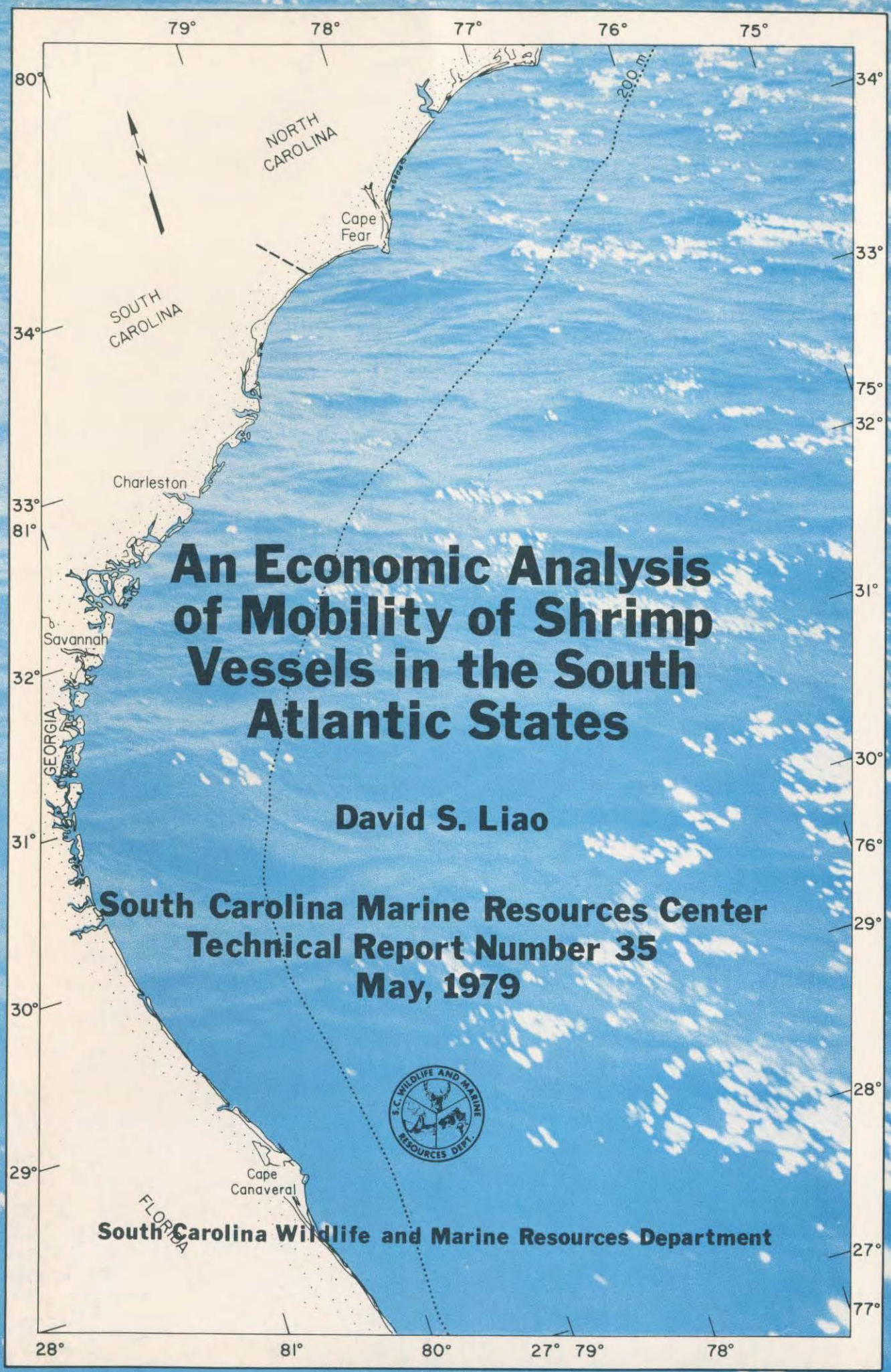

An Economic Analysis of Mobility of Shrimp Vessels in the South Atlantic States

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AN ECONOMIC ANALYSIS OF MOBILITY OF SHRIMP VESSELS IN THE SOUTH ATLANTIC STATES[1]

by

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I. INTRODUCTION

The South Atlantic shrimp fishery exhibits economic characteristics and problems common to most commercial marine fisheries. The commonality of these characteristics stems from the fact that most marine fish populations are common property resources. A unique problem associated with common property resources is that the harvesters are not subject to the self restraints that influence the exploitation of privately owned resources. Because of this and because fishermen compete vigorously with others to get the largest possible share of the resource, we generally find fisheries over-capitalized, inefficient, and heavily exploited.

To protect the shrimp resource, regulations and restrictions pertaining to licenses, gear, and seasons have been imposed by state agencies (Calder, Eldridge, and Joseph, 1974). Although existing regulations governing the harvest of shrimp assure the perpetuation of the resource, they do not appear to be sufficient to maximize the economic yield.

A study of productivity gains in U.S. fisheries (Bell and Kenoshita, 1973) indicated that the Atlantic shrimp fishery is beset by inefficiency. The study compared rates of productivity gains (output per man hour or annual landings per fisherman) in several fisheries and other sectors of the economy. The findings indicated that productivity gains grew at a rate of 3% per year for the total private economy during the period 1950-1969; a rate of 9.8% for the poultry sector; 3.8% for the meat sector; yet during the same period the rate of growth in productivity of the Atlantic shrimp fishery was a disappointing 0.7%.

Shrimp migrate through waters of adjacent states and fishing grounds of each state are fished by shrimp trawlers from both home and out-of-states. The entry of out-of-state vessels results in an increase of total fishing vessels for each state which tends to lower the productivity (catch per unit of effort) of those fishing the resource because more people share a fixed resource base. Out-of-state fishermen create law enforcement difficulties because of their lack of familiarity with state fishery regulations. Also, resident fishermen resent out-of-state fishermen.

The South Atlantic State/Federal Shrimp Fishery Management program was established to promote an orderly fishery on a regional basis. The development of an appropriate regional shrimp management program required some information on mobility of South Atlantic trawlers and their economic performance. However, little of such information was available.

Purpose and Objectives of the Study

The purpose of this study was to develop economic information concerning mobility of shrimp trawlers in the South Atlantic states. The study examined the mobility patterns of trawlers, factors associated with the trawler mobility, and the economic performance of various types of shrimping operations. It was hoped that the study would provide benchmarks for decision-making to improve the shrimping industry and to utilize the resources more efficiently. In addition, the study analyzed some existing and alternative management programs that were related to the mobility of trawlers in the region. However, the study did not present a recommended management plan. The general objective was to provide information and analysis to policy makers, not to make policies. More specifically the study focused on the following objectives:

A. to determine the pattern and extent of vessel mobility
B. to describe vessels and captains in terms of socio-economic characteristics, investment, and fishing activities
C. to identify some factors affecting vessel mobilities
D. to compare the productivity and profitability of vessel mobility classes
E. to evaluate impacts of management options on vessel mobility

Research Methods

A. Sampling Design for the Trawler Survey

All commercial trawlers in the South Atlantic that exceeded 20 feet in length constituted the "population" for the survey. A commercial trawler was defined as a vessel that had a commercial license for shrimping. Trawler license data files for 1976 were obtained from each state's fishery agency in the South Atlantic region for the development of a sampling frame for the trawler survey. The detailed data files included the following information for each trawler licensed: (1) vessel size, (2) name of vessel and owner, (3) address of vessel owner and captain, (4) home port, and (5) license number.

The trawler license data files were then utilized to determine the number of trawlers in each vessel mobility class. Three mobility classes of shrimp trawlers were identified: (1) those that fished only one state (denoted Mobility class I), (2) those that fished in two states (denoted Mobility class II), and (3) those that fished in three states (denoted Mobility class III). The results of the pre-survey classification for trawlers in each state are shown in Table 1.

There were 1,967 commercial trawlers in the region as of December, 1976. The population of trawlers was stratified with respect to home state, mobility class, and vessel size. The distribution of trawlers in the stratified sampling frame is shown in Appendix (table A.1).

Since 1,967 commercial trawlers were too large to survey, it was necessary to take a sample. Because of variability in the size of trawlers and in their mobility, a simple random sample did not appear to be appropriate. Therefore, in order for the sample to represent a cross section of the shrimping industry, a stratified random sample was drawn from each strata. This reduced sampling bias and increased the degree of representativeness of the sample taken. A total of 391 trawlers were randomly selected from the stratified sampling frame (for details see Appendix table A.2). The sample size was based on the availability of research funds, the research objectives, and the anticipated completion rate.

B. Data Collection

Personnel used for conducting the trawler survey were recommended either by state fisheries' administrators or by Sea Grant Advisory specialists. Most of the interviewers had some previous interviewing experience and were required to sign a legal contract. Then, a training session was held to familiarize interviewers with the survey form (Appendix B). The survey form was explained in detail and questions and problems were discussed.

The survey forms were administered by the interviewer and began in late December, 1976. A total of 301 sample trawlers were surveyed by the interviewers. The survey completion rate was about 77 percent of the sampling design. In some instances, the sample quota for a mobility class was not reached because of the difficulty of contacting persons selected for the sample survey. The harsh winter of 1976-1977 forced late season openings and adversely affected white shrimp abundance in the South Atlantic states. This fact and bumper crops in the Gulf of Mexico induced many fishermen to leave their home state to shrimp off Alabama and Mississippi. The dislocation of fishermen was the most serious problem faced by interviewers, particularly in Florida. Because of this problem, lack of time, and economic limitations, interviews were terminated on August 30, 1977.

C. Calculation of Trawler Population by Mobility Classes

After the survey, it was noticed that some trawlers were inconsistent with pre-survey classification in terms of their mobility class. There are several reasons for this inconsistency: (1) some trawlers had purchased out-of-state licenses but did not use them, (2) some trawlers had been shrimping in other states, but did not purchase the out-of-state license, and (3) some trawlers fished outside the South Atlantic region. As indicated in Table 1, the number of completed samples by mobility classes based on the post-survey classification were different from that of pre-survey classification.

The trawler population in each mobility class was recalculated to correct the pre-survey classification bias. The formula for re-estimating trawler population in Mobility class I, II, and III was:

$$N_{ij} = N'_{ij} + N'_{ij} \left(\frac{n_{ij} - n'_{ij}}{n_{ij}} \right)$$

When: N_{ij} = number of trawlers in population in state i (i=1,4), mobility class j (j=1,3).

n_{ij} = number of trawlers in sample in state i (i=1,4), mobility class j (j=1,3).

N'_{ij} = number of trawlers in population based on pre-survey classification in state i (i=1,4), mobility class j (j=1,3)

n'_{ij} = number of trawlers in sample based on pre-survey classification in state i (i=1,4), mobility class j (j=1,3).

The trawler population in mobility class IV was calculated as follows:

$$N_{i4} = N'_{i1} + N'_{i2} + N'_{i3} + N'_{i4} - N_{i1} - N_{i2} - N_{i3}$$

Table 1. Number of Shrimp Trawlers in the Population and the Sample by Home State and Mobility Class, 1976.

Home State	Mobility Class	Pre-survey Classification			Post-survey Classification		
		Estimated population N'_{ij}	Completed sample n'_{ij}	Sample size (%)	Estimated population N_{ij}	Completed sample n_{ij}	Sample size (%)
South Carolina	I	282	47	17	264	44	17
	II	89	19	21	103	22	21
	III	12	9	75	11	8	73
	IV	0	0	0	5	1	20
		383	75	20	383	75	20
North Carolina	I	959	90	9	938	88	9
	II	103	33	32	130	41	32
	III	12	12	100	6	6	100
	IV	0	0	0	0	0	0
		1074	135	13	1074	135	13
Georgia	I	219	46	21	176	37	21
	II	89	17	19	106	21	20
	III	22	11	50	28	14	50
	IV	0	0	0	20	2	10
		330	74	22	330	74	22
Florida (east coast)	I	144	7	5	144	7	5
	II	35	9	26	27	7	26
	III	1	1	100	1	1	100
	IV	0	0	0	8	2	25
		180	17	9	180	17	9
All South Atlantic States	I	1604	190	12	1522	176	12
	II	316	78	25	366	91	25
	III	47	33	70	46	29	63
	IV	0	0	0	33	5	15
		1967	301	15	1967	301	15

D. Economic Analysis Methods

The survey data were first grouped according to the mobility class and home state of trawlers. Statistical techniques were then used to analyze the mobility patterns of trawlers and their characteristics. The significance of physical, economic, and sociological factors affecting vessel mobility were tested by multiple regression analysis.

Survey data were then used in conducting production function analysis by the statistical procedure of least squares regression. The Cobb-Douglas type of production function was used in the analysis. This analysis permitted the examination of several factors that appear related to annual productivity of trawlers.

Standard techniques of costs and returns analysis were used in determining the profitability of trawlers by mobility class. Net returns (i.e. profit) were measured as the gross returns less total costs. Distribution of trawlers with loss or profit in their shrimping operations was also determinated.

Fishermen's opinions, attitudes, and comments on several existing and alternative management programs were analyzed. State and Federal statutes and regulations in the region were examined to understand management practices under which commercial fishermen operate. The methods of public policy analysis were then employed to explore some of the consequences that may arise from different management approaches in the region.

II. MOBILITY PATTERNS OF TRAWLERS

The mobility of trawlers has to do with place, i.e. state and time of shrimping. These two elements, therefore, were chosen as a basis for analyzing the mobility of trawlers. The first section deals with mobility patterns based on states which the trawlers fished. The extent of trawler mobility in the population is also estimated. In addition, distances traveled to fishing grounds by various types of trawlers are determinated. In the second section, intra-seasonal mobility of trawlers are presented for each state in the region.

Inter-State Mobility

According to the number of states shrimped, four mobility classes of trawlers were identified:

Mobility class I trawler - those who fished only one state
Mobility class II trawler - those who fished in two states
Mobility class III trawler - those who fished in three states
Mobility class IV trawler - those who fished in four states

The trawler population in the four mobility classes for each state in the South Atlantic region is shown in Table 2. The most obvious fact is the predominant number of mobility class I trawlers. This one type made up about 78 percent of the total shrimp trawlers in the region in 1976. Thus, the majority of trawlers in the region fished only in their home state. There were about 366 trawlers (19%) in mobility class II. Mobility class III and IV had 46 and 33 trawlers respectively.

Within each mobility class, trawlers were also classified into various mobility patterns based on the specific state's shrimping ground they fished in 1976. Table 3 provides the number of trawlers belonging to each of the mobility patterns. As an illustration, there were 6 mobility patterns for South Carolina's resident trawlers, indicated as SC, SC→GA, SC→FE, SC→GA→NC, SC→GA→FE, SC→GA→FE→AL. The mobility patterns of SC→GA indicate that the trawlers in the group shrimped in South Carolina and then moved to fish shrimp in Georgia. It was estimated that a total of 70 (18%) trawlers belonged to the mobility pattern of SC→GA; 33 (9%) to SC→FE; 3 (1%) to SC→GA→NC; 8 (2%) to SC→GA→FE; and 5 (1%) to SC→GA→FE→AL mobility pattern.

Information on the total number of trawlers that utilize a particular state shrimping ground and the state of origin is useful for shrimp management effort on non-resident trawlers. As indicated in Table 3, the South Carolina shrimping grounds were shrimped by 383 South Carolina resident trawlers, 117 trawlers from North Carolina, and 105 trawlers from Georgia during 1966. In Georgia coastal waters, 70 percent of the shrimp fleet came from the home state trawlers and 30 percent were from South Carolina, Florida, and North Carolina. In Florida, 43 percent of the trawlers were from Georgia and South Carolina. In contrast, only about one percent of the trawlers shrimping off North Carolina were from out-of-state.

Table 2. Number of Shrimp Trawlers in the Four Mobility Classes in 1976

State or Region	Mobility Class	Estimated Number 1/ of Shrimp Trawlers	Percent of Total Trawlers
South Carolina	I	264	69
	II	103	27
	III	11	3
	IV	5	1
		383	100
North Carolina	I	938	87
	II	130	12
	III	6	1
	IV	0	0
		1074	100
Georgia	I	176	53
	II	106	33
	III	28	8
	IV	20	6
		330	100
Florida (east coast)	I	144	80
	II	27	15
	III	1	1
	IV	8	4
		180	100
All South Atlantic States	I	1522	78
	II	366	19
	III	46	2
	IV	33	1
		1967	100

1/ Source: Table 1. Estimated population of trawlers (N_{ij})

With regard to distance traveled, respondents were asked how many miles they normally travel from dock to fishing grounds (Table 5). As expected, the distances were distributed differently among mobility classes and whether they fished in home states or out-of-state. Among the mobility classes, the average travel distance of mobility class I trawlers was no more then 15 miles from their home port and shorter than that of mobility classes II, III and IV trawlers. The mean distance traveled for shrimping in home state was shorter than the distance traveled in out-of-state shrimping. Thus, it is true that higher mobility class trawlers tend to shrimp further off shore and in deeper water. It is also true that trawlers fishing out-of-state also traveled longer distances as compared to when they fished in their home state.

Intra-seasonal Mobility

Table 6 shows the percentage of resident trawlers fishing in their home state by months during 1976. The peak shrimping season in North Carolina occurred between May and September, while the period of peak shrimping in Florida occurred from September to December. The peak shrimping season was from June to November for South Carolina as well as Georgia. This was due to the commercial trawling seasons during 1976 in South Carolina and Georgia being similar.

Table 3. Number of Shrimp Trawlers in the Sample Survey and in the South Atlantic States by Mobility Patterns

State	Mobility Class	Mobility 1/ Pattern	Number of Trawlers in population	Number of 2/ Trawlers in population	Percent of Trawlers in population
South Carolina	I	SC	44	264	69
	II	SC→GA	15	70	18
		SC→FE	7	33	9
	III	SC→GA→NC	2	3	1
		SC→GA→FE	6	8	2
	IV	SC→GA→FE→AL	1	5	1
			75	383	100
North Carolina	I	NC	88	938	87
	II	NC→SC	35	111	10
		NC→GA	5	16	2
		NC→VA	1	3	3
	III	NC→SC→GA	5	5	5
		NC→SC→TX	1	1	2
			135	1074	100
Georgia	I	GA	37	176	53
	II	GA→FE	8	40	12
		GA→SC	12	61	18
		GA→FW	1	5	2
	III	GA→FE→SC	12	24	7
		GA→FE→FW	1	2	1
		GA→FE→AL	1	2	1
	IV	GA→FE→SC→NC	1	10	3
		GA→FE→SC→FW	1	10	3
			74	330	100
Florida	I	FE	7	144	80
	II	FE→GA	7	27	15
	III	FE→FW→LA	1	1	1
	IV	FE→LA→TX→GA	1	4	2
		FE→TX→LA→FW	1	4	2
			17	180	100

1/ SC = South Carolina GA = Georgia NC = North Carolina FE = Florida (east coast)
FW = Florida (west coast) TX = Texas LA = Louisiana AL = Alabama VA = Virginia

2/ The formula for these estimates: $N_{ij}(P_{ijk}/n_{ij})$

Where N_{ij} = number of trawlers in population in state i(i=1,4), mobility class j(j=1,4)
P_{ijk} = number of trawlers in sample in state i(i=1,4), mobility class j(j=1,4), and mobility pattern k(k=1,10)
n_{ij} = number of trawlers in sample in state i(i=1,4), mobility class j(j=1,4)

Table 4. Number of Trawlers Fished in the South Atlantic States' Shrimping Grounds by Home State of Trawlers

Home State of Trawlers	Shrimping Ground: South Carolina		North Carolina		Georgia		Florida (east coast)	
	Number of Trawlers	Percent of total	Number of Trawlers	Percent of total	Number of Trawlers	Percent of total	Number of Trawlers	Percent of total
South Carolina	383	63.3	8	.2	86	18.4	46	14.6
North Carolina	117	19.3	1074	98.8	21	4.5	0	0
Georgia	105	17.4	10	1.0	330	70.5	88	28.1
Florida (east coast)	0	0	0	0	31	6.6	180	57.3
Total	605	100.0	1087	100.0	468	100.0	314	100.0

Table 5. Number of Miles Traveled from Dock to Fishing Grounds by Mobility Class of Shrimp Trawlers

State or Region	Mobility Class	Home port to fishing ground in home state		Dock to fishing grounds out-of-state	
		N 1/	X 2/	N	X
South Carolina	I	44	8.1	0	0
	II	22	10.0	15	11.6
	III	7	14.3	7	31.3
	IV	1	14.0	1	50.0
North Carolina	I	88	12.2	0	0
	II	41	13.8	40	28.1
	III	6	34.2	6	50.3
	IV	0	0	0	0
Georgia	I	37	15.0	0	0
	II	21	15.0	19	24.4
	III	13	10.8	13	35.0
	IV	2	11.5	2	34.8
Florida (east coast)	I	7	10.3	0	0
	II	7	7.7	7	33.3
	III	1	10.0	1	18.5
	IV	2	11.5	2	48.5

1/ N = Number of samples

2/ X = Average miles traveled from dock used to fishing grounds.

Commercial trawling seasons in 1976 for South Carolina and Georgia were as follows:

A. South Carolina

Inshore waters:

Southern zone	May 14 - Dec. 22
Central zone	May 14 - Dec. 8
Northern zone	June 1 - Nov. 26

Sounds and Bays:

Calibogue Sound	Sept. 15 - Dec. 8
Port Royal Sound	Sept. 15 - Dec. 8
St. Helena Sound	Sept. 15 - Nov. 26
North Santee Bay	Sept. 15 - Nov. 4
Winyah Bay	Sept. 15 - Nov. 4
Bulls Bay	July 14 - July 20
	Sept. 15 - Dec. 8

B. Georgia

Inshore waters: June 1 - Dec. 31

Sounds:

Wassaw	Oct. 4 - Dec. 3
Ossabaw	Oct. 24 - Dec. 3
Sapelo S.	Oct. 4 - Dec. 3
St. Simons	Oct. 25 - Dec. 3
St. Andrews	Oct. 4 - Dec. 3
Cumberland	Oct. 4 - Dec. 3

Most out-of-state trawlers entered the South Carolina fishery during the peak period of the shrimping season (Table 7). In September, the highest percentage (70%) of the total out-of-state trawlers entered into the South Carolina shrimp fishery because most of the sounds and bays were just opened for trawling. September was also the highest percentage (96%) of the total resident trawlers engaged in shrimping activities in South Carolina. In Georgia, most out-of-state trawlers entered in June and November due to inshore opening in June and the sounds opening in mid-October. These results indicate that coordination in season openings among states could be particularly important if fishery managers considered that fewer out-of-state trawlers entering in their home waters were desirable.

An attempt was also made to determine what months of the year most home state trawlers would leave their home state and fish in another state. Most resident trawlers tended to leave when shrimping in their home state began to fall off from the peak season (Table 8). For example, more South Carolina resident trawlers shrimped out-of-state in June and November following May inshore and September sound openings. The same exit mobility was also observed for trawlers in Georgia.

III. CHARACTERISTICS OF TRAWLERS AND CAPTAINS

This section describes the "average" characteristics of shrimp trawlers and captains who were surveyed. The four inter-state mobility categories identified in the sample survey are compared in this characterization. Trawler characteristics described include: vessel size, age of vessel, beam, horsepower, gross tonage, net size, market value, equity, and vessel equipment. Four socio-economic variables of captains were analyzed; age, formal education, commercial fishing experience, and non-fishing employment.

Characteristics of Trawlers

The average mobility class I trawler in the South Atlantic states was about 40 feet in length (Table 9). The mean horsepower for all trawlers in this category was 180. Size of net was about 46 feet. The trawlers generally were not equipped with radar and loran and had a market value of about $23,157. Owner's equity in the vessel varied among the four states. Equity for vessels averaged approximately $16,429 which was about 71 percent of the market value of the vessel.

Mobility class II trawlers averaged 57 feet in length and were equipped with 237 horsepower engines (Table 10). The mean gross tonage for all trawlers was 44. Over 80 percent of these trawlers were equipped with recorder, VHF, and C.B. radio. About 62 percent of these trawlers had radar and 48 percent were equipped with loran.

Physical characteristics for mobility class III trawlers are shown in Table 11. All trawlers in this category in North Carolina and Florida carried all specialized navigation and communication equipment. It is also interesting to note that sample trawlers in these two states were also newer and bigger than those of South Carolina and Georgia. On the average, mobility class III trawlers were larger and better equipped than trawlers in mobility classes I and II.

Mobility class IV trawlers averaged 65 feet in length and 19 feet in beam which were the same as mobility class III trawlers (Table 12). The average trawler was 7 years old, which was newer than other classes. Class IV trawlers carried the largest nets. All trawlers in this group carried special equipment such as loran, recorder, VHF, and C.B. two-way radio.

Table 6. Percent of Total Home State Trawlers Fishing Shrimp in Their Home State by Month, 1976

Home State of Trawler	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total Home state trawlers
North Carolina	7	4	7	43	73	82	96	93	75	65	55	21	1074
South Carolina	2	0	1	12	69	81	84	87	96	92	75	43	383
Georgia	11	5	4	23	61	91	89	89	93	92	88	69	330
Florida (east coast)	53	47	47	41	41	41	41	61	76	76	76	76	180

Table 7. Percent of Total Out-of-State Trawlers Fishing Shrimp in a Specific State's Shrimping Grounds by Month, 1976

State of shrimping ground	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total Out-of-State trawlers
North Carolina	0	0	0	0	0	0	100	67	0	0	0	0	13
South Carolina	2	2	3	5	25	34	31	39	70	64	48	12	222
Georgia	12	2	2	10	29	48	19	19	26	24	31	21	195
Florida (east coast)	49	49	44	26	5	5	8	3	5	5	44	41	134

Table 8. Percent of Total Home State Trawlers Fishing Shrimp in Out-of-State by Month, 1976

Home State of trawler	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total trawler fished in Out-of-State
North Carolina	2	0	0	1	9	10	4	7	26	24	17	2	136
South Carolina	9	8	7	3	5	16	8	8	3	4	19	17	119
Georgia	20	20	20	16	17	22	29	24	24	22	30	17	154
Florida (east coast)	0	0	0	6	11	23	18	18	29	18	18	23	36

Table 9. Average Characteristics of Mobility Class I Trawlers by Home State, 1976

CHARACTERISTICS	SOUTH CAROLINA N=44	NORTH CAROLINA N=88	GEORGIA N=37	FLORIDA N=7	ALL SOUTH ATLANTIC STATES N=176
Age (years)	18	10	18	14	14
Length (feet)	44	33	53	40	40
Beam (feet)	14	10	16	12	13
Engine Horsepower	176	167	214	181	180
Gross tonage	24	12	35	25	20
Net Size (feet)	50	41	53	46	46
Market Value of the trawler ($)	24,210	17,977	33,824	25,286	23,157
Equity of the trawler ($)	20,000	10,845	25,800	12,400	16,429
Percent of Trawlers with the following equipment:					
Radar	21	11	30	29	18
Loran	16	14	27	14	17
Recorder	34	67	57	57	56
VHF	30	45	57	85	45
C.B.	89	86	100	100	90

Table 10. Average Characteristics of Mobility Class II Trawlers by Home State, 1976

CHARACTERISTICS	SOUTH CAROLINA N=22	NORTH CAROLINA N=41	GEORGIA N=21	FLORIDA N=7	ALL SOUTH ATLANTIC STATES N=91
Age (years)	15	9	12	9	11
Length (feet)	58	56	58	64	57
Beam (feet)	17	17	17	18	17
Engine Horsepower	229	230	226	329	237
Gross tonage	41	43	44	55	44
Net Size (feet)	63	56	58	72	59
Market Value of the trawler ($)	49,714	67,781	48,333	89,286	60,700
Equity of the trawler ($)	33,810	46,285	37,650	78,571	43,610
Percent of Trawlers with the following equipment:					
Radar	68	66	38	86	62
Loran	27	63	29	86	48
Recorder	64	93	71	86	80
VHF	96	90	57	100	85
C.B.	91	98	100	100	97

Table 11. Average Characteristics of Mobility Class III Trawlers by Home State, 1976

CHARACTERISTICS	SOUTH CAROLINA N=8	NORTH CAROLINA N=6	GEORGIA N=14	FLORIDA N=1	ALL SOUTH ATLANTIC STATES N=29
Age (years)	16	8	13	6	13
Length (feet)	65	70	63	73	65
Beam (feet)	19	21	18	20	19
Engine Horsepower	227	366	270	400	279
Gross Tonage	47	84	55	65	59
Net Size (feet)	71	80	58	65	66
Market Value of the trawler ($)	60,438	110,833	61,786	80,000	72,190
Equity of the trawler ($)	50,786	39,000	39,850	80,000	44,813
Percent of Trawlers with the following equipment:					
Radar	63	100	43	100	59
Loran	50	100	36	100	55
Recorder	75	100	79	100	79
VHF	100	100	79	100	86
C.B.	100	100	100	100	100

Table 12. Average Characteristics of Mobility Class IV Trawlers by Home State, 1976

CHARACTERISTICS	SOUTH CAROLINA N=1	GEORGIA N=2	FLORIDA N=2	ALL SOUTH ATLANTIC STATES N=5
Age (years)	4	11	4	7
Length (feet)	50	67	71	65
Beam (feet)	16	19	21	19
Engine Horsepower	250	275	335	261
Gross Tonage	25	51	93	62
Net Size (feet)	50	64	83	69
Market Value of the trawler ($)	47,000	64,000	112,500	80,000
Equity of the trawler ($)	29,000	28,000	35,000	31,000
Percent of Trawlers with the following equipment:				
Radar	100	50	100	60
Loran	100	100	100	100
Recorder	100	100	100	100
VHF	100	100	100	100
C.B.	100	100	100	100

Characteristics of Captains

Captains of mobility class I trawlers tended to be slightly older than captains of mobility class II and III trawlers (Table 13). It is interesting to note that the difference between the means of age was less than 10 years. The four classes of captains were similar in terms of years of formal education. Lack of facilities in rural and sometimes remote areas limited most of the older captains to an elementary education.

The experience in commercial fishing reported by captains averaged 21 years, of which 10 years was worked as a captain and 11 years served as a crew on the trawler. Captains of the mobility class IV trawlers had fewer years of commercial fishing experience than did other types of captains.

Approximately 50 percent of all captains in mobility class I trawlers in the region had non-fishery employment. Only 13 and 21 percent of captains for mobility classes II and III, respectively, had non-fishery employment. No captain in mobility class IV trawlers worked outside the fishery; thus, every captain in this category was a full-time commercial fisherman.

Eighty-eight of 176 captains in mobility class I had spent, on the average, about 8 months in non-fishery jobs (Table 14). Thus, these are persons who are in occupations other than fishing, but take time off from regular employment, or use their holidays or spare time after working hours, to shrimp commercially. Shrimping is usually done to supplement income from employment outside the commercial shrimping industry for class I captains. Most of these captains held blue collar jobs.

About 12 sample captains in mobility class II had non-fishery employment. The length of their non-fishery employment was about 6 months. Captains with non-fishery employment in mobility class III trawlers spent, on the average, only 4 months at non-fishery jobs in 1976.

IV. FACTORS AFFECTING MOBILITY OF TRAWLERS

With an understanding of mobility patterns (section II) and characteristics of trawlers and captains (section III), the next logical step is to examine the relationships between two sets of variables. These relationships are determined by empirical estimation of a mobility function for shrimp fleet in each state. Fishermen's reasons for shrimping outside of their home state are also examined in this section. Finally, the impact of shrimp prices and abundance of stock on the entry of out-of-state trawlers into a particular fishery is quantified by statistical analysis.

Mobility Functions of Trawlers

The following general mobility function was specified for the South Atlantic shrimp fleet:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5$$

Where:
Y = Mobility class index of trawler
- 1= trawler who fished only home state
- 2= trawler who fished two states
- 3= trawler who fished three states
- 4= trawler who fished four states

x_1= ratio of gross returns per day fished in out-of-state and home state
x_2= length of the vessel
x_3= age of the vessel
x_4= number of years as captain
x_5= number of months of captain's non-fishery employment

A mobility function was estimated for each state in the region through multiple regression analysis of the survey data. The results of estimation are shown in Table 15. The statistical results were good. The overall "fit" of the data in the mobility function was high, especially when one considers the heterogenity of the fleet. Many variables were statistically significant with the right signs.

South Carolina The first equation in Table 15 is the mobility function of South Carolina trawlers. Ratio of gross returns per day fished in out-of-state and home waters (x_1) was statistically significant. Gross returns are quantities of catch multiplied by prices. Thus, the higher catch or prices in out-of-state plays an important role in the extent of trawler mobility. Length of vessel (x_2) was positively related to the vessel mobility. This is true because larger vessels are generally better able to operate in and cope with rough seas and storms than are smaller vessels. Therefore, the larger vessel can fish farther from shore and is able to shrimp in other states. The number of months of the captain's non-fishery employment (x_5) was negatively associated with vessel mobility because captains with longer periods of non-fishery employment would have less available time to fish in other states and less interest.

North Carolina In the second equation, three independent variables, i.e. ratio of gross returns per day fished in out-of-state and home state, length of vessel, and the number of months of captain's non-fishery employment were statistically significant.

Table 13. Average Characteristics of Trawler Captain by Mobility Class and Home State, 1976

State	Mobility Class	N	Age	Years of Formal Education	Years of Commercial Fishing Experience	% of Captain with Non-Fishing Employment
South Carolina	I	44	42	11	15	59
	II	22	36	12	15	23
	III	8	38	12	13	38
	IV	1	25	12	4	0
North Carolina	I	88	43	10	21	52
	II	41	45	10	26	15
	III	6	41	11	21	67
Georgia	I	37	42	10	18	27
	II	21	42	9	18	5
	III	14	39	11	20	0
	IV	2	33	13	10	0
Florida	I	7	49	10	25	86
	II	7	48	10	26	0
	III	1	55	7	30	0
	IV	2	39	10	24	0
South Atlantic	I	176	43	10	19	50
	II	91	42	11	22	13
	III	29	40	11	19	21
	IV	5	33	12	14	0

Table 14. Occupational Distribution and Length of Captain's Non-Fishery Employment, 1976

Item	Mobility Class			
	I	II	III	IV
Number of captains in sample	176	91	29	5
Number of captains with non-fishery employment	88	12	6	0
Professional and technical worker	4	1	0	0
Managers and administrators	5	0	0	0
Blue collars-craftsmen, skilled workers, etc.	51	4	5	0
Sales and clerical worker	7	0	0	0
Self-employed	11	4	0	0
Laborers and others	10	3	1	0
Average Length of non-fishery employment for those working outside the fishery (months)	8	6	4	0

Table 15. Mobility Functions of Trawlers in the South Atlantic Shrimp Fishery by State, 1976

State	Ratio of gross returns per day fished in out-of-state and home state x_1	Length of Vessel x_2	Age of Vessel x_3	Number of years as captain x_4	Number of months of captain's non-fishery employment x_5	
South Carolina	$Y = 1.199 + 0.472x_1 + 0.012x_2 - 0.008x_3 - 0.008x_4 - 0.037x_5$					$R^2 = 0.56$
	$(3.32)^{***} \quad (5.78)^{***} \quad (2.36)^{**} \quad (-1.35) \quad (-1.19) \quad (-1.67)^{*}$					D-W= 1.03
						N = 62
North Carolina	$Y = 1.013 + 0.421x_1 + 0.010x_2 - 0.004x_3 - 0.001x_4 - 0.026x_5$					$R^2 = 0.73$
	$(7.02)^{***} \quad (9.81)^{***} \quad (5.00)^{***} \quad (-1.09) \quad (-0.58) \quad (-2.12)^{**}$					D-W= 0.98
						N = 114
Georgia	$Y = 2.124 + 0.329x_1 + 0.009x_2 - 0.010x_3 - 0.003x_4 - 0.169x_5$					$R^2 = 0.71$
	$(4.35)^{***} \quad (3.66)^{***} \quad (1.21) \quad (-1.72)^{*} \quad (-0.53) \quad (-7.72)^{***}$					D-W= 1.32
						N = 64
Florida (east coast)	$Y = 2.670 + 0.047x_1 + 0.011x_2 - 0.056x_3 + 0.012x_4 - 0.168x_5$					$R^2 = 0.83$
	$(3.08)^{**} \quad (0.37) \quad (0.89) \quad (-1.36) \quad (0.59) \quad (-3.06)^{**}$					D-W= 1.31
						N = 14

Where figures in the parentheses are t- statistics.
*** - significant at 1 percent probability level
** - significant at 5 percent probability level
* - significant at 10 percent probability level
D-W = Durbin - Watson statistic
N = Sample size

However, the age of the vessel and number of years as captain were not significantly related to vessel mobility. All five variables collectively explained 73 percent of the variation in mobility of the North Carolina shrimp fleet.

Georgia Age of vessel was an important indicator of trawler mobility in the state of Georgia. Ratio of gross returns per day fished in and out-of-state and number of months of captain's non-fishery employment were other factors which contributed significantly to trawler mobility.

Florida The mobility function of Florida shrimp trawlers differed somewhat from mobility functions of other states in the region. Number of months of captain's non-fishery employment was the only factor affecting the extent of trawler mobility in Florida.

Fishermen's Reasons for Fishing in Other States

Fishermen who fished outside of their home states were asked to state their reasons for fishing in other states. (Table 16) Thirty percent of the sample fishermen stated better catch in other states as the reason for shrimping in another state. Twenty-six percent reported that the absence of shrimp in home state was the reason for shrimping in another state. Another leading reason was high shrimp prices in other states. The answers indicated that a trawler was not likely to fish in other states unless the catch or prices in other states were greater than that of the home state.

Table 16. The Main Reason of Shrimpers Fishing in Other States in 1976 Mobility Class

Reason	Percent by Mobility Class			
	II N=89	III N=28	IV N=5	All N=122
Better catch in other states	34	21	0	30
No shrimp in home state	25	21	80	26
Higher shrimp prices in other states	19	29	20	21
Follow shrimp season pattern in the region	15	21	0	18
Too many boats in home state	5	4	0	3
Early season opening in other states	2	4	0	2
	100	100	100	100

Entry Function of Trawlers

As indicated by fishermen, better shrimp prices and catches were the major reasons for entry to fish in other states. The shrimp catch by commercial trawlers was primarily influenced by the availability of shrimp. An attempt was, therefore, made to determine the impact of shrimp prices and the abundance of shrimp on the entry of out-of-state trawlers in the fishery.

Although sufficient data were not available for the South Atlantic shrimp fishery, data from the South Carolina shrimp fishery were available and employed for the estimation. Severe winter weather was chosen as the proxy for abundance of shrimp because biological research indicated that if two consecutive months of winter sea water temperatures were below 50° F, the forthcoming white shrimp season was always poor. An entry function estimated with yearly data for South Carolina shrimp fishery over the 1960-1976 period was:

$$Y = 125.02 + 1.889x_1 - 65.656x_2$$

$$(2.71)^{**} \quad (3.20)^{***} \quad (-1.81)^{*}$$

$$R^2 = 0.60$$

Y = Number of out-of-state trawlers entered in South Carolina's shrimp fishery

x = Ex-vessel shrimp price per pound (¢)

x = Severe winter winter (yes=1, i.e. if 2 consecutive months of winter sea water temperature in Charleston Harbor were less than 50°F; No=0, otherwise)

Where figures in the parentheses are "t" statistics:

*** significant at 1% probability level

** significant at 5% probability level

* significant at 10% probability level

This equation revealed a positive, significant relationship between entry of out-of-state trawlers and shrimp price. With other independent variables remaining constant, a one percent increase in shrimp price tended to increase the number of out-of-state trawlers by two. The significant coefficient of severe winter weather shows that out-of-state trawlers engaged in shrimping in South Carolina during a poor year was about 66 trawlers less than under a normal year. This shows that the abundance of the shrimp stock played an important role in the decision-making of out-of-state fishermen.

The coefficient of multiple determination (R^2) was small for the entry function. Only 60 percent of variation in the number of out-of-state trawlers entered in the South Carolina fishery could be accounted for by the combined effects of the two variables. This suggests that additional variables should be included in further analysis in order to arrive at a better predictive device.

V. PRODUCTIVITY OF TRAWLERS

The consistently low shrimp catch of trawlers in the South Atlantic states makes the analysis of vessel productivity in terms of shrimp landed per day and per season important. The analysis includes only sample trawlers with completed information on landings, prices, and fishing effort. Mobility class IV trawlers are omitted throughout the productivity analysis because of small sample size.

Vessel Productivity per Day and Prices

Vessel productivity per day is measured in terms of pounds of shrimp

landed. Vessel productivity per day varied considerably according to mobility classes of trawlers (Table 17). Average vessel productivity per day was higher for trawlers in higher mobility classes in each state's shrimping grounds in 1976. For example, vessel productivity per day was about 156 pounds of shrimp for mobility class I trawlers, about 204 pounds for mobility class II trawlers, and about 248 pounds for the mobility class III trawlers in South Carolina. The higher catch per day for more mobile trawlers could be due to larger vessel, more crew, and fishing deeper waters.

Vessel productivity per day was also associated with richness of shrimping grounds. In the 1976 season, vessel productivity per day in North Carolina and South Carolina waters was higher than in Georgia and Florida. It was also observed that the mobility class II and III trawlers had a higher catch per day from shrimping in home state than in out-of-state. The captains of these trawlers could be more knowledgeable about fishing grounds in their home state; consequently, they could fish in good locations and at the best time of the season.

The price received by commercial fishermen is extremely important in determining the financial outcome of their operation. Price per pound of shrimp is shown in Table 18. It can be observed that shrimp landed in the east coast of Florida were paid higher prices because the most shrimp production took place between September and December when the volume of landings was low and price is inversely related to supply. The average prices paid to fishermen of mobility classes II and III trawlers were higher than that of mobility class I trawlers. This was due to the larger trawlers generally shrimping in deeper water and farther out from the shore where larger shrimp are more abundant. Larger shrimp usually command a higher price. It is interesting to note that shrimpers received higher prices out-of-state than in their home state. This was one of their main reasons for shrimping in other states.

Vessel Productivity per Year and Fishing Effort

Vessel productivity is also measured in terms of pounds and value of shrimp landed per year. Vessel productivity per year is related to the extent of the fishing effort. Table 19 gives the vessel productivity per year and factors associated with fishing effort.

Vessel productivity per year for the average mobility class II and III trawlers was higher than that of the average mobility class I trawler, since they had more fishing days and higher catch per day. These trawlers also had larger crews on the trawlers and larger operating capital in their shrimping operation. The highest vessel productivity in terms of value of shrimp landed for the mobility class III trawlers may indicate that the greater potential returns that could be derived from the investment in more mobile, larger trawlers.

The differences in vessel productivity per year among four states' trawlers were also observed. For the mobility class II and III trawlers, vessel productivity of North Carolina was consistently higher than that of other states' trawlers. This could be attributed to the higher capital - labor ratio in the North Carolina trawlers. Among mobility class I trawlers, vessel productivity per year was the highest for Georgia trawlers because of the greater number of days fished.

The results of the productivity analysis indicated that the higher mobility class trawlers produced higher catch per day and per year, better price, and consequently higher annual gross returns. The relationship of fishing effort and vessel productivity per year from commercial shrimping are examined in the next section.

Production Function Analysis on Vessel Productivity

The general form of the production functions of an individual trawler can be written as follows:

$$Y = F\ (X_1, X_2, \ldots X_j \mid X_{j+1}, \ldots X_n)$$

Where Y represents output, $X_1, X_2 \ldots X_j$ represent factor inputs related to fishing effort which can be controlled by the decision makers of the trawler, and $X_{j+1}, \ldots X_n$ denote uncontrollable factors for the trawler, e.g. the abundance of the shrimp and the climate factor. No data are available for the uncontrollable factors; therefore, these factors are not included in the study. Fishing effort may be defined as the product of fishing power and time spent fishing. Factors of fishing power may include horsepower of the vessel, crew size, and operating capital. The role of horsepower in the shrimp trawler appears to be that the larger the engine, the deeper the water that can be shrimped. Also, the larger horsepower engine has a larger "search power" for the trawler. Large crew and

Table 17. Pounds of Shrimp Catch per Day per Trawler by Mobility Class and Shrimping Grounds in 1976

Vessel's Home State	Mobility Class	Shrimping Grounds: South Carolina N 1/	South Carolina X 2/	North Carolina N	North Carolina X	Georgia N	Georgia X	Florida N	Florida X
South Carolina	I	39	156						
	II	20	204			11	118	4	25
	III	5	248	1	25	4	156	3	70
North Carolina	I			80	155				
	II	27	248	29	228	2	124		
	III	6	867	5	1089	5	387	1	144
Georgia	I					33	147		
	II	7	115			17	221	5	95
	III	8	192			13	224	11	211
Florida (east coast)	I							7	44
	II					5	29	5	43
	III					1	10	2	128
South Atlantic States	I	39	156	80	155	33	147	7	44
	II	54	214	29	228	35	156	14	56
	III	19	420	6	912	23	238	17	176

1/ N = Number of Trawlers 2/ X = Pounds of shrimp catch per day per trawler

Table 18. Price per Pound of Shrimp (head on) by Mobility Class and Shrimping Grounds in 1976

Vessel's Home State	Mobility Class	Shrimping Grounds: South Carolina N 1/	South Carolina X 2/	North Carolina N	North Carolina X	Georgia N	Georgia X	Florida N	Florida X
South Carolina	I	40	1.34						
	II	18	1.70			10	1.93	4	2.09
	III	5	1.52	2	.97	4	2.67	3	2.18
North Carolina	I			87	1.23				
	II	35	2.05	40	1.41	4	2.13		
	III	6	2.09	5	1.86	5	2.23	1	3.00
Georgia	I					35	1.74		
	II	8	2.04			19	1.77	6	1.86
	III	7	2.24			14	2.12	12	2.18
Florida (east coast)	I							7	2.28
	II					7	3.04	7	3.05
	III								
South Atlantic States	I	40	1.34	87	1.23	35	1.74	7	2.28
	II	61	1.94	40	1.41	40	2.07	17	2.40
	III	18	1.99	7	1.39	23	2.24	16	2.23

1/ N = Number of respondents reporting 2/ X = Dollars per pound of shrimp

operating capital contribute to efficiency. Thus, the specific form of the production function of an individual trawler can be rewritten as:

$$Y = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5}$$

Where Y = the value of shrimp landed per year
X_1 = horsepower
X_2 = operating capital
X_3 = crew size
X_4 = days shrimped in home state
X_5 = days shrimped out-of-state

The results of the production function analysis are shown in Table 20. The production function for the mobility class I trawlers in South Carolina indicated that horsepower (X_1) elasticity of the shrimp production is 0.527. An increase in horsepower by one percent would bring an increase in the value of shrimp production of about 0.527 percent for the South Carolina mobility class I trawlers, if other inputs are held constant. An increase in shrimping days off the South Carolina coast by one percent would bring an increase in shrimp production of about 1.391 percent for trawlers. In this production function, days shrimped in home state was the most significant, as indicated by the "t" value in explaining annual shrimp production of the trawlers.

For mobility class I trawlers in the region, days shrimped in the home state was the most significant variable affecting gross returns. These trawlers could expand fishing days in order to increase gross returns from shrimping. For the mobility class II and III trawlers in Georgia, an increase in the number of days shrimped in out-of-state would also increase their shrimp production.

Horsepower exhibited a positive elasticity which is consistent with the hypothesis that horsepower increases range and ability to fish in deeper waters as well as speed in trawling. Horsepower has negative elasticity for North Carolina's mobility classes II and III trawlers. This is not necessarily inconsistent since "t" value for this variable is not statistically significant.

The significant explanatory variable for shrimp production of North Carolina trawlers and Georgia mobility class II and III trawlers was operating capital; that is, the higher the operating capital on these vessels, the higher gross returns from shrimp trawling.

Over all, shrimping days was the most important variable in determining the gross returns for the mobility class I trawlers in the region and the mobility class II and III trawlers in Georgia. Operating capital was the most important variable affecting gross returns of North Carolina's mobility classes II and III trawlers and second in importance in North Carolina's mobility class I trawlers. Engine horsepower was the most significant variable in determining gross returns for South Carolina's mobility class II and III trawlers. Results were inconclusive for crew size variable.

VI. PROFITABILITY OF TRAWLERS

The profitability of an enterprise is measured by the net returns received from its operations after all costs of production have been deducted from its gross returns. This section is concerned with a comparison on a regional basis of gross returns, costs, and net returns, income above variable costs of the shrimp trawlers. This knowledge is important for understanding the South Atlantic commercial shrimping industry.

The analysis of profitability of trawler operations was based on those sample trawler captains who reported their catch, price received, and costs of production. The data were then analyzed on an annual costs and returns basis for the three mobility classes of trawlers.

Gross Returns

The gross returns are amounts received from the sale of shrimp and fish landed during the survey year. The average gross returns of three types of trawlers varied considerably. Mobility class III trawlers had the highest annual gross returns ($122,000) of three mobility classes (Table 21). Shrimp represented the predominate gross returns from all trawlers, while gross returns from other fish were very small. The gross returns from shrimp sales were determined not only by the quantity of shrimp landed, but also by the price at which they were sold. The fishermen did not have much control over shrimp prices. Factors associated with shrimp catch had been determined in section V.

Cost of Production

Production costs are broken down into two categories, variable and fixed. Variable costs comprise all cost items that vary with fishing effort. Fixed costs represent those costs that are incurred regardless of whether or not the vessel is away from the dock. Thus, total fixed

Table 19. Average Shrimp Catch per Trawler and Fishing Effort by Mobility Class

State	Mobility Class	N	Pounds of shrimp landed	Dollars of shrimp landed	Number of Days shrimped in		Total Number of days shrimped	Crew Size	HP	Operating Capacity
					Home State	Out-of-State				
South Carolina	I	38	17,276	20,717	93	0	93	2.7	176	8625
	II	18	38,232	62,847	150	31	181	3.9	237	19279
	III	5	57,632	86,902	141	48	189	4.6	325	39054
North Carolina	I	80	18,578	23,943	110	0	110	2.9	167	6893
	II	29	49,626	75,377	115	50	165	4.4	208	22652
	III	5	121,050	194,760	53	86	139	4.2	296	48744
Georgia	I	33	24,528	41,919	148	0	148	3.7	226	18877
	II	17	40,152	62,642	126	49	175	3.8	242	21974
	III	13	48,615	99,547	104	111	215	3.5	282	26104
Florida (east coast)	I	7	7,143	14,700	162	0	162	2.7	201	5826
	II	5	12,980	31,066	118	67	185	4.0	314	25350

Table 20. Production Functions of Trawlers by Mobility Classes and Home State of Trawler

	South Carolina		North Carolina		Georgia		Florida
	I	II&III	I	II&III	I	II&III	I
Value of a (log form)	-0.199	2.972	-0.594	1.110	1.874	1.324	1.757
Value of b_i (elasticities)							
b_1 : Horsepower	0.527	0.749	0.425	-0.020	0.529	0.450	0.577
b_2 : Operating capital	0.134	0.343	0.338	0.740	0.049	0.389	-0.109
b_3 : Crew size	-0.191	0.143	0.020	-0.159	-0.171	-0.591	0.454
b_4 : Days shrimped in home state	1.391	-0.661	1.232	-0.072	0.608	0.257	0.603
b_5 : Days shrimped out-of-state		0.035		0.441		0.304	
Value of "t" for elasticities							
Horsepower	1.81*	1.77*	1.69*	-0.03	1.60	1.79*	1.26
Operating capital	1.11	1.31	2.50**	2.37**	0.22	1.93**	-0.61
Crew size	-0.50	0.42	0.08	-0.44	-0.59	-2.84***	0.96
Days shrimped in home state	7.40***	-1.25	4.55***	-0.22	2.01**	1.53	4.41**
Days shrimped out-of-state		0.31		1.62		4.15***	
R^2	0.86	0.56	0.51	0.40	0.36	0.65	0.94
D-W	2.12	1.66	1.93	1.96	1.86	1.60	2.27
Sample size	38	23	80	34	33	30	7

*** Significant at 1 percent probability level ** Significant at 5 percent probability level
* Significant at 10 percent probability level

costs will remain the same regardless of the level of fishing effort. Fixed costs include depreciation, license fee, interest, insurance, and other fixed costs. Depreciation was determined by asking the owner of the vessel what he considered the market value of his vessel and all the equipment and how long he planned to keep the vessel, and what he thought he could get for it if he sold it at that time (salvage value). The rate of depreciation was calculated as the market value less salvage value, divided by the depreciation life. As expected, this approach was below the "depreciation for tax purposes" which normally ranged from 7 to 15 years of vessel life.

Variable costs represent the largest proportion of total costs for all three groups of vessels. The average mobility class I and II vessel incurred variable costs of $26,835 and $61,373, respectively. The mobility class III vessel's variable costs ($96,707) were about 4 times higher than that of mobility class I trawlers. Variable costs tended to increase as the size of the vessel increased. The largest variable cost items were crew share, captains' share, fuel, and repair and maintenance for the vessel and gear.

Annual fixed costs for the average mobility class III trawler were about $11,564, compared to $2,164 for the mobility class I trawler. Fixed costs items were much higher for mobility II and III trawlers due to higher capital investments associated with these larger vessels.

As stated, the fisherman has little control individually over shrimp stock and over the price he received for his catch. He does have a measure of control over the various inputs that make up his fishing effort and hence over his costs of production. Some daily expenses will be variable in accordance with the fisherman's decisions about the kind and amount of fishing activity that is likely to yield the most profit. Their cost items vary in the degree to which they can be controlled by the fishermen. For example, fuel expenses are directly related to the number and distance of trips made. Control of labor expenses varies according to owner and crew arrangements. A fisherman possessing bookkeeping skills and an understanding of business accounting would enhance his ability to compute costs of production and have better control over expenses.

Net Returns

Net returns are the difference between gross returns and total costs. Net returns for the average mobility class III trawler were $13,729 which was the highest with respect to all mobility classes. However, not all trawlers in the mobility class III experienced positive net returns; 48 percent of the trawlers in this group had negative net returns i.e. a loss (Table 22). About 13 percent realized net returns ranged from $9,000 to $14,999. About 39 percent of them had net returns greater than $25,000.

The average mobility class I and II trawlers had total costs greater than gross returns. Net returns were about $1,647 for the average mobility class I trawler and $278 for the average mobility class II trawler. Of the 158 mobility class I trawlers, 108 trawlers (68%) sustained losses in commercial fishing. Among the mobility class II trawlers, 62 percent had unprofitable operations and only 38 percent could show a profit.

A wide dispersion in net returns was observed for the South Atlantic shrimp fleet. On the average, commercial fishing was more profitable operation for more mobile, larger trawlers. The ability of larger trawlers to generate more revenue per unit of input was the principle reason for their superior earnings performance. This was probably linked to the number of days fished and other economies of scale.

Income above Variable Costs

Income above variable costs is gross returns less total variable costs. It reflects the amount which will be left over to help cover fixed costs. As long as fishermen can cover all variable costs, it will pay them to fish in a fishing season. This is because they will incur fixed costs regardless of the fishing effort.

Income above variable costs was about $517 for the average mobility class I trawler (Table 21), $5,208 for the average mobility class II trawler, and $25,293 for the average mobility class III trawler. This shows that the average mobility class I and II trawlers were better off by fishing even though their annual net returns were negative. By engaging in commercial fishing, they were able to generate some gross returns over variable costs to cover some fixed costs and thus losses were reduced.

Not all trawlers in the three mobility classes realized income above variable costs (Table 23). Approximately 59 percent of mobility class I trawlers did not have income above variable costs in their commercial fishing operations. These trawlers clearly had unprofitable operations in 1976.

Table 21. Average Annual Costs and Returns among Three Mobility Classes of Trawlers in the South Atlantic States, 1976

Item	Mobility Class I N=158 1/	II N=69	III N=23
Gross returns:			
Shrimp fishery	$26,512	$65,760	$117,498
Other fisheries	840	821	4,502
Total	27,352	66,581	122,000
Variable costs:			
Vessel repair & maintenance	2,378	4,405	8,443
Gear repair & maintenance	1,234	2,250	4,243
Ice	649	1,898	2,398
Fuel	3,205	6,709	10,908
Heading & packing	1,264	4,090	4,940
Crew shares	9,968	26,144	44,190
Captain shares	6,938	12,707	17,369
Other variable costs	1,198	1,169	4,216
Total variable costs	26,835	61,373	96,707
Fixed costs:			
Depreciation	1,138	2,522	6,357
License fee	55	231	295
Interest	382	1,044	1,718
Insurance	433	1,314	2,781
Other fixed costs	156	375	413
Total fixed costs	2,164	5,486	11,564
Total costs (Variable and Fixed costs)	28,999	66,859	108,271
Net Returns (Gross return - Total costs) 2/	-1,647	- 278	13,729
Income above variable costs (Gross return - variable costs)	517	5,208	25,293

1/ N = Number of vessels

2/ Return to owner's labor, management, and investment

Table 22. Frequency Distribution of Net Returns from Commercial Fishing by Mobility Class of Trawlers, 1976

Net returns	I		II		III	
	N	%	N	%	N	%
Under 0	108	68	43	62	11	48
1 - 2,999	17	11	3	4	0	0
3,000 - 5,999	11	7	2	3	0	0
6,000 - 8,999	4	3	4	6	0	0
9,000 -14,999	5	3	6	9	3	13
15,000 -19,999	2	1	1	2	0	0
20,000 -24,999	2	1	2	3	0	0
25,000 and over	9	6	8	11	9	39
	158	100	69	100	23	100

Table 23. Frequency Distribution of Income above Variable Costs from Commercial Fishing by Mobility Class of Trawlers, 1976

Gross returns less total variable costs	I		II		III	
	N	%	N	%	N	%
Under 0	93	59	38	55	9	39
1 - 2,999	25	16	3	4	1	4
3,000 - 5,999	15	10	4	6	0	0
6,000 - 8,999	2	1	2	3	0	0
9,000 -14,999	5	3	8	12	2	9
15,000 -19,999	5	3	2	3	0	0
20,000 -24,999	3	2	3	4	1	4
25,000 and over	10	6	9	13	10	44
	158	100	69	100	23	100

VII. MANAGEMENT PROGRAMS AND VESSEL MOBILITY

The primary goal of this section is the evaluation of some existing and alternative shrimp management programs. This evaluation is intended to predict the potential effects of some important management programs on vessel mobility without endorsing any specific programs. Evaluation of some of the existing and alternative shrimp management programs has to take into account the interests and preferences of commercial fishermen. This is essential, not only for reasons of political and administrative feasibility, but also for purposes of assessing the socio-economic impact of shrimp management programs.

Existing programs concerning trawling seasons, vessel licenses, trawling areas, and management structures are included in the analysis. This evaluation does not intend to be an in-depth analysis of these specific programs, since this would require numerous additional research projects. Evaluation of alternative management programs such as a single regional vessel license, a fixed date for season opening, and a regional management regime are attempted. The program evaluations are not meant to be exhaustive and there may be others that are worthy of consideration.

Trawling Season Regulation

A. Existing Management Programs

In North Carolina, trawling seasons are controlled by the director of the Division of Marine Fisheries based on the concept of optimum utilization. Oceans, sounds, and major rivers will remain open to shrimping year round except (1) when extreme environmental conditions cause significant migration of pre-commercial size shrimp into these areas, or (2) when commercial and pre-commercial size shrimp occupy the open waters simultaneously.

In South Carolina, the area from the shoreline to the three mile limit may be fished May 15 through December 15. Sounds and bays are open August 15 through December 15. However, the Division of Marine Resources may vary opening or closing by a month in spring and summer based on shrimp size.

The shrimp trawling season in Georgia's offshore is open from June 1 through December 31; however, the director of the Division of Coastal Resources may open seaward territorial waters during January and February when the shrimp count is below 50 per pound, heads on.

In Florida, the trawling season is set by Marine Resource Division based on shrimp count sampling. It requires a minimum count of 70 per pound, heads off. The regulation, as set forth in the statutes, is relatively inflexible.

B. Comments on Existing Management Programs

The existing programs in the region except North Carolina allow a shrimp season opening depending on shrimp conditions. Fishermen were asked: Do you favor a flexible season opening date dependent on the condition of the shrimp in your state? There were 301 respondents to this question, with 274 (91%) answering yes. (Table 24) This clearly indicates that fishermen currently prefer to have a season opening dependent on shrimp size.

Table 24. Do you favor a flexible season opening date dependent on the condition of shrimp in your state?

Opinions	Percent by type of Shrimpers				
	I N=176	II N=91	III N=29	IV N=5	All N=301
Yes	88	97	93	80	91
No	10	2	4	20	7
Don't Know	2	1	3	0	2
	100	100	100	100	100

Fishermen were also asked for their comments on the existing system. Typical responses in favor of the system are summarized below:

a. It would provide a better catch.
b. The season should be held until shrimp reach marketable size, but not too long that they leave the area.
c. The season should be shorter or longer depending on the size of the shrimp.
d. The industry should be involved along with conservation people in determining the opening of the season.
e. The opening of the season should be better enforced.

Many shrimpers feel strongly that there was not sufficient consultation between fishermen and management. They also feel that the season opening and closing should be more strictly enforced.

There were about 7 percent of shrimpers who disliked a flexible season opening date dependent on shrimp size. Their major reason was that they cannot plan ahead for the season.

Shrimpers were asked to comment on the impact when shrimping seasons in neighboring states open later than in their home state.

Table 25. How are You Affected when Shrimping Seasons in Neighboring States Open Later than in Your Own State?

Impact	All responses (in percent)
Too many vessels, catch per vessel decreases	46
No effect	42
Better catch	5
Hurts prices or price becomes unstable	4
No comment or Don't know	2
Other	1

As may be seen in Table 25 (when responses to the open end question are abstructed), the majority of shrimpers indicated either negative impact on them such as too crowded, catch decreases and hurt prices or no effect. Only 5 percent indicated a positive impact i.e. better catch.

Existing management programs introducing some degree of uncertainty relative to when the shrimp will achieve the appropriate conditions for a season opening, may in fact keep some trawlers from shrimping in other states for fear of missing their home state opening. Thus, under existing season opening regulations, interstate mobility of shrimp trawlers is likely to be no greater than that associated with various fixed date openings in the region. However, the flexible season opening scheme entails additional costs not necessarily associated with fixed opening schemes. One additional cost would be the cost of implementing and conducting an annual sampling program to determine when the season should open or close.

C. Alternative Management Option - Various Fixed Opening Dates for Shrimping

Under this system, each state would assign a fixed date for season opening for every year. This system would save the cost of sampling necessary to open the season on the basis of shrimp condition. A survey of shrimpers found lack of strong support for this alternative season opening system (Table 26). Of the fishermen responding to this question, 33 percent supported the system.

Table 26. Do You Favor Various Fixed Opening Dates for Shrimping Four States in the Region?

Opinions	Percent by type of Shrimpers I N=176	II N=91	III N=29	IV N=5	All N=301
Yes	26	41	45	60	33
No	45	48	48	20	46
Don't Know	29	11	7	20	21
	100	100	100	100	100

The typical responses for those supporting this alternative scheme are listed below:

a. Flexible opening hurts planning.
b. Set dates so boats can fish peak seasons in various states.
c. Would allow for shrimping in other states.
d. So I can be there on opening date.

Some typical responses from those fishermen opposed to the system are:

a. Prefer flexible opening - depending on shrimp condition.
b. Shrimp don't follow the same pattern in different places.
c. Brings in too much competition - affects price too much.
d. Prefer all states open and close simultaneously to spread out boats.

This alternative season opening method allows the more mobile vessels to capitalize on good fishing generally characteristic of the early part of the season. Because of this, some owners of small, less mobile vessels have endorsed a policy in which all states open and close at the same time, generally citing the fact that such a policy would reduce fleet mobility.

Vessel License Regulation

A. Existing Management Programs

Commercial shrimp vessels in North Carolina are subject to license fees according to the length as follows:

without motors	$1.00
with motor, less than 18'	$3.00
with motor, over 18'	$0.50/ft.
with motor, over 26'	$0.75/ft.

South Carolina shrimp trawlers are assessed more stringently:

commercial vessels under 18'	$ 2.50*
commercial vessels over 18'	$ 10.00*
resident shrimp trawler	$ 75.00
non-resident shrimp trawler	$200.00

*not required of shrimp trawlers

Georgia's commercial fishermen pay according to the following, more demanding schedule:

trawlers under 18'	$25.00
trawlers over 18'	$25.00*
non-trawlers under 18'	$ 5.00
non-trawlers over 18'	$ 0.50/ft.

*plus $0.50/ft. in excess of 18'

Florida pro-rates its license fees according to size of commercial fishing vessel:

Class 1-A	all boats less than 12'	$ 2.00*
Class 1-B	12' - 16'	$ 6.00*
Class 2	16' - 26'	$11.00*
Class 3	26' - 40'	$31.00*
Class 4	40' - 65'	$51.00*
Class 5	65' - 110'	$61.00*
Class 6	110' or more	$76.00*

*plus $0.50 for registration fee
Non-residents are required to pay an additional $50.00 in fees.

B. Comments on Existing Management Program

Monetary disincentives can be used to control access to a fishery by setting license fees at a level where many individuals become unwilling or unable to obtain a license. Under the present management program, a license fee is imposed on all commercial shrimp vessels in the region. In addition, non-resident shrimp vessels are charged an additional fee or higher license fees than that of resident vessels in South Carolina, Georgia, and Florida.

The apparent intent of the higher license fee for out-of-state vessels is to provide a partial barrier for entry into the fishery. However, it does not significantly limit entry of out-of-state vessels into the shrimp fishery in South Carolina, Georgia, and Florida. In fact, at least 33 percent of the total vessels in these states were out-of-state vessels. Although North Carolina did not charge a non-resident vessel fee, only 13 out-of-state vessels engaged in shrimping in North Carolina during 1976. Thus, the impact of existing out-of-state license fees in decreasing total fishing effort was minimal.

C. Alternative Management Option - A Regional License

The regional license would be valid for shrimping any area outside the home state in the region. Fishermen were asked their opinions about this alternative license scheme. The majority of shrimpers who fished two or more states in the region preferred this license system, while only 22 percent of the shrimpers who did not fish outside their home state favored the regional license (Table 27).

Table 27. In Addition to a Home State License, Do You Favor a Regional License Instead of Individual Out-Of-State Licenses for Shrimping outside your Home State?

Opinions	Percent by type of Shrimpers I N=176	II N=91	III N=29	IV N=5	All N=301
Yes	22	54	83	60	38
No	47	32	7	0	37
Don't Know	31	14	10	40	35
	100	100	100	100	100

The typical responses in favor of the regional license are listed below:

a. End the confusion of the present system.
b. It would be more convenient.
c. Make one fee - no loopholes and worry about separate licenses.
d. When fishing on state borders we would not have to worry about separate licenses.
e. It would be better to have a regional license including home state.
f. It may cut down on illegal shrimpers.

Sample comments from those against the regional license are:

a. It would be a waste for those

who do not shrimp out-of-state.
b. Do not shrimp off all states; would not use license for all states.
c. Boats whould be allowed only to fish in their own state.
d. It might bring more vessels to home state creating less profit.
e. License fees would be too high.
f. Leave it as it is.

The greatest advantage of this alternative approach is that it would be more convenient for shrimpers. It would save time and effort for shrimpers to obtain separate out-of-state licenses for each state. It may also cut down administrative costs for management agencies in the region. Revenues for the regional license could be distributed to participating states in an equitable or suitable manner.

The economic impact of this scheme on the fishery will depend on the amount that is charged for the regional license fee. If the regional license fee was reasonable, it would encourage fleet mobility. The less mobile vessels would generally suffer from increases in vessel mobility in the region. However, if the regional license fee was set very high so that many shrimpers found it non-profitable to use the license, it might reduce fleet mobility. This would tend to favor smaller, less mobile vessels over larger, more mobile ones.

Trawling Area Regulation

A. Existing Management Program

Opening and closure of areas to shrimping in North Carolina are controlled through state statutes. Primary nursery areas are closed to trawlers, while the oceans, sounds and major rivers are open to trawling year-round except under extreme environmental conditions.

In South Carolina, trawling is restricted within ¼ or ½ mile of the shore line along most inhabited beaches during May 15 through September 15. It is illegal to trawl within ½ mile of any fishing pier in Horry County. In general, all coastal areas, other than offshore waters and six sounds and bays, are considered nursery areas and are off-limits to shrimp trawling.

The legal trawling areas in Georgia are offshore waters only. The Division of Coastal Resources has permanently closed all sounds and bays to shrimp trawling since 1977.

Florida has some nursery areas permanently closed to commercial shrimp trawling. At present, other areas except in St. John's river are opened and closed to shrimp trawling on the basis of shrimp size, determined by a series of tests prescribed by the legislature.

B. Comments on Existing Management Programs

Shrimpers were questioned: How would it affect your shrimping if sounds were not closed to shrimping? The majority of respondents believed that opening sounds would deplete the shrimp population (Table 28) and preferred that nursery areas be closed to shrimp trawling. About 2 percent of the shrimpers indicated that they would have more out-of-state trawlers to compete with than if sounds were not closed to shrimping.

Table 28. How Would It Affect Your Shrimping if Sounds Were Not Closed to Shrimping?

Impact	All responses (in percent)
It would deplete the shrimp population	62
No effect	14
It would improve catch	6
Price would go down	4
More out-of-state vessels	2
Don't know or no comment	2

If sounds were not permanently closed to shrimping, more out-of-state trawlers could be expected in the fishery when sounds were opened for trawling. This can be observed from Table 7. As an example, most out-of-state trawlers entered into the South Carolina shrimp fishery in September because most of its sounds were opened for shrimping in this month. Thus, the opening of sounds for trawling based on shrimp size could bring more crowding externalities to resident trawlers.

Management Structures

A. Existing Management Structures

The agencies having control over shrimp management responsibility over the state's coastal waters from shoreline to

the three mile limit are:

North Carolina - Division of Marine Fisheries, North Carolina Department of Natural Resources and Community Development
South Carolina - Division of Marine Resources, South Carolina Wildlife and Marine Resources Department
Georgia - Coastal Resource Division, Georgia Department of Natural Resources
Florida - Marine Resource Division, Florida Department of Natural Resources

In the states of North Carolina, South Carolina, and Georgia the management agencies are authorized to promulgate rules for the control of shrimp fisheries consistent with existing state policies and statutes. These agencies have some flexibility in shrimp management measures such as control of the season and the trawling areas in coastal waters. However, the shrimp management system in Florida as set forth in the statutes, is relatively inflexible and allows for limited regulatory authority through administrative direction. Fisheries managers in the four South Atlantic coastal states generally recognize a need for greater regulatory flexibility in their management programs.

The state agencies consider both the economics and biology of resource use and base their decisions on a combination of factors. The objectives of the shrimp management programs have been to protect the breeding stock and maximize the catch. The management agencies have attempted to obtain the objectives by regulating the harvest season, areas, and the size of the shrimp harvested. However, these efforts are limited by biological information gaps, inadequate shrimp catch and effort statistics and lack of sufficient socio-economic data. Enforcement problems exist. Lack of legal regional management authority also hinders present management efforts.

Because of the need for coordination in shrimp management among states, the South Atlantic State-Federal Fishery Management Board was established. The Board is composed of the Regional Director of the National Marine Fishery Service (NMFS) and the heads of each state's fishery division. A supporting unit for the board is the Shrimp Management Committee which has representation from each state in the region and NMFS. Under this system, each state attempts to better coordinate management and administrative activities, but continues to manage the shrimp fishery on an individual state basis. The board cannot adopt regional regulations because of the lack of jurisdictional authority.

B. Alternative Management Structure-The South Atlantic State-Federal Management Commission

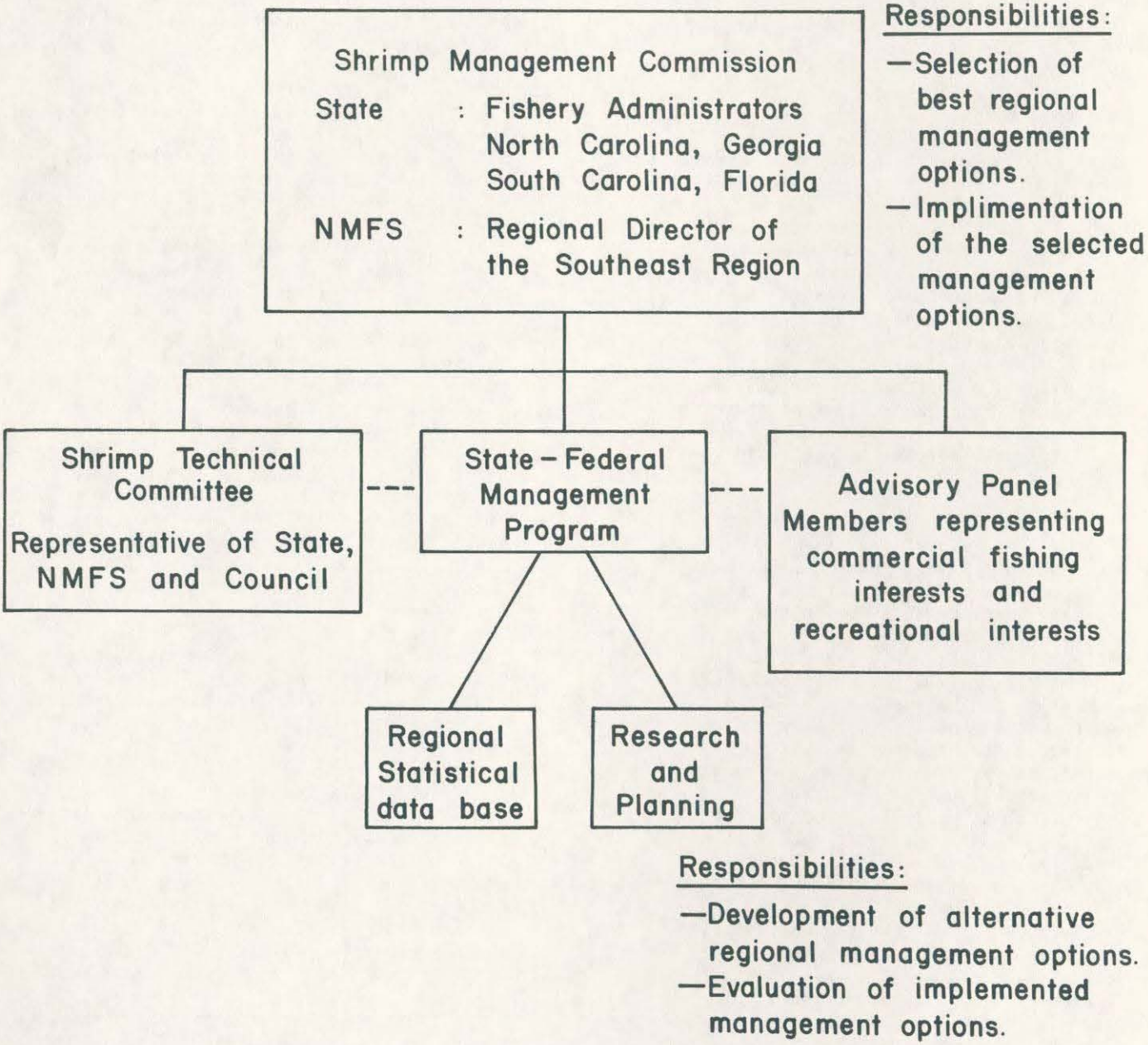
In the South Atlantic shrimp fishery, there is some linkage through migration of stock between states and the mobility of the fleet among states. A regional approach would seem desirable. However, state-state jurisdictional problems severely limit the ability of existing management structure to pursue coordination, rational management of the regional fisheries. An alternative is to establish a regional shrimp management structure that will permit development and implementation of regional management options. One of the alternative management structures is shown in Figure 1.

The South Atlantic State-Federal Shrimp Management Commission would be composed of the state fisheries administrator appointed to the Atlantic State Marine Fishery Commission (ASMFC) by the four states and Regional Director of NMFS. The important advantages of this alternative structure are that the Atlantic State Marine Fishery Commission is already in existence and states can adopt regional regulations through use of Amendment One of the ASMFC and by passing legislation in each state that would treat the ASMFC as an agency of the state. Funding for a Regional Statistical Data Base Unit under the State-Federal management program could come from the NMFS. Federal funding may be made available for the Research and Planning Unit to develop regional management options and evaluate the management system from a multi-disciplinary point of view.

Under this alternative system the states would continue to manage the shrimp fishery within their boundaries but would cooperate in managing the regional aspects of the fishery which cannot be managed under the existing system. For example, the state resident license would be administered by each state, but a single regional license that would allow shrimping within the territorial sea could be administered by the Shrimp Management Commission or the ASMFC. Shrimping outside the territorial sea could be managed by the South Atlantic Fishery Management Council.

The advantages of this alternative system are to:

FIGURE I. REGIONAL MANAGEMENT STRUCTURE FOR THE SOUTH ATLANTIC SHRIMP FISHERY



a. allow states and NMFS to coordinate administrative, research, statistical gathering, and planning policies.
b. establish a research and planning unit that can focus on development and evaluation of fishery management alternatives.
c. save administrative and enforcement costs through eliminating unnecessary duplication.
d. adopt regional resource management programs, such as regional license system.
e. help establish regional vessel registration of commercial shrimp vessels.
f. establish mechanisms for timely changes in management to deal with changes in abundance and in fleet mobility or development.
g. allow maximum freedom for each state to pursue its state management objectives.

The disadvantage of this system is that the industry may resist accepting the new system since fishermen have been used to the old system.

VIII. SUMMARY AND CONCLUSIONS

This study was conducted to provide economic information concerning mobility of trawlers in the South Atlantic states. The specific objectives of the study were to (1) determine the pattern and extent of vessel mobility, (2) develop socio-economic profiles of vessels and captains, (3) identify some factors that affect vessel mobilities, (4) compare the productivity and profitability of vessel mobility classes, and (5) evaluate impacts of management options on vessel mobility. Data for the study have come from personal interviews with sample shrimpers and secondary data such as state statutes and fishing regulations in the region. The study has been funded by the National Marine Fisheries Service.

Trawlers were classified into four mobility classes based on the number of states that the trawlers shrimped. The estimation of trawler population in the four mobility classes indicated that about 78 percent of the trawlers in the region were in mobility class I (those who fished only one state), 19 percent of them were classified as mobility class II trawlers, and 3 percent were in mobility classes III and IV trawlers.

Intra-seasonal mobility of trawlers was also analyzed to determine the entry and exit mobility patterns in the shrimp fishery. The results indicated that most trawlers entered to shrimp in an out-of-state fishery during the peak shrimping season in the out-of-state fishery, and the off-peak shrimping season in their home state. This may indicate that the coordination in season opening among states could be particularly significant in managing fleet mobility.

Mobility class I trawlers averaged about 40 feet in length and were generally not equipped with radar and loran. Mobility class II trawlers averaged 57 feet and about 62% of them had radar. Mobility class III and IV trawlers were larger and better equipped than mobility class I and II trawlers.

The captains of trawlers tended to be middle-aged, had a low level of education, and had been shrimping for a good while. About 50 percent of the captains in mobility class I trawlers had non-fishery employment. These captains engaged in commercial shrimping on a part-time basis and made most of their income from non-fishery employment. Since many shrimpers had non-fishery employment in addition to commercial shrimping, development of a fishery management program should consider its potential impact on fishing and non-fishing sectors in the coastal economy.

A number of factors appeared to be closely associated with mobility of trawlers. The more mobile trawlers appeared to have (1) larger vessels, (2) captains with no outside fishery employment, and (3) greater productivity per day in out-of-state shrimping.

Productivity analysis of trawlers indicated that the more mobile, larger trawlers had a higher catch per day, received higher average prices, and yielded higher gross returns per year than less mobile, smaller trawlers. The production function analysis was employed to determine factors associated with vessel productivity by mobility class. The number of shrimping days was the most important variable in determining the annual shrimp production for the mobility class I trawlers in the region. Operating capital was the most important variable affecting gross returns of the mobility class II and III trawlers in North Carolina. For mobility class II and III trawlers in South Carolina, engine horsepower was the most significant variable in determining their gross annual returns. That is, the higher the horsepower on the engine, the higher the annual gross return from shrimping for the trawlers.

The average gross returns of mobility class I trawlers were $27,352 while total costs were $28,999. Similarly, the mobility class II trawlers received gross returns of $66,581 and spent $66,859 for production costs. In contrast to these trawlers the mobility class III trawlers had gross returns of $122,000, total costs of $108,271, and net returns of $13,729. This shows that the most profitable trawlers were those more mobile trawlers that fished more states. The captains of these trawlers were able to obtain a better catch and price from different states and achieved superior financial returns.

Shrimpers have no control individually over shrimp stocks and over the price they receive for their catch, the former being influenced by habitat and environmental conditions and the latter being influenced by market demand on shrimp. The shrimpers do have some degree of control over some costs of production. Proper maintenance of the vessel with all equipment will cut down the incidents of major breakdowns and thus diminish repair costs.

The profitability analysis of this study was based only on data from 1976, a year which was a mediocre season in terms of landings and a very good season in terms of shrimp prices. Under such conditions, only mobility class III trawlers showed profits. Thus, the problems facing shrimpers were high production costs. Production costs for commercial trawlers have been rising sharply over the past few years and continue to rise, in part because of increases in fuel prices. This problem will become more severe when shrimp abundance and prices are poor.

The attitudes and opinions of shrimpers were quite varied in regard to selected existing and alternative management programs. The captains of more mobile trawlers expressed support for a regional license system while captains of mobility class I trawlers had negative opinions about this system. The shrimpers were generally favorable about season opening based on shrimp size. Shrimpers expressed reservations about opening sounds for commercial shrimping. If sounds were not permanently closed for trawling, more out-of-state trawlers would enter the fishery. The coordiantion in season opening of inshore waters for trawling among the states in the region could reduce inter-state mobility of trawlers.

Because the South Atlantic Shrimp fishery lies primarily within three miles of state waters, the Fishery Conservation and Management Act of 1976 does not appear to directly apply to its management. Therefore, regional management depends on all states in this region. The established South Atlantic State-Federal Fishery Management Board presently lacks jurisdictional power for regional fishery management. Thus, the first step in regional management of the shrimp fishery would be to establish an appropriate South Atlantic Management regime with jurisdictional authority. At the present time, all management agencies in the region should continue and increase their effort to work cooperatively in order to improve the vitality of the shrimping industry in the region. The National Marine Fisheries Service should continue to support the State-Federal Fishery Management Program as much as possible.

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APPENDIX A. Distribution of Trawlers in Population and Sample by State, Vessel size, and Mobility Class.

Table A.1 South Atlantic Shrimp Trawlers in 1976 by State, Vessel Size and Mobility Class

Vessel Size	Florida			Georgia			N. Carolina			S. Carolina			S.Atl. States		
	I*	II**	III***	I	II	III	I	II	III	I	II	III	I	II	III
21'-30'	30	2	0	5	2	0	538	5	0	76	0	0	649	9	0
31'-40'	10	1	0	29	1	0	189	16	0	53	3	0	281	21	0
41'-50'	19	9	0	57	18	0	75	16	2	70	15	0	221	58	2
51'-60'	22	9	0	57	26	10	59	32	5	45	33	5	183	100	20
61'-70'	53	14	0	54	30	12	64	20	2	32	25	5	203	89	19
71'-80'	10	0	1	16	11	0	27	14	2	6	13	2	59	38	5
over 80'	0	0	0	1	1	0	7	0	1	0	0	0	8	1	1
Total:	144	35	1	219	89	22	959	103	12	282	89	12	1604	316	47

*I Mobility Class One (One State Fished)
**II Mobility Class Two (Two States Fished)
***III Mobility Class Three (Three States Fished)

Table A.2 Sample Distribution of Shrimp Trawlers in the South Atlantic States by State, Vessel Size & Mobility Class

Vessel Size	Florida			Georgia			N. Carolina			S. Carolina			S.Atl. States		
	I	II**	III***	I	II	III	I	II	III	I	II	III	I	II	III
21'-30'	8	1	0	2	0	0	27	2	0	19	0	0	56	3	0
31'-40'	2	0	0	8	0	0	28	5	0	13	1	0	51	6	0
41'-50'	5	4	0	13	6	0	12	5	2	17	4	0	47	19	2
51'-60'	5	4	0	14	6	10	8	10	5	11	9	5	38	29	20
61'-70'	14	6	0	14	7	12	10	6	2	8	5	5	46	24	19
71'-80'	2	0	1	4	3	0	4	5	2	2	3	2	12	11	5
71'-80'	0	0	0	0	0	0	1	0	1	0	1	0	1	1	1
Total vessels	36	15	1	55	22	22	90	33	12	70	23	12	251	93	47 =391
Completed Sample	7	9	1	46	17	11	90	33	12	47	19	9	190	78	33 =301

*I Mobility Class One (One State Fished)
**II Mobility Class Two (Two States Fished)
***III Mobility Class Three (Three States Fished)

APPENDIX B. - The Survey Form

South Carolina Wildlife & Marine Resources Department

SHRIMP TRAWLERS SURVEY

I. VESSEL CHARACTERISTICS

1. _____ Years — How old is your shrimp trawler?

2. Length _____ — What is the length of your trawler?
   Beam _____ — How wide is trawler's beam?
   Gross tonnage _____ — What is the gross tonnage?

3. Engine 1 _____ H.P. — What horsepower are the engine(s) of your trawler?
   Engine 2 _____ H.P.

4. Do you have the following equipment on your trawler?

Equipment	Yes	No
Radar	___	___
Loran	___	___
VHF	___	___
Fish recorder	___	___
C.B.	___	___
Freezing facility	___	___

5. Would you tell us your gear type, size and number? Approximately, what is the market value of the gear?

Gear Type	Gear Number	Gear Size	Gear Value
___	_____	___	_____
___	_____	___	_____
___	_____	___	_____

6. $_____ — What do you estimate the market value of your vessel, and all equipment to be? That is, roughly, what could you sell it for today?

7. _____ Years — How long do you plan to keep this vessel?

8. $_____ — Roughly, what could you get for it if you sold it at that time?

9. $_____ — What is your equity in this vessel now--that is, the amount you would receive over what you owe, if you chose to sell it?

II. FISHERMAN CHARACTERISTICS

1.	a) Owner-operator _____ b) Hired captain _____ c) Striker _____ d) Absentee owner _____	During 1976, did you work mostly as: owner-operator, hired captain, or striker?
2.	Yes____ No ____ (If "no", skip No. 3 and 4)	While fising in 1976, did any family member(s) other than yourself work as strikers on your trawler?
3.	_____ persons	If yes, how many family members usually worked on your trawler?
4.	_____ percent	What percent of crew share was paid to family who worked?
5.	_____ persons	Not counting family members, how many strikers did you hire in 1976?
6.	_____ percent	What is the share of gross paid per hired striker?
7.	Yes _____ No _____	Was the share paid the striker based on gross catch?
8.	Yes _____ No _____	Were your strikers covered by a guaranteed wage?
9.	$_____	How much was paid by a guaranteed wage in 1976?
10.	Yes _____ No _____	Did you hire a captain to operate your vessel?
11.	_____ percent	What was the share paid to the hired captain?
12.	Yes _____ No _____	Was the share paid to the captain based on gross catch?
13.	_____ years	What is the captain's age?
14.	_____ years	What is the last grade or year the captain completed in school?
15.	_____ years	How many years has the captain been fishing commercially?
16.	_____ (captain) years _____ (striker) years	Of this total, could you tell me how many years the captain has been a captain and how many years he worked as a striker?
17.	Yes _____ No _____ (If "no", skip 18 and 19)	Did the captain work other than in commercial shrimp fishing during 1976?

18. Job 1 _____
Job 2 _____

What specifically did the captain do for work in 1976 other than shrimping?

19. Job 1 _____ months
Job 2 _____ months

How many months during 1976 did the captain work on this job(s)?

III. VESSEL MOBILITY AND CATCH

1. Town _____
State _____

What was your home port or the port you used most while shrimping in your home state during 1976?

2. _____miles

What was average traveled distance from your home port to fishing grounds?

3. Yes _____
No _____

Did you catch shrimp or fish commercially in any state other than your home state in 1976?

4. State 1_____miles_____
State 2_____miles_____
State 3_____miles_____
State 4_____miles_____

If yes, in what states did you shrimp? Approximately what distance was traveled from the dock used, to fishing grounds?

5. _____

What were the main reasons to fish in other states in 1976?

_____

_____

6. Would you tell me the approximate number of days you were fishing or shrimping with this vessel during each month since January 1, 1976?

Type Fishery	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
SHRIMP: North Carolina												
South Carolina												
Georgia												
Florida (east coast)												
Other												
OTHER FISHERIES: (specify)												
_____												
_____												
_____												

7. How many pounds of shrimp and fish, in total, did you land with this vessel for each state in which you fished in 1976?

Fishery Type	Total Pounds	Average Price Per Pound ($)
SHRIMP (heads on) North Carolina		
South Carolina		
Georgia		
Florida (east coast)		
Other		
OTHER FISHERIES (specify):		

8. Yes _____
   No _____ (If "no", skip 9)

   Did you sell incidental catch taken during the normal shrimping operation in 1976?

9. $_____

   How much did you get from selling incidental catch?

IV. FISHING EXPENSES

Now, let me ask a few questions about your expenses while fishing in 1976. As was indicated earlier, all information received from you will remain strictly confidential. It can't be traced to you or your business, since the results of all such questionnaires are combined for use as a whole.

1. $_____

   How much did you spend for maintenance and repair of fishing gear in 1976?

2. $_____

   How much did you spend for maintenance and repair on your vessel in 1976?

3. _____ days

   How many days did you spend on above maintenance and repair of gear and vessel?

4. _____ persons

   How many people took part in above maintenance and repairs?

5. Here is a list of some vessel expenses some fishermen may have. As I read each one would you please tell me, as best you can, how much money you spent for this vessel for 1976?

Amount ($)	Expense
$_____	hull insurance
$_____	interest
$_____	property taxes (fishing business only)
$_____	license and fee (in state and out of state)
$_____	association dues
$_____	utilities (electricity, water, etc.)

6. Please indicate below your operating trip expenses incurred in 1976 while fishing in any of the fisheries listed.

	SHRIMP:				OTHER FISHERIES:
Item	No.Carolina	So.Carolina	Georgia	Florida (east)	
Ice					
Fuel & Oil					
Bait & lures					
Nets					
Heading & packing					
Groceries					
Payroll tax					
Others					

V. FISHERY MANAGEMENT

Now I would like to find out your opinion concerning shrimp fishery management.

1. Yes _____
   No _____
   Don't know _____

   Do you favor a flexible season opening date dependent on the condition of the shrimp in your state?

   Comments _____

2. Yes _____
   No _____
   Don't know _____

   Do you favor various fixed opening dates for shrimping among four states in the region?

   Comments _____

3. How are you affected when shrimping season in neighboring states opens later than in your own state?

4. How would it affect your shrimping if the sounds were not closed to shrimping?

5. Yes _____
   No _____
   Don't know _____

   In addition to a home state license, do you favor a regional license instead of individual out-of-state licenses for shrimping outside of your own state?

   Comments _____

Thank you very much for your time and cooperation.

I hereby certify that this interview was actually taken and with the correct respondent and represents a true account of the interview.

_____ _____ _____

Interviewer's Signature Date Telephone