expenses and distance traveled. Postseason mailout survey to estimate season catch and effort, determine use of launching sites, define conflicts and problems, and obtain socioeconomic data (household size, gross household income, occupation). (Low 1990)

1990- Postseason mailout survey, introducing evaluation by shrimping areas. Opinion poll on management options, i.e.,1) no changes, 2) longer season, 3) setting limit per permit holder instead of per boat, 4) authorizing MRD to set a flexible season, 5) allowing baiting from an anchored boat only with no poles, and 6) lottery drawing to set the numbers of permits per shrimping area. (Low 1991b)

1991- Postseason mailout survey, including questions on net dimensions, trip expenses, distances traveled, household size and income, age, years of baiting experience, documentation of problems/conflicts, and comments on management. (Low 1992)

1992- Basic survey. An attempt was made to monitor in-season CPUE by distributing catch reporting cards to shrimpers when they purchased their permits. Cards were postage-paid, pre-addressed, and asked for the date, fishing area, and catch for each trip. This effort was unsuccessful with only 24 cards returned. (Low 1993)

1993- Postseason mailout survey, including an opinion poll on illegal sales and various management options. (Low 1994)

1994- Basic survey. (Low 1995)

1995- Basic survey. (Low 1996)

1996- Basic survey. (Low 1997)

1997- Basic survey. (Low 1998b)

1998- Basic survey and questions evaluating the MRD's management . (Low 1999)

1999- Windshield (on-site) survey, creel census, and postseason mailout survey. The windshield survey consisted of cards left on cars at launching sites. These cards asked about the start/end times of trips, waiting time to launch, types of people in the boat, the amount of fish meal used, and the type of binder. The creel census measured shrimp and net dimensions (length and mesh size). The mailout survey included questions on mesh sizes used. (Low and Waltz 2000)

2000- Basic survey with questions concerning support for a fee increase for the marine recreational fishing license. (Low 2001)

2001- Basic survey. (Low 2002)

2002- Basic survey with questions about the locations of planned trips, cancellation and/or relocation of planned outings, and reasons for same. (Low 2003)

Fishery Trends

Distribution of permit holders by area of residence is summarized in Table 2. At the start of permit sales in 1988, residents of Charleston, Beaufort, and Berkeley Counties comprised 60% of the total permit holder population; in 2002, they were about 40% of it. In the North Coast counties, permit sales increased steadily until 2000, then leveled off at a slightly lower amount. In 2002, the actual numbers of permits sold in the individual Central Coast and South Coast counties were nearly the same as in 1991. Charleston County sales in 2002 were 25% less than in the peak year, 1998, and were the lowest since the initial year (1988). The permit holder population has been most stable in the South Coast counties with relatively minor fluctuations since 1991. Sales to residents of the Central Inland counties peaked in 1998 and have since steadily declined, especially in

Lexington County. Although aggregate sales for the other inland counties have declined a little in the last two years, their percentage of the overall total is currently at its highest level. A notable feature of the annual fluctuations since 1991 has been that the changes have been similar across the board with no one area showing a distinctly different shift.

Table 2. Distribution of permit holders by area of residence, in percentages of annual numbers of permit holders.

Area	1988	1989-91	1992-94	1995-97	1998-00	2001-02
North Coast						
Georgetown	2.4	3.5	5.7	5.7	5.8	5.4
Horry	0.3	0.8	1.6	2.3	3.3	3.3
Total	2.8	4.2	7.2	8.0	9.1	8.8
Central Coast						
Berkeley	9.4	12.0	10.1	9.9	8.7	8.0
Charleston	41.2	31.9	26.8	25.7	22.3	22.4
Dorchester	6.9	6.2	5.7	5.5	4.8	4.9
Total	57.5	50.2	42.6	41.0	35.9	35.4
South Coast						
Beaufort	10.3	11.9	11.6	10.0	10.1	10.3
Colleton	5.0	5.1	5.0	4.9	4.6	4.3
Hampton	4.0	3.8	3.4	2.9	2.7	2.6
Jasper	3.4	3.1	2.7	1.9	1.8	1.6
Total	22.7	23.9	22.7	19.6	19.1	18.9
Central Inland						
Aiken	2.0	2.8	3.5	3.7	3.9	3.8
Allendale	1.2	1.1	0.9	0.9	0.8	0.6
Bamberg	1.5	1.5	1.4	1.3	1.2	1.2
Barnwell	1.3	1.7	1.7	1.9	1.9	1.9
Lexington	2.5	3.1	4.4	5.1	5.9	5.8
Orangeburg	4.0	3.6	3.8	3.6	3.9	3.7
Richland	1.4	1.9	2.6	3.0	3.2	3.3
Total	13.9	15.7	18.3	19.4	20.7	20.3
Other Inland	3.1	6.5	9.0	11.9	15.2	16.7

The trend in total annual sales is shown in Fig. 1. Except for the slight decline in 1992, overall annual sales increased steadily to a peak in 1998. Since then, the fall white shrimp crops have been rather mediocre and fall weather has been somewhat inconsistent with several tropical storms during mid-season. The trend in participation has been

similar to that in permit sales; during 1991-2001, the annual percentages of active permit holders ranged from 81-91% and the average number of assistants has varied rather randomly.

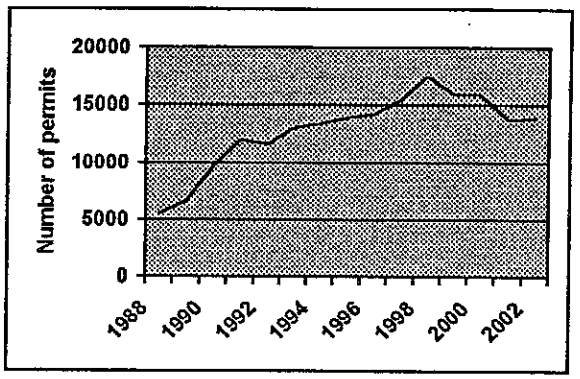

Fig. 1. Trend in total annual permit sales.

The trend in annual statewide effort is illustrated in Fig. 2. Total effort has been quite variable from year to year, since it is a function of several factors. During the last four years, effort has been well below the peak level attained in the 1997-1998 seasons. Since the permitted fishery was initiated, baiters have made slightly over one million estimated trips.

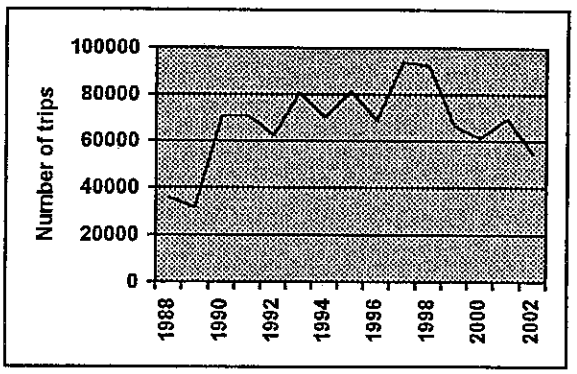

Fig. 2. Trend in annual statewide effort (numbers of trips).

The amount of statewide effort in a given year depends on 1) the total number of permits sold, 2) abundance of shrimp, 3) weather during the season, and 4) contemporary catch rates. These factors in turn are somewhat interactive. During the summer, the level of abundance of juvenile shrimp is fairly obvious to fishermen and becomes well-known among shrimping enthusiasts. The MRD also conducts a statewide sampling program and publicizes its findings.

The number of permits sold prior to the opening of the season appears to be rather strongly influenced by the perception of relative shrimp abundance. After the season has opened, the number of permits sold seems to depend on how well shrimpers are doing and the weather. The total number of permits sold annually has been fairly strongly associated with the average season CPUE ($r = 0.70$ with the hurricane years 1989 and 1999 excluded) with CPUE obviously being largely influenced by the abundance of shrimp.

If shrimping conditions have been favorable, the percentage of active permit holders has been higher. Fig. 3 shows the relationship between percentages of active permit holders and seasonal CPUE ($r = 0.80$ with data for 1989 and 1999 not included). Effort is calculated as the number of active permit holders multiplied by the average number of trips made per permit holder, and the latter variable is partly a function of CPUE as well (Fig. 4, $r = 0.79$ with 1989 and 1999 data excluded).

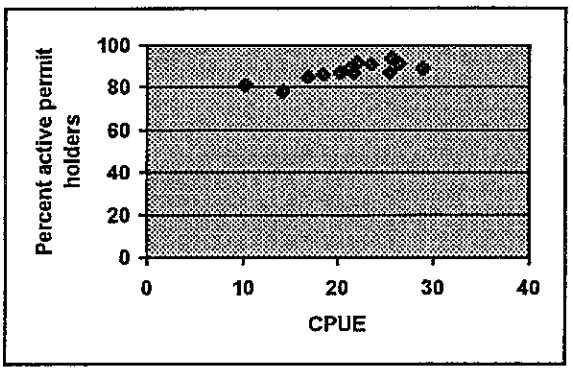

Fig. 3. Relationship between seasonal catch rates (CPUE) and permit holder activity.

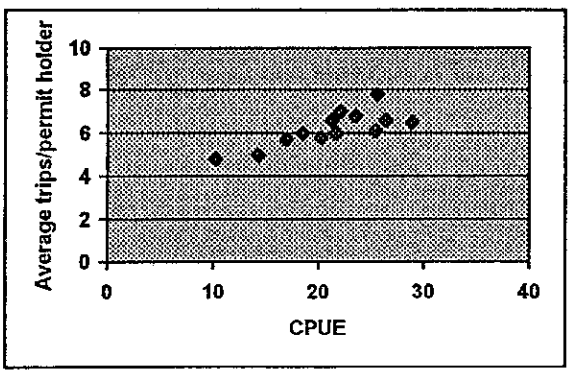

Fig. 4. Relationship between seasonal catch rates (CPUE) and average effort per permit holder (trips/season).

Table 3 lists the estimated numbers of trips made annually in each shrimping area. Until 1994, most of the effort was directed at the Beaufort and Charleston areas. During the 1994 season, nearly as many trips were made to Bulls Bay as to the Beaufort area. Since then, Bulls Bay has been nearly as popular as the Beaufort and Charleston areas (Fig. 5). There has been a tendency for Central Coast shrimpers to shift effort between the Charleston (Harbor) area and Bulls Bay as a function of relative shrimping success in each locale, particularly in recent years. The data below show the relative distribution of effort between the two areas and the ratios of CPUE.

Table 3. Estimated numbers of trips by shrimping areas.

Year	Beaufort	St. Helena	Wadmalaw/Edisto	Charleston	Bulls B.	Georgetown
1990	22,263	4,130	5,090	34,639	2,331	2,700
1991	24,659	3,520	5,476	24,441	10,947	1,991
1992	23,453	3,848	5,952	19,283	8,876	1,047
1993	25,685	5,272	6,084	29,347	6,896	7,425
1994	14,785	7,445	6,559	26,280	12,223	3,137
1995	24,385	6,590	9,902	20,441	18,620	1,694
1996	15,449	6,909	7,990	24,763	12,850	966
1997	28,010	10,092	9,335	23,944	20,419	2,354
1998	28,257	9,722	9,201	23,585	18,978	2,741
1999	21,694	8,087	6,204	11,534	16,926	1,951
2000	15,582	9,382	6,007	12,818	15,944	1,712
2001	19,998	9,698	6,306	23,932	7,696	2,217
2002	12,771	9,648	3,461	12,599	12,586	3,545

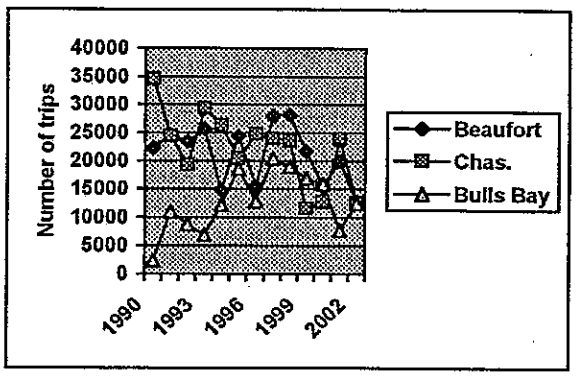

Fig. 5. Trends in annual effort in the Beaufort, Charleston, and Bulls Bay areas (numbers of trips).

Year	Bulls Bay share of trips (%)	Bulls Bay CPUE/Charleston CPUE
1994	32	1.07
1995	48	1.10
1996	34	0.84
1997	46	1.06
1998	45	1.11
1999	59	1.23
2000	55	1.23
2001	24	0.55
2002	50	1.69

In seasons when the CPUE ratio has been <0.9,an average of 29% of the area effort has been expended in Bulls Bay. When the CPUE ratio has been 0.9-1.1, the average Bulls Bay share has increased to 43%. With a CPUE ratio >1.2, Bulls Bay has attracted over half of the effort.

Bulls Bay has also become an increasingly popular destination of shrimpers from the noncoastal counties. Table 4 shows the distribution of estimated effort by shrimping area for residents of noncoastal counties. Also reflected is the relatively recent tendency of noncoastal residents (most of whom are from the southwestern and central parts of the state) to shift effort from the Beaufort area to the less crowded St. Helena Sound region.

Table 4. Distribution of trips by shrimping area for noncoastal residents (in percentages).

Year	Beaufort	St. Helena	Wadmalaw/Edisto	Charleston	Bulls Bay	Georgetown
1990	56	13	15	10	3	3
1991	53	11	13	7	12	4
1992	65	11	10	4	9	1
1993	50	14	13	8	7	8
1994	35	21	14	13	15	3
1995	42	14	17	7	18	3
1996	41	16	16	11	15	2
1997	42	20	14	6	17	2
1998	41	20	11	8	17	3
1999	41	24	9	4	20	3
2000	31	26	13	8	19	3
2001	40	29	9	11	10	3
2002	26	34	9	8	19	5

Table 5 shows the distribution of average individual effort (in trips per permit holder per season). Obviously, the vast majority of shrimpers view the fishery as a recreational activity with <15% making more than 10 trips in a typical season. It is likely that many, if not most, of those making more trips are primarily subsistence fishermen catching relatively small amounts per trip, but on a regular basis, for personal consumption.

Table 5. Distribution of average individual seasonal effort (in percentages).

	Trips/permit holder/season				
Year	1-4	5-10	11-15	16-20	>20
1988	37	39	10	3	11
1989	NA	NA	NA	NA	NA
1990	44	35	12	5	4
1991	58	30	8	2	3
1992	48	38	9	2	3
1993	46	38	10	3	2
1994	55	32	8	3	1
1995	50	34	9	3	2
1996	52	35	8	3	2
1997	41	42	11	3	2
1998	48	40	6	3	2
1999	60	31	5	3	1
2000	63	29	5	2	1
2001	63	29	5	2	1
2002	58	34	5	2	1

The reliability of the effort estimates is somewhat problematic; attempts at verification have been inconclusive. One of the principal objectives of the windshield card survey (conducted in 1999) was to examine this aspect. Trailer counts (which assumed that all trailers belonged to baiters) were extrapolated by time intervals to derive potential numbers of trips by launching site. These in turn were expanded to estimate potential area effort (for Bulls Bay, the Charleston metro area, and the Beaufort area). In each instance, these hypothetical estimates were substantially lower than the figures generated from the postseason survey data. A serious complicating factor was the poor weather, which curtailed effort in that season and reduced the effectiveness of the field survey through small sample sizes and limited site coverage.

The most reasonable impression is that there is a substantial probability that effort is being overestimated with data from the postseason surveys. This interpretation assumes that the permit holders who are the most active are also the most likely to respond to the survey. Since their average individual effort is greater than that of the nonrespondents, there is a positive bias associated with use of the data provided by them. In the 1987 survey, Theiling (1988) assumed that nonrespondents participated at one-half the rate of the respondents.

The presumption that respondents are more likely to participate contradicts the findings of Thompson and Hubert (1990), however, as noted previously. Also discussed was the fact that Waltz and Hens (1989) found no significant difference in the average numbers of trips made between respondents and nonrespondents to the initial survey. What has not been investigated, and what is the key element, is the active vs nonactive status of survey respondents vs nonrespondents. The estimation procedure assumes that

the percentage of inactive respondents is identical to that in the overall population of permit holders. If permit holders who did not go shrimping respond at a lower rate than those who did participate, then the survey overestimates the number of active permit holders and also the level of effort. This appears to be a more likely situation than the opposite case.

The trend in statewide annual landings is shown in Fig. 6. Table 6 lists the distribution of annual catch per permit holder. In most seasons, the majority of the baiters has harvested less than 200 quarts of whole (heads-on) shrimp.

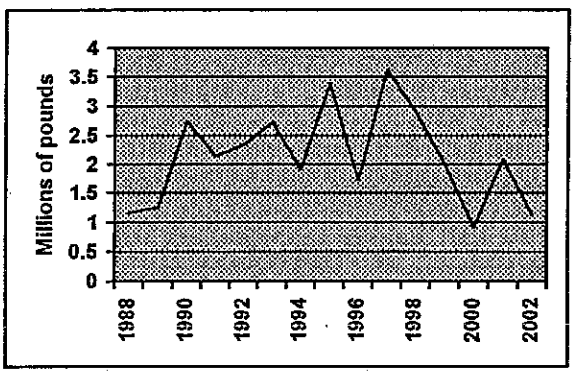

Fig. 6. Trend in annual statewide landings (in pounds heads-on).

Table 6. Distribution of season catches (quarts heads-on) in percentages of respondents by category.

Year	<99	100-199	200-299	300-399	400-499	>500	average
1990	36	26	16	8	7	7	203
1991	54	24	14	4	2	2	140
1992	47	25	13	6	4	5	157
1993	47	27	15	5	3	3	155
1994	59	24	10	4	2	2	113
1995	39	27	15	8	5	6	184
1996	68	18	8	3	1	2	98
1997	41	29	14	6	4	4	168
1998	55	25	11	5	2	2	121
1999	66	20	8	3	< 1	2	96
2000	87	10	2	< 1	< 1	< 1	45
2001	58	25	10	4	2	1	110
2002	76	16	5	2	1	< 1	71

The annual baiting catch has not been closely related to either the number of permits issued or the number of active permit holders. It has been most strongly associated with the level of effort and catch rates, which are interrelated, as noted previously (effort alone has accounted for two-thirds of the variability in annual catch). Both factors are in part functions of the abundance of shrimp and their relative availability to baiters. These elements in turn are strongly influenced by environmental conditions, both prior to and during the season.

Overall shrimp abundance during the baiting season is determined by a sequence of climatic conditions. In chronological order, the first is water temperature during the previous winter. If it falls below 47 degrees F, mortality of the overwintering shrimp increases with time. If it declines into the low 40's, even for a short period, nearly all of the population is lost. The winter water temperature regime largely determines the extent of the spring roe shrimp stock that is of local origin (assuming that there were reasonable numbers of shrimp present at the beginning of the winter).

These roe shrimp spawn in April-June and produce the young that will grow into the fall season's crop. The spawning population includes both shrimp that overwintered locally and those that migrate northward from NE Florida and Georgia, thus a severe winter in South Carolina does not necessarily result in an unsuccessful spawn. The MRD samples the roe stock and this provides the first general indicator of the potential fall crop. It should be noted that quite limited numbers of roe shrimp have produced adequate numbers of juveniles and, after recent cold winters, there have been area closures and trawl opening delays to provide maximum protection for the spawning stock.

The MRD also monitors the status of the juvenile population in nursery areas during the summer. Juvenile abundance and distribution are substantially affected by summer rainfall with moderate amounts conducive to optimal survival and growth. In drought conditions, such as have prevailed in the last four years, juvenile shrimp are smaller than normal and farther inland in the estuarine systems. Excessive summer rains, however, can flush small shrimp out of the estuaries and into the ocean to be essentially lost to all of the fisheries.

The amount of rain during August and early September has a pronounced impact on the extent and distribution of fall shrimp landings. Dry conditions limit growth and tend to cause the shrimp to remain in the upper estuarine reaches. Moderate, periodic rainfall causes the shrimp to grow and move into the lower estuarine areas. Torrential rains usually flush most of the shrimp out of the estuaries and into the ocean. When this occurs, the trawlers usually have abnormally high landings (of relatively small shrimp) and much of the fall crop is unavailable to the baiters. During the baiting season, the situation is much the same. Mild, dry weather favors the baiting fishery in that it keeps the shrimp where the baiting occurs and promotes effort.

Catches by area are listed in Table 7. Area-specific landings are influenced by the same general elements as the overall landings. Additional factors include the 1) proximity to population centers, 2) relative accessibility (as measured in numbers and quality of boat launching sites), 3) extent and configuration of estuarine systems, and 4) seasonal catch rates and sizes of shrimp in comparison to those in adjacent areas.

Table 7. Baiting catches (in pounds heads-on) by shrimping area.

Year	Beaufort	St. Helena	Wadmalaw/Edisto	Charleston	Bulls B.	Georgetown
1990	941,360	145,352	158,424	1,189,877	99,287	106,773
1991	890,486	130,240	196,128	510,035	364,536	30,941
1992	996,189	169,143	264,269	667,809	266,671	22,314
1993	870,517	185,702	202,597	886,045	269,440	295,605
1994	288,840	180,705	156,288	840,119	417,879	61,284
1995	1,104,348	270,164	375,167	789,595	790,903	49,892
1996	354,401	192,236	202,211	667,017	289,074	13,726
1997	1,272,662	391,327	309,474	839,860	761,547	81,175
1998	1,074,783	309,354	292,777	617,833	550,514	87,219
1999	760,939	233,392	161,601	310,680	558,626	73,341
2000	212,164	149,962	78,236	178,324	273,726	24,831
2001	763,603	292,371	176,859	737,077	129,392	22,869
2002	204,132	198,478	44,564	223,758	378,134	137,986

Initially, the Charleston and Beaufort areas produced the majority of the statewide catch, because they had large populations of baiters and readily available access. Both also had large amounts of estuarine area suitable for baiting. As the fishery expanded in participation, crowding in the most popular areas became an increasing problem, judging from baiters' comments in the surveys, and shrimpers directed more effort to more remote locations, such as in the St. Helena Sound and Bulls Bay areas (see Table 4). These areas became increasing larger contributors to the statewide catch (Table 8). The Georgetown area has seldom produced large annual landings. Access there is somewhat problematic and the shrimp have typically been smaller than in Bulls Bay. In Horry County, there is practically no estuarine area suitable for baiting.

The trend in annual statewide CPUE is shown in Fig. 7. In-season catch rates have varied substantially between areas (Table 9). From south to north, there has been progressively less correlation between individual area CPUE and statewide CPUE (from $r = 0.93$ for the Beaufort area to 0.38 in the Georgetown area). The statewide CPUE can be considered as a proxy for an index of overall shrimp abundance, although it does reflect availability to baiters as well. A possible explanatory factor for the declining association between area CPUEs and abundance/availability may be the relative extent of estuarine area in each baiting area; this also tends to decrease from south to north. Bulls Bay has less river discharge into it than the other areas and less associated inner estuarine staging area; it is known as an early season spot with shrimp generally scarce there after mid-October.

Table 8. Distribution of catches by area (in percentages).

Year	Beaufort	St. Helena	Wadmalaw/Edisto	Charleston	Bulls B.	Georgetown
1990	36	6	6	45	4	4
1991	42	6	9	24	17	2
1992	42	7	11	28	11	1
1993	32	7	8	33	10	11
1994	15	9	8	43	22	3
1995	33	8	11	23	23	2
1996	21	11	12	39	17	1
1997	35	11	9	23	21	2
1998	37	11	10	21	19	3
1999	36	11	8	15	27	4
2000	23	16	9	19	30	3
2001	36	14	8	35	6	1
2002	17	17	4	19	32	12

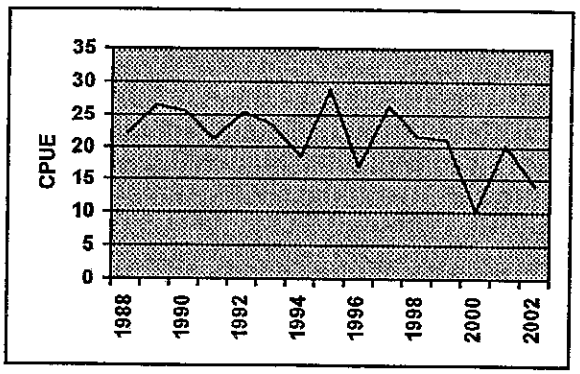

Fig. 7. Trend in annual statewide CPUE (quarts/trips).

Table 9. Catch rates (CPUE, quarts/trip) by shrimping area.

Year	Beaufort	St. Helena	Wadmalaw/Edisto	Charleston	Bulls B.	Georgetown
1990	28.6	23.8	21.0	23.2	23.8	26.7
1991	24.4	25.0	24.2	14.1	22.5	10.5
1992	28.7	29.7	30.0	23.4	20.3	14.4
1993	22.2	23.8	22.5	20.4	26.4	26.9
1994	13.2	16.4	16.1	21.6	23.1	13.2
1995	30.6	27.7	25.6	26.1	28.7	19.9
1996	15.5	18.8	17.1	18.2	15.2	9.6
1997	30.7	26.2	22.4	23.7	25.2	23.3
1998	25.7	21.5	21.5	17.7	19.6	21.5
1999	23.7	19.5	17.6	18.2	22.3	25.4
2000	9.2	10.8	8.8	9.4	11.6	9.8
2001	25.8	20.4	19.0	20.8	11.4	7.0
2002	10.8	13.9	8.7	12.0	20.3	26.3

Comparative catch rates have been a factor influencing within-season distribution of effort, as noted previously. When CPUE has been low in either the Georgetown or Charleston areas, there has been a noticeable shift of effort to Bulls Bay. Similarly, lower CPUE in the Beaufort area has been reflected by increased effort in the St. Helena Sound area.

The principal harvesters of the fall shrimp crop are the baiters and commercial trawlers. Although noncommercial shrimpers also cast net without bait or use other gears, the aggregate catch by nonbaiting is considered negligible in comparison. There is a small channel net commercial fishery in Winyah Bay in most years, but its landings are insignificant vs those of the trawlers. The division of landings between the baiters and trawlers has been a major topic of interest. In 1992, a monitoring system for commercial landings was implemented that facilitates direct comparison of baiting and trawler landings for comparable area/time units.

The approximate shares of each group are indicated in Table 10. "In-season" refers to the period of the baiting season, while "total" includes the entire white shrimp harvest during August through the end of the trawler season. Area-specific division has been rather variable and is influenced by several factors, including 1) the relative fishing power of the baiters, 2) the fishing capacity of the trawlers, and 3) escapement rate of the shrimp from baiting areas. The baiting percentages of the total fall harvest by area are listed in Table 11.

Table 10. Division of baiting and commercial landings.

	Percent baiting	
Year	In-season	Total
1987	NA	29
1988	NA	32
1989	NA	24
1990	NA	46
1991	NA	29
1992	55	39
1993	58	44
1994	48	34
1995	48	33
1996	50	35
1997	58	43
1998	54	41
1999	43	31
2000	43	24
2001	64	47
2002	51	31

Table 11. Approximate baiting shares of the total fall harvest by area (in percent).

Year	Beaufort	St. Helena	Wadmalaw/Edisto	Charleston	Bulls B.	Georgetown
1992	85	12	40	63	38	2
1993	81	15	38	67	37	22
1994	64	16	26	63	37	5
1995	78	11	27	50	43	3
1996	71	16	36	70	38	1
1997	79	19	38	61	53	6
1998	87	19	39	59	39	8
1999	75	15	22	34	34	7
2000	59	15	16	36	35	4
2001	76	21	32	64	44	21
2002	67	23	18	39	38	16

Relative fishing power of the baiters is reflective of the density of the baiters, which depends on their numbers and extent of area suitable for baiting. It is probably highest in populous areas, e.g. Beaufort and Charleston, where effort is usually the greatest. Capacity of the trawlers is speculative, because effort by area is not precisely documented and is difficult to measure in standard units. It appears to be greatest between St. Helena Sound and Rockville and in the vicinity of Cape Romain. Escapement of shrimp probably varies enormously, depending on the density of baiting effort, duration of availability in baiting areas, and length (in time and space) of migration between baiting and trawling grounds. In 1990, a tagging study done at the beginning of the baiting season showed that most of the returns came from baiters with relatively few by trawlers. This suggested that, at least under some conditions, the baiters are capable of taking a significant amount of the shrimp present. The baiters' percentage of the total fall harvest has been highest in the Beaufort and Charleston areas, where their effort has been greatest.

The statewide division of landings is determined primarily by environmental conditions with the baiters' share being largest during dry years (Low 1999). Dry weather in August and early September reduces outmigration from estuarine areas prior to the opening of the baiting season. Continued dry weather during the season prolongs availability of the shrimp to baiters and is also conducive to greater effort. Conversely, heavy rains flush a large percentage of the fall crop seaward from the baiting areas. Heavy rain and unusually large trawl catches in August and early September are good indication that the baiters' share will be below average. Tropical storms during the season promote outmigration as well as discouraging effort. During the "dry" years (1990, 1993, 1997, 1998, 2001), the average baiters' share of the total fall landings has been 44%. In the "wet" years (1989, 1991, 1992, 1994, 1995, 1996, 1999, 2000, 2002), it has been 31%.

Table 12 lists the values for principal characteristics of each season of the permit fishery. The following summarizes the relative status of each season vs the long-term (1988-2002) averages, where A denotes the average +/- 15%, L is more than 15% below the average, and H is more than 15% above the average. An * denotes the lowest/highest value for the indicated parameter.

Year	Permits	Participation	Effort	CPUE	Catch	Baiters' share
1988	L*	L	L	A	L	A
1989	L	L*	L*	H	L	L*
1990	L	A	A	H	H	H
1991	A	A	A	A	A	L
1992	A	A	A	H	A	A
1993	A	A	H	A	H	H
1994	A	A	A	A	A	A
1995	A	H	H	H*	H	A
1996	A	A	A	L	L	A
1997	H	H	H*	H	H*	H
1998	H*	H*	H	A	H	H
1999	H	A	A	A	A	L
2000	H	A	A	L*	L*	L
2001	A	A	A	A	A	H*
2002	A	A	L	L	L	L

Table 12. Season comparisons of participation, effort, and catch parameters.

	1987	1988	1989	1990	1991	1992	1993	1994
Permits issued	NA	5509	6644	9703	12005	11571	12984	13366
% active permits	NA	92	82	94	89	87	91	86
Average assistants	NA	2.50	2.14	2.79	2.24	2.15	2.43	2.32
Participants	21735	17749	17171	34662	34821	31812	40620	38081
Average trips	NA	7.0	5.7	7.8	6.6	6.1	6.8	6.0
Total trips	40101	35609	31624	71153	71034	62459	80709	70429
Average CPUE	28.5	22.1	26.5	25.6	21.3	25.4	23.5	18.5
Catch (lbsM heads-on)	1.80	1.16	1.25	2.75	2.14	2.35	2.72	1.91
Pounds/participant	83	65	73	79	62	74	67	50
Share of total harvest	29	32	24	46	29	39	44	34

	1995	1996	1997	1998	1999	2000	2001	2002
Permits issued	13919	14156	15488	17497	15895	15929	13698	13903
% active permits	89	85	91	87	81	81	87	78
Average assistants	2.39	2.25	2.44	2.31	2.09	1.93	2.18	1.96
Participants	41971	38932	48544	50436	39514	37622	37699	32038
Average trips	6.5	5.7	6.6	6.0	5.1	4.8	5.8	5.0
Total trips	81632	68927	94154	92484	66396	61445	69847	54610
Average CPUE	28.9	16.9	26.4	21.7	21.1	10.2	20.3	14.2
Catch (lbsM heads-on)	3.40	1.73	3.63	2.91	2.02	0.91	2.09	1.11
Pounds/participant	81	44	72	58	46	23	53	35
Share of total harvest	33	35	43	41	31	24	47	31

Socioeconomic Characteristics

This information was obtained during the 1989 and 1991 surveys (Low 1990, Liao 1993). Table 13 summarizes socioeconomic information from the 1989 study. In most respects, there was little difference in profile between coastal and noncoastal residents. There was a wide diversity in employment and income status.

Table 13. Socioeconomic characteristics of permit holders by area of residence (in percentages of respondents in each category).

Category	Charleston County	Other coastal	Noncoastal	Statewide
Household members				
1	9	5	5	6
2	32	33	35	33
3	24	27	23	25
4	27	25	28	26
> 4	8	10	9	9
Gross household income (1989 $)				
< $10,000	3	2	2	2
$10,000 - $19,999	10	14	8	11
$20,000 - $29,999	16	18	18	17
$30,000 - $39,999	21	25	20	22
$40,000 - $49,999	17	16	17	17
$50,000 - $59,999	12	12	13	12
$60,000 - $69,999	10	7	10	9
> $70,000	11	7	11	9
Employment				
Unemployed	1	< 1	< 1	< 1
Retired	13	13	14	13
Professional/technical	40	36	36	37
Tradesman/manufacturing	17	19	17	18
Managerial/proprietor	15	14	16	15
Clerical/sales	4	4	4	4
Agricultural	1	3	5	3
Other	7	8	8	7

Information on individual trip expenditures was obtained from an on-site intercept survey in 1989 (Low 1990) and a postseason mailout survey in 1991 (Liao (1993). Permit holders were asked how many miles (one-way) they traveled per trip and how much was spent for gas, ice, bait, food, and travel. In each study, the results were very similar; those from the 1990 exercise are listed below.

Residential category	Miles traveled	Trip cost (1990 $)
North Coast	27.8	20.23
Central Coast		
Charleston County	9.4	18.21
Berkeley/Dorchester	32.6	22.03
South Coast	23.1	19.09
Central Inland	102.5	41.38
Other Inland	137.5	43.81

(An approximate multiplier to convert these figures into 2001 $ is 1.31)

Issues

This section addresses conflicts and problems identified by baiters, management changes suggested by them, and various issues associated with the baiting fishery that have been raised by commercial shrimpers, seafood dealers, environmentalists, and other concerned parties. A brief discussion of major issues can be found in Low (1991a).

Competition with trawlers- This was one of the complaints originally lodged by trawlers as the baiting fishery developed. Trawler operators argued that baiters had an unfair competitive advantage in harvesting shrimp, because they were allowed to shrimp in areas closed to trawlers. Trawler interests had no problem, however, with people shrimping in these areas without the use of bait. Baiting does occur almost exclusively in areas closed to trawlers, since the sounds and bays closure went into effect (some areas of Winyah and Santee Bay are sometimes open to trawlers as well as being used by baiters). Baiters have argued that they obviously cannot compete effectively with trawlers on the same grounds and that baiting is simply another means for the noncommercial harvest of shrimp. They have also maintained that baiting is a more environmentally acceptable practice than trawling , because it doesn't damage the bottom and has a negligible bycatch of finfish (Low 1990). The trawlers' characterization of the baiting grounds as nursery areas with the obvious negative connotation associated with harvest within them is not entirely accurate. Most of the baiting locations serve primarily as staging areas for larger shrimp just prior to their movement into the ocean. The major nursery grounds, characterized by large populations of small shrimp, are situated further up in the tidal creeks.

Baiting reduces commercial harvest- This also was one of the original arguments against baiting made by commercial interests. Obviously, any shrimp taken before they reach the legal trawling areas are lost from potential commercial harvest. Although bait has been conclusively shown to produce larger catches for cast netters than casting without the attractant, it apparently does so by acting as a very short-term food attractant rather than in the sense of dove or deer baiting. The shrimp bait is quickly dissipated by water movement. Since the amount of food it represents is insignificant compared to that ambient in the ecosystem, it cannot be the main cause of any delay in shrimp leaving the estuaries.

The extent to which baiters reduce the trawler catches is difficult to evaluate, although several attempts have been made. Some aspects of this issue have been discussed previously. Economic dislocation of the commercial shrimping industry has long been a concern and was emphasized by an Ad Hoc Shrimp Baiting Committee formed in 1999 (Rhodes 2000b). From a preliminary statistical analysis of baiting vs commercial landings, Rhodes (2000a) projected a potential 17% decrease in commercial landings based on a model of baiting permit sales. Low (1998a) had calculated a potential 16% increase in average fall commercial landings in the absence of a baiting fishery. Any such conclusions, however, must be regarded as speculative given the large number of variables involved and assumptions that must be made.

Illegal sales- Commercial interests also included this issue in their original objections to the baiting fishery. In addition to lost sales, they contended that the supply of baited shrimp would lower prices, thus further reducing their revenues. This issue was the subject of an opinion poll included in the 1993 shrimp baiting survey and most of the following discussion is from the report of its results (Low 1994) or Low (1991b). It should be noted that recreational shrimpers have also expressed dissatisfaction with the practice of selling shrimp caught over bait. They consider it an abuse of what was clearly intended by the General Assembly to be solely a noncommercial activity and resent what they perceive of as excessive catches taken solely for sale.

In the 1993 opinion poll, 47% of the 1192 respondents statewide considered illegal sales to be a major problem, while 43% termed it a minor problem. A majority of about 3:2 believed that such sales can be largely prevented.

Any workable approach to reducing or eliminating illegal sales needs to address the following aspects: 1) source of the shrimp, 2) the distribution system, 3) equitability of laws, and 4) their enforceability.

Most of the shrimp sold illegally appears to originate from a small number of baiters who deliberately and systematically violate the law for this purpose. Imposition of additional restrictions is unlikely to either deter these outlaws or reduce their harvest. Most of the shrimp appears to be distributed through irregular channels rather than by licensed dealers. A "paper trail" system imposed on established dealers would therefore accomplish little.

Baiters include both coastal and noncoastal residents. Coastal residents tend to shrimp more often, but take less shrimp per trip. Restrictions on effort are therefore more burdensome to coastal residents, while catch limitations disproportionately impact the noncoastal residents. The vast majority of baiters are legitimate and resent laws that they perceive as inappropriate for them, ineffective, and/or unnecessary. Enforcement depends on the degree of acceptability of the laws. If laws are largely viewed as unacceptable, then enforcement is difficult and often ineffective.

The respondents were asked to comment on a number of management options that potentially could reduce illegal sales. Their position can be summarized as follows. Additional restrictions will mainly impact the legitimate majority of baiters and be ignored by the outlaws, and therefore do little to reduce illegal sales. These measures are unfair, because they apply mainly to the group that does not cause the problem. Corrective action needed to be targeted on the group responsible for the sales. This can best be done by improving the enforcement of existing laws and increasing the penalties for violating them.

Baiting alters the ecosystem- Environmentalists have speculated that baiting adds excessive nutrients to the ecosystem. The 1999 windshield card survey determined that bait usage was similar in all shrimping areas, averaging 8.8 pounds of dry fish meal per trip with white clay used as the binder on 72% of the trips (Low 2000). Studies by the MRD have indicated that this level of supplementation is negligible compared to natural sources from river discharge, agricultural runoff, etc.

The presence of the baiting fishery in the Cape Romain National Wildlife Refuge (Bulls Bay) has been controversial. Environmentalists have asserted that the nighttime lights, noise, litter, and general disturbance associated with the fishery are disruptive to wildlife, particularly birds, and thus contrary to the purpose of the Refuge. They have requested a ban on baiting there, a shorter season, or limitation to daytime activity only as corrective measures.

While the extent of negative impact from baiting in the Refuge has proven difficult to quantify, the importance of continued access to this area to shrimp baiters is obvious. The level of effort expended there is indicated in Tables 3 and 4, while the relative contribution to catch is shown in Table 8. Any direct approach to reducing shrimp baiting's impact would entail substantial disadvantages for these shrimpers. Limiting baiting to daytime only is probably the most politically realistic measure that has been proposed, but the 1993 opinion poll found that it was the least acceptable to baiters of the 14 management options listed.

Baiting causes wastage of small shrimp- Trawler operators have argued that baiting results in excessive harvest of small shrimp and associated wastage. Whitaker et al. (1991) noted that "although recreational shrimpers prefer to fish in areas where large shrimp are abundant, ... changes in hydrological conditions can force small shrimp into the lower reaches of estuaries where larger shrimp are normally found." If baiters are shrimping in the lower estuarine areas where larger shrimp congregate just prior to moving into the ocean, the size of the shrimp they catch is usually comparable to that of the trawler catch. The same conditions that force small shrimp into these areas also cause them to move onto the trawler grounds. It therefore makes little difference in terms of the size of shrimp caught by either group whether the estuarine shrimpers are using bait.

Whitaker and Wenner (1988) found that the size composition of white shrimp was not significantly different between baited and unbaited areas The solution to the small shrimp problem is thus independent of the use of bait. The relative amount of small shrimp caught is a function of the mesh size of the cast net (Woodward 1989, Whitaker et al. 1991) with 3/8 inch mesh catching about the same amount of usable shrimp as larger mesh nets when larger shrimp prevail, but far more unusable shrimp when small shrimp are present. Whitaker et al. (1991) recommended that "... 3/8 inch mesh should be banned in the shrimp baiting fishery and a minimum mesh size of ½ inch be adopted." Historically, the baiters have not been opposed to mesh restrictions: in the 1988 survey, the second-most cited need for change (in the 1988 legislation) was a limit on mesh size (Waltz and Hens 1989).

In 1999, 34% of the mailout survey respondents statewide reported using 3/8 inch mesh nets, which emphasized the desirability of mandating use of larger mesh. Legislation was subsequently passed which made ½ inch the minimum mesh size, starting with the 2002 season.

Crowding- In the 1991 survey, the most frequent complaint of respondents was crowding, particularly at Bulls Bay (Low 1992). As permit sales steadily increased during the mid-1990's, crowding continued to be a concern with baiters complaining about both limited space on the water and inadequate parking capacity. One of the reasons for limiting the number of poles and specifying their spacing in the Shrimp Baiting Act was to minimize competition for baiting space.

Crowding has been addressed in several surveys. The 1990 questionnaire offered two options for comment (Low 1991b). Elimination of the poles and requiring use of an anchored boat would allow more boats per area and obviate problems associated with lost poles, tag replacement, and navigation hazards. Statewide, only 4% of the respondents supported this concept. The other option was limitation of the number of permits issued per area with selection by lottery (similar to the restriction of access to some Game Management Areas). Only 3% of the respondents favored this proposal.

Several other approaches have been suggested that could indirectly reduce crowding, most dealing with some type of reduction in either participation or effort. An increased permit fee would presumably eliminate some shrimpers. In the 1993 survey, when asked their willingness to pay for a baiting permit, 74% of the sample responded that $25 (the current fee) was the maximum. Percentages of respondents strongly opposed were as follows for other options:

Daytime baiting only 69
Specified days/nights 61
Limited areas 58
Fewer poles 55
Limited permits 51

The four most strongly opposed measures placed some restriction on effort. Some could potentially aggravate crowding under some circumstances. Obviously, a daytime only fishery would compete with anglers for both access and fishing space, particularly on weekends. Limiting baiting to certain areas could just increase crowding within them if no companion measures were adopted. Limiting use of a permit to designated locations was suggested in the 1990 survey and attracted virtually no support.

Crowding at access sites was examined in the 1999 survey using the windshield card questionnaire (Low and Waltz 2000). Unfortunately, the weather (e.g. Hurricane Floyd) markedly impacted effort and adversely influenced survey effectiveness. Over 50% of the respondents indicated that they had no waiting time to launch their boats at nine of the 13 sites routinely visited. Very few respondents reported waiting periods exceeding 15 minutes.

Changes in the catch limit- The most direct and enforceable way to limit the amount of shrimp landed by baiters would be to change the provisions governing catch limits. The current limit (48 quarts heads-on per boat per 24 hrs) is liberal compared to those in other states, particularly if applied to a single individual, e.g. the permit holder. For example, in 1991 the Louisiana legislature enacted a possession limit of 50 pounds (about 34 quarts) per boat per day for recreational cast netters. The Florida daily limit has been a 5-gallon pail (about 30 pounds) of heads-on shrimp per person .

The catch limit has been a long-term issue that has been thoroughly explored in terms of constituent opinion. In the 1988 survey, the second-most frequently mentioned change needed in the Shrimp Baiting Act was to increase the daily catch limit. The most common suggestions offered by respondents were to change the limit to 48 quarts per permit holder or to 48 quarts per head of household with a maximum of two limits per boat (Waltz and Hens 1989). Similar comments were repeated in the 1989 survey (Low 1990). In the 1990 survey, the only management option that received statewide support from a majority of the respondents was to allow a limit per permit holder (Low 1991b). Support for this measure was reiterated in the 1991 survey (Low 1992). In the 1993 survey, respondents were strongly opposed to a simple reduction in the limit without compensatory measures (such as a longer season) (Low 1994).

Low (2000) evaluated the possible effects of changes in the limit. If the limit was changed to 48 quarts per permit holder, the total catch could have increased by about 14%. With a 36 quart limit per permit holder, the maximum potential increase would have been 7%. Based on shrimpers' views of the level of satisfaction with their trips (which appeared to depend heavily on their catch), this seemed to be the minimum level acceptable to the majority of shrimpers if a change was to be made.

Baiting from docks- The Shrimp Baiting Act of 1988 applied only to baiting from boats. In the 1988 survey, the most cited new provision needed was to legalize baiting from docks (Waltz and Hens 1989). In 1989, the Marine Advisory Board drafted a resolution urging the General Assembly to allow permit holders to bait from docks and piers, but there was no further action. The 2000 survey inquired which platform (boat, dock, or both) baiters used with <5 % indicating that they did any baiting from a dock. Nonetheless, the law was amended to allow shrimpers with a permit to bait from docks.

Changes in the season- In 1988, the most needed change in the baiting law, according to the baiters surveyed, was to lengthen the season. Changes in the season continued to be the most frequently mentioned management item over the next several years with baiters generally in favor of a longer season. Supporting arguments were that this would alleviate crowding by dispersing effort over a longer period (which assumes that overall effort would not increase) and allow more individual flexibility in scheduling trips. After Hurricane Hugo in 1989, many respondents inquired as to why the season was not extended to compensate for time lost; this cannot be accomplished under the current law. In the 1990 survey, a proposal to give the MRD authority to adjust the season received the support of 32% of the respondents (Low 1991b) (this should not be interpreted as meaning that 68% were opposed- the question simply asked if the respondent supported an option). To date, there have been no changes made by the General Assembly.

Summary

Baiters have consistently expressed general satisfaction with the current management regime with a statewide approval index of 3.8 (on a scale of 1 to 5 with 5 the most favorable) in 1998 (Low 1999). The most important need cited has been for more and better law enforcement, principally to control the illegal sale of shrimp taken with bait. Respondents have strongly opposed additional restrictions, particularly on effort, because they do not believe that legitimate shrimp baiters are causing a problem. They have instead advocated increased enforcement of the existing laws and more severe penalties for violators. Following an extensive review of issues in 1999, the Department of Natural Resources concluded that "... there was no evidence of a resource or environmental problem associated with shrimp baiting" (Waltz and Boyles 2000).

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