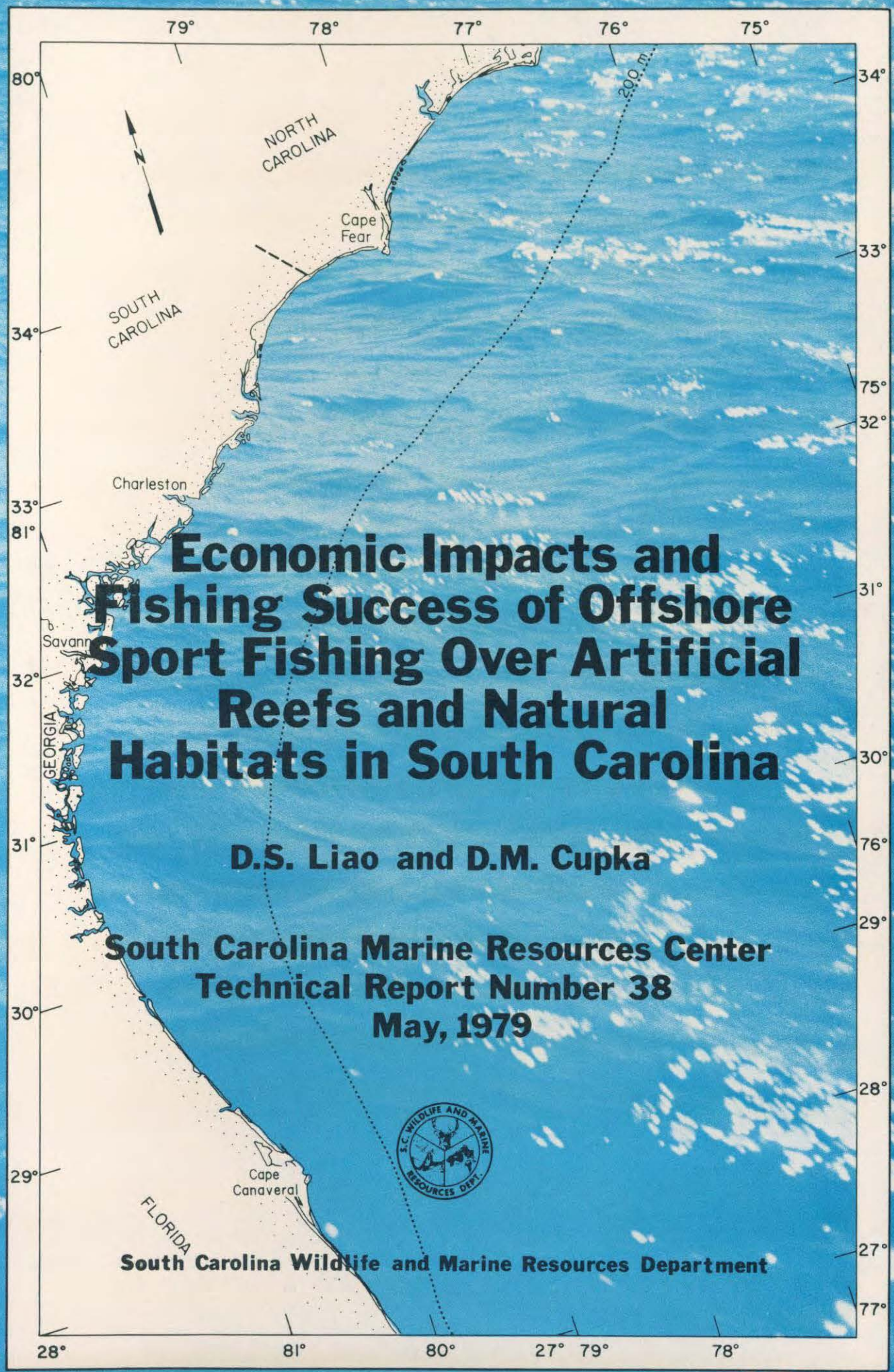

Economic Impacts and Fishing Success of Offshore Sport Fishing Over Artificial Reefs and Natural Habitats in South Carolina

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South Carolina Marine Resources Center
Technical Report Number 38
May, 1979

South Carolina Wildlife and Marine Resources Department

ECONOMIC IMPACTS AND FISHING SUCCESS OF OFFSHORE SPORT FISHING OVER ARTIFICIAL REEFS AND NATURAL HABITATS IN SOUTH CAROLINA

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Technical Report No. 38

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I. INTRODUCTION

Artificial reefs are man made objects intentionally placed in selected areas of the marine environment to provide habitat for marine life and result in concentrations of fish and invertebrates. Artificial reefs have been recognized as effective management tools that fisheries agencies can use to develop fisheries which benefit anglers. Thus, the establishment of artificial reefs along the coastline of the United States is becoming quite popular.

South Carolina's artificial reefs are primarily constructed with scrap tires because of their ease of handling, durability, and low cost. Presently there are ten artificial reefs established by the South Carolina Wildlife and Marine Resource Department. All of them are located within 13 miles of shore and are near to boat access areas. Moderate sized boats can reach the sites easily and safely.

The effects of an artificial reef off Murrells Inlet, South Carolina on sport fishing have been investigated by Stone, et al (1972). Their findings indicate that the artificial reef provided an improved habitat for fish thereby attracting more anglers. However, no research has been undertaken on any of the other reefs off the South Carolina coast. In particular, the economic impact of offshore sport fishing over artificial reefs and natural habitats in South Carolina waters remains unknown.

Hence, this study was conducted to provide economic information concerning the contribution of offshore sport fishing over artificial reefs and non-reef locations to the South Carolina economy. In addition, information was obtained concerning fishing success (in terms of catch/effort) relative to artificial reefs and naturally occuring habitats.

This knowledge may aid in deliberations about investment in artificial reefs as viable methods of offshore sport fishery development and management.

More specifically, this study attempts to answer such questions as the following:

1. What is the extent of participation in offshore sport fishing over artificial reefs and non-reef fishing grounds in South Carolina?

2. What is the average expenditure per artificial reef fishing trip and non-reef fishing trip?

3. What is the composition of average trip expenditures for artificial reef and non-reef fishing?

4. How much does artificial reef fishing and non-reef fishing contribute both directly and indirectly to the economy of coastal communities and the state?

5. How do artificial reef areas compare with non-reef areas in terms of fishing success?

In an attempt to answer the above questions, surveys of offshore anglers fishing from (1) private boats, (2) head boats, and (3) charter boats were conducted and responses included in the study.

This report presents the findings of this study. The report has been divided into five sections. The first section describes the economic impact of offshore fishing from private boats. The next section discuses the economic impact of head boat fishing. The third section examines the economic impact of charter boat fishing off the South Carolina coast. The fourth section examines fishing effort and catches of private boats, head boats, and charter boats utilizing reefs and non-reef habitats. The final section summarizes the total economic impact of all offshore sport fishing activities over reef and natural habitats and provides the major implications of the study.

II. ECONOMIC IMPACT OF PRIVATE BOAT OFFSHORE FISHING

This section presents a description of the economic impact of expenditures incurred by offshore private boat anglers. A comparison of fishing activities and expenditures between reef and non-reef anglers is also made. This provides the necessary background for evaluating the components of economic impact of private boat offshore fishing.

The Private Boat Anglers Survey

Out of 36,917 private recreational boat owners in South Carolina with boats measuring 16 feet or more in length, 5,538 were randomly selected from the South Carolina boater registration file for the mail survey. A total of 1,055 individuals completed and returned the survey form (Table 1). Seventy-eight survey forms were returned as non-deliverable by the United

States Postal Service. The remaining 4,405 failed to return the survey form.

The survey form used in this survey consisted of two parts. In the first part, boat owners were asked to provide information on the number of days fished offshore on different habitats annually, as well as their evaluation of artificial reefs and personal background information. In the second part, private boat anglers were asked to list any expenditures made during the past 12 months for boat and fishing equipment used by their families for offshore fishing. Since some of the investment items purchased were not exclusively for offshore fishing, anglers were asked to list the appropriate percentage of the cost which should be allocated to offshore fishing.

To obtain data concerning trip expenditures and fishing effort for private boat anglers, a second private boat angler survey was developed. A total of 5,547 private boat owners with boats measuring 16 feet or more in length were randomly selected for the survey. Approximately 615 survey forms were mailed out at the end of each month during the 1977 fishing season. This monthly survey was adopted to reduce recall biases in the data.

Sample fishermen in this survey were asked to recall their offshore fishing activities and trip expenses if any, during the past month. Expenditures included the amount spent on food, transportation, lodging, and all other expenses incurred on each fishing trip. Other information included the number in the fishing party, the number and pounds of fish caught, and the fishing location. A total of 692 individuals completed and returned the survey form (Table 2), with 113 having fished offshore.

One deficiency of the private boat angler surveys was that offshore fishing was not clearly defined in the survey forms although the authors' implicit definition of offshore fishing was angler activity outside the three nautical mile zone. Because of this failure to clearly define "offshore fishing or offshore areas", some survey respondents may have utilized different definitions of offshore fishing and the data obtained from them may have been influenced by this limitation; i.e. they may have also included data on fishing activities which occurred in the area from the beach to the three nautical mile limit. In the case of artificial reef fishing, since the reefs are clearly located more than three nautical miles offshore, the lack of a precise definition of 'offshore fishing" would not have influenced the data provided by respondents in regards to their reef fishing activities.

Number of Offshore Private Boats and Artificial Reef Users

Overall response to the first private boat angler survey was 19.5 percent. Some assumptions had to be made to deal with the 80 percent who did not respond in order to estimate the unbiased number of private boat owners who went offshore fishing and fished over the reefs. Table 3 shows that about 51 percent of the initial returns indicated they went fishing offshore. Twenty-nine percent of the respondents who received a reminder letter indicated that they went fishing offshore during the year. Thus, it was estimated that the percent of those who did not respond but who went offshore ranged from 0 to 29 with a median of 14.5 percent. Similarly, the percent of those who fished over the reef was estimated to be between 0 to 14 percent. Thus, it was assumed that 14.5 percent of those who did not respond and 45.7 percent of the total number who did respond went offshore fishing. It was assumed that 7 percent of those who did not respond fished over the reef and 26.9 percent of those who did respond were reef users.

Based on these operational assumptions, the estimated number of private boats which made offshore fishing trips is given in Table 4. As indicated, there were 7,473 private boats in South Carolina which fished offshore, of which 3,947 fished over the artificial reefs and 3,526 did not use the reef on their offshore fishing trips.

Number of Offshore Fishing Days

The average non-reef user spent approximately 10 days fishing offshore while the average reef user spent 23 days (Table 5). The number of days fished per boat was then multiplied by the number of offshore private boats to obtain a crude estimate of total offshore fishing days (Table 6). Fishing over the reefs accounted for 26 percent of the total days of offshore fishing. However, the artificial reefs consisted of less than 0.001 percent of the total square miles of habitats available. Thus, the number of fishing days per square mile over the reef was much higher than that over natural habitats. The total number of fishing days over the reefs was 33,550; the total number of non-reef fishing days for all private boats in South Carolina was 93,549.

Expenditures of Resident Private Boat Anglers

Resident private boat anglers with boats

Table 1. Summary of Responses to the Survey of Resident Private Boat Anglers by Boat Sizes.

ITEM	16 to 25 feet		26 to 39 feet		Greater than 39 feet		Total	
	Number	% of Total	Number	% of Total	Number	% of Total	Number	% of Total
Total response	966	18.8	83	29.0	6	15.8	1055	19.3
Total a/ nonresponse	4170	81.2	203	71.0	32	84.2	4405	80.7
Total b/ survey forms mailed and received	5136	100.0	286	100.0	38	100.0	5460	100.0

a/ includes survey forms returned with no information or non-useable information

b/ excludes undelivered samples from total sample size

Table 2. Summary of Responses to the Monthly Survey of Resident Private Boat Anglers with Boats Measuring Sixteen Feet or more in Length.

Month	Total Responses		Total Non-Response		Total survey forms mailed
	Number	% of Total	Number	% of Total	Number
March	93	15.1	519	84.9	615
April	105	17.0	511	83.0	616
May	43	7.0	572	93.0	615
June	77	12.5	539	87.5	616
July	70	11.4	545	88.6	615
August	83	13.5	533	86.5	616
September	71	11.5	544	88.5	615
October	83	13.5	532	86.5	615
November	67	10.9	548	89.1	615
Total	692	12.5	4855	87.5	5547

Table 3. Percent of Total Responses and Estimated Percent of Total Non-Responses in the Sample Survey Concerning Their Offshore Fishing Activities

Item	Percent of Total Responses			Estimated Percent Total Non-Responses	
	Answering 1st letter	Answering 1st reminder	Total	Range	Median
Offshore fishing					
Yes	51	29	45.7	29-0	14.5
No	49	71	54.3	71-0	85.5
Artificial reef fishing					
Yes	30	14	26.0	14-0	7.0
No	70	86	73.1	86-100	93.0

Table 4. Estimated Number of Resident Private Boats Measuring Sixteen Feet or more in Length in the Sample Survey and in the State of South Carolina by Offshore Fishing Activities.

Item	Sample	Population	
	Number of Private Boats in the Sample Survey	Number of Private Boats in South Carolina	
		Number	% of total
Offshore fishing			
Yes	1,121	7,473	20.5
No	4,339	28,927	79.5
Artificial reef fishing			
Yes	592	3,947	10.8
No	4,868	32,453	89.2

Table 5. Average Fishing Activities by South Carolina Private Boat Anglers Who Went Offshore Fishing and Used the Artificial Reefs and Who Went Offshore Fishing and Did Not Use the Reefs. Sample Based on Anglers Utilizing Boats Measuring Sixteen Feet or More in Length.

Item	Reef Users	Non-Reef Users
Days spent offshore Fishing over:		
Artificial reefs	8.5	0
Wrecks	2.9	2.2
Natural Habitats	11.6	8.1
Total days fished Offshore	23.0	10.3

Table 6. Estimated Number of Days Spent in Offshore Fishing by Resident Private Boat Anglers in South Carolina. Sample Based on Anglers Utilizing Boats Measuring Sixteen Feet or More in Length.

Type of Fishing Trip	Type of Boat	Number of Private Boats	X	Average Number of Days Fished per Boat	=	Total Fishing Days
Reef	Reef user	3,947		8.5		33,549.50
Non-Reef	Non-Reef user	3,526		10.3		36,317.80
	Reef user	3,947		14.5		57,231.50
Total:						127,098.80

Table 7. Average Trip Expenses per Day Fished, Incurred by Resident Private Boat Anglers Using the Reefs and by Non-reef Users. Sample Based on Anglers Utilizing Boats Measuring Sixteen Feet or More in Length.

Type of expenditures	Artificial Reef		Non-reef User	
	Average trip expenses per fishing party	Average trip expenses per angler	Average trip expenses per fishing party	Average trip expenses per angler
Gasoline & oil for car	$ 10.18	$ 4.53	$ 7.51	$ 2.63
Lodging	12.67	5.63	5.09	1.78
Food & beverages in restaurant	10.50	4.67	15.52	5.43
Fuel & oil for boat	17.36	7.72	28.34	9.91
Boat launching & storage	2.82	1.25	2.41	.84
Lures & bait	7.56	3.36	7.42	2.59
Other trip expenses	5.79	2.57	9.26	3.24
Total	66.88	29.73	75.55	26.42

measuring 16 feet or more in length were asked to provide information on all expenses incurred during their offshore fishing trips. A summary of trip expenses by reef and non-reef anglers is presented in Table 7. Reef anglers on the average spent $29.73 for their offshore fishing trip, while the average non-reef angler spent $26.42 per trip. Fuel and oil were the largest expenditures accounting for over 26 percent of the total trip expenditure for reef users and about 35 percent for non-reef anglers.

Each resident private boat angler surveyed was asked to report his expenditures on boat and fishing related equipment during the previous 12 months, and to list an appropriate percent of the cost which should be allocated to offshore fishing. The amount of expenditures on equipment associated with offshore fishing was then estimated. Table 8 reveals that a relatively high proportion of the total expenditures were incurred for boat and boating equipment. It appears that reef anglers allocate a considerably high percentage of boat and fishing equipment cost to offshore fishing. This was due to the fact that the average reef user spent more days fishing offshore than did the average non-reef user.

Economic Impact of Resident Private Boat Anglers' Expenditures

Based on the estimates of 33,549.5 total fishing days and $66.88 for average trip expenses per day, total trip expenditures for reef fishing were estimated at about $2.24 million during 1977 (Table 9). Total trip expenditures for non-reef fishing was an estimated $7.07 million. Thus, total trip expenditures by all offshore resident private boat anglers with boats measuring 16 feet or more were about $9.31 million during 1977.

In a similar manner, total expenditures for boat and fishing equipment have been estimated for reef and non-reef fishing. Total expenditures for boat and fishing equipment related to reef fishing were $2.28 million, while for non-reef fishing were $5.68 million (Table 10).

Total expenditures for reef fishing by all resident private boat anglers with boats 16 feet or larger in length are obtained by adding the total trip expenditures and the total boat and fishing equipment expenses:

Total Expenses = $2.24 million

Boat and fishing equipment expenses = $2.28 million

$4.52 million

Similarly, total expenditures for non-reef fishing by all resident private boat anglers were:

Trip expenses = $7.07 million

Boat and fishing equipment expenses = $5.68 million

$12.75 million

Thus, total expenditures or total direct economic impact of resident private boat fishing utilizing boats measuring 16 feet or more in length off South Carolina was estimated at over $17.27 million for 1977.

Money spent by resident private boat anglers on trip expenses and boat and fishing equipment generates additional output through a "multiplier" effect. For example, sales of boats by boat dealers results in dealers purchasing additional inputs in the form of labor, more boats, and other items. The size of this multiplier depends on "leakages" from the state economy and on the types of expenditures by anglers. Weighted output multipliers for trip expenses and fishing equipment expenses are shown in Table 11. One noticeable feature is that the multipliers are larger for trip expenses than for boat and fishing equipment expenses. This is because the purchase of boat and boating equipment accounted for over 82 percent of total annual expenditures for non-reef users and over 87 percent for reef users. The output multiplier for these items is relatively low since South Carolina dealers buy most of these items from out-of-state and draw relatively little on local inputs.

The total economic impact of expenditures resulting from resident private boat offshore fishing utilizing boats 16 feet or more in length can be derived from the weighted output multipliers for the state of South Carolina (Table 12). For reef fishing, the total economic impact in 1977 would be:

Trip expenses $2.24 million x 2.05=$4.60 million

Boat and fishing equipment expenses $2.28 million x 1.97=$4.49 million

$9.09 million

For non-reef fishing, the total economic impact on the South Carolina economy would be:

Trip expenses $7.07 million x 2.14=$15.12 million

Boat and fishing equipment expenses $5.68 million x 1.97=$11.19 million

$26.31 million

Thus, the total economic impact of reef and non-reef fishing by all resident private boat anglers utilizing boats measuring 16 feet or more in length during 1977 was approximately $35.40 million.

III. ECONOMIC IMPACT OF HEAD BOAT FISHING

The main objective of this section is to estimate the economic impact of head boat fishing off the South Carolina coast. To achieve this objective, two types of data were essential: (1) how many head boat anglers are there, and (2) how much do they spend? These data were obtained from surveys of head boat captains and their customers. Description of the surveys and results are discussed below.

Survey of Head Boat Captains and Anglers

Personal interviews were used as the means of collecting data from head boat captains. Fourteen out of sixteen head boat captains were interviewed for the survey (Table 13). Captains surveyed were asked to give information on their annual fishing activities, use of artificial reefs and background information.

Sport fishermen who had gone head boat fishing off South Carolina during the 1977 fishing season were also surveyed by means of personal interviews during their fishing trips. A total of 1,052 survey forms were completed (Table 14). Head boat anglers were asked to provide data on their fishing activities and trip expenses. Total number and pounds of fish caught were determined by the interviewers.

Number of Head Boat Anglers

The total number of fishing trips for head boats using the reefs was 144 (Table 15). Only 30 out of 144 trips involved fishing over the artificial reefs. For the head boats not using the reefs, total fishing trips per year were 143. Thus it appears that there was no marked difference in the total number of fishing trips between reef and non-reef users. However, the reef users carried 7,512 individuals offshore fishing while the non-reef users carried 6,301 anglers per year to fish offshore.

The total number of head boat anglers by

type of fishing (reef or non-reef) was estimated (Table 16). There were 10,920 head boat anglers who fished over the reefs off South Carolina during the study period. This accounted for 10 percent of the total number of head boat anglers (109,044). A total of 98,124 head boat anglers did not fish over the artificial reefs.

Trip Expenditures of Head Boat Anglers

The average trip expenditure per angler fishing over the reefs on blackfish trips was $23.30 (Table 17). These anglers spent, on the average, $12.30 for tickets to fish on head boats. For non-reef users, the average expenditure per angler on blackfish trips was $23.20. There was therefore no difference in expenditures for reef versus non-reef fishing trips.

Table 8. Average Annual Expenditures for Boat and Fishing Equipment Allocated to Offshore Angling per Resident Private Boat Measuring Sixteen Feet or More in Length.

Item	Reef User	Non-Reef User
Fishing equipment	$ 168.70	$ 83.68
Boat and boating equipment	1,361.09	421.20
Special clothing	2.74	.97
Camping equipment	26.80	5.26
Total:	$1,559.33	$511.10

Table 9. Estimated Total Trip Expenditures by Resident Private Boat Anglers Utilizing Boats Sixteen Feet or More in Length.

Type of Fishing Trip	Estimated Total Fishing Days	X	Average expenses per Day Fished	=	Total Trip Expenditures by Private Boat Anglers	Percent of Total
Reef	33,549.5		$ 66.88		$ 2,243,791	24.1
Non-Reef	93,549.3		$ 75.55		$ 7,067,650	75.9
Total:					$ 9,311,440	100.00

Table 10. Estimated Total Expenses for Boat and Fishing Equipment By Resident Private Boat Anglers Utilizing Boats Measuring Sixteen Feet or More in Length.

Type of Fishing Trip	Type of Boat	Number of Private Boats	X	Average Annual Expenses per Boat	=	Total Expenses for Boating & Fishing Equipment
Reef	Reef User	3947		577 a/		2,227,419
Non-Reef	Non-Reef User	3526		511		1,801,786
	Reef User	3947		982 a/		3,875,954
Total						7,955,159

a/ The average annual expenditure of $1,559 for reef users was proportionally allocated to reef and non-reef fishing according to percent of total days fished over the reef and the non-reef sites.

Table 11. Output Multipliers Relating to the Pattern of Expenditures by Resident Private Boat Anglers Utilizing Boats Measuring Sixteen Feet or More in Length.

Types of Expenses	Expenditure Items	Sector	Output a/ Multiplier	Expenditure Allocation (%)	
				Reef user	Non-Reef user
Trip Expenses	Gasoline	Transportation	2.099	15.2%	9.8%
	Lodging	Hotel & Lodging place	1.372	18.9%	6.8%
	Food	Wholesale & retail trade	2.312	15.7%	20.6%
	Fuel	Transportation	2.099	26.0%	37.5%
	Boat Launching	Wholesale & retail trade	2.312	4.2%	3.2%
	Lures & Bait	Wholesale & retail trade	2.312	11.3%	9.8%
	Other	Wholesale & retail trade	2.312	8.7%	12.3%
	Weighted output Multiplier b/			2.05	2.14
Boating & fishing equipment expenses	Fishing equipment	Wholesale & retail trade	2.312	10.8%	16.4%
	Boat & Boating equipment	Transportation equipment	1.921	87.3%	82.4%
	Special Clothing	Wholesale & retail trade	2.312	.2%	.2%
	Camping equipment	Transportation equipment	1.921	1.7%	1.0%
	Weighted output Multiplier b/			1.97	1.97

a/ from 1972 input-output model of South Carolina economy

b/ The weighted output multipliers show what effect on the total output would be if offshore anglers had allocated their expenditures according to the indicated patterns.

Table 12. Total Economic Impact of Offshore Resident Private Boat Fishing Utilizing Boats Measuring Sixteen Feet or More in Length.

Type of fishing	Type of Expenses	Total Expenditure	X	Multiplier	=	Total Economic Impact
Artificial Reef	Trip expense	$2,243,791		2.05		$4,599,771
	Boat and Fishing Equipment expenses	$2,277,419		1.97		$4,486,515
	Total					$9,086,286
Non-Reef	Trip Expenses	$7,067,650		2.14		$15,124,770
	Boat and fishing Equipment Expenses	$5,677,740		1.97		$11,185,148
	Total					$26,309,918
	Grand Total					$35,396,204

Table 13. Survey of Head Boat Captains.

Location	Population	Number of samples in the survey
Horry County	5	5
Georgetown County	7	6
Charleston County	3	2
Beaufort County	1	1
Total	16	14

Table 14. Survey of Head Boat Anglers by Month.

Month	Number of fishing trips surveyed	Number of survey forms completed	Number of anglers included in the survey
April	2	18	32
May	3	25	41
July	14	238	500
August	38	539	1179
September	13	134	302
October	6	93	141
November	1	5	7
Total	77	1052	2202

Table 15. Average Fishing Activities by South Carolina Head Boats Which Used Artificial Reefs and by Those Which Did Not Use Artificial Reefs.

Item	Artificial Reef User	Non-reef User
Number of trips fished over the reefs	30	0
Annual total fishing trips	144	143
Monthly distribution of fishing trips		
March	2	0
April	12	3
May	17	9
June	23	30
July	27	30
August	27	30
September	18	27
October	13	10
November	5	4
Number of anglers served by the boat	7,512	6,301

Table 16. Estimated Number of Head Boat Anglers in South Carolina By Type of Fishing Trip.

Type of Fishing Trip	Type of Boats	Number of Boats	X	Number of Trips per Boat	X	Average Number of Anglers per Trip	=	Total Number of Head Boat Anglers
Reef	Reef user	7		30		52		10,920
Non-reef	Non-reef user	9		143		44		56,628
	Reef user	7		114		52		41,496
Total								109,044

Table 17. Average Fishing Trip Expenses of Head Boat Anglers Using or Not Using the Reefs.

Type of Expenditure	Artificial Reef User	Non-reef User		
	Blackfish	Blackfish	Snapper-Grouper	Both
Food	$ 3.10	$ 3.00	$ 4.40	$ 3.70
Lodging	5.20	6.10	5.60	6.00
Transportation	1.60	2.10	5.30	3.60
Fishing fee	12.30	11.40	28.20	18.90
Others	1.10	0.60	2.70	1.50
Total	23.30	23.20	46.30	33.70

On snapper-grouper trips, head boat anglers paid an average of $28.20 for fishing fees. In addition, these anglers spent $18.10 for food, lodging, and miscellaneous expenses. Average cost per angler for the snapper-grouper trip was $46.30.

The largest expenditure for head boat anglers was the fishing fee. The second and third largest items were lodging and food. Thus, the primary beneficieries of head boat anglers' expenditures, aside from the head boat industry, were motels, restaurants, and beverage industries in the coastal communities.

Economic Impact of Head Boat Anglers' Expenditures

Total expenditures by head boat anglers fishing over reefs and non-reef locations were estimated. Table 18 shows that head boat fishing over artificial reefs accounted for an estimated $254,436 in total expenditures during 1977 in South Carolina coastal communities. Total estimated expenditures of head boat anglers who did not fish over the reef were $3,306,779. Thus, the total direct economic impact of all South Carolina head boat fishing was $3,516,215. Fishing over the reefs by head boat anglers accounted for 7.1 percent of the total direct economic impact on the coastal communities.

The money spent by head boat anglers on their offshore fishing trips generates additional output within the state through a "multiplier" effect. For example, the multipliers of trip expenses of head boat anglers who fished over the reefs is 2.29 (Table 19). This means that for every $1.00 of receipts from this type of angler, $2.29 of the total output is generated in the state of South Carolina. This multiplier represented a weighted average of the various impacts of anglers' trip expenses to different industries.

An estimate of the total economic impact of expenditures incurred by head boat anglers can thus be derived from the output multipliers for the state of South Carolina. For fishing over artificial reefs, the total economic impact would be $582,658 (Table 20). This means that re-spending of money spent by the anglers who fished over the reefs generated an indirect economic impact of $328,222 of goods and services in addition to direct economic impact of $254,436 which were the total expenditures of the reef anglers. For head boat fishing in locations other than reefs, the total economic impact was $7,638,659. The combination of reef and non-reef fishing by head boat anglers contributed an estimated $8.2 million to to the economy of the state of South Carolina.

IV. ECONOMIC IMPACT OF CHARTER BOAT FISHING

This section deals with the third type of offshore fishing-charter boat. Many coastal communities benefit from the economic impact of charter boat fishing because expenditures by charter boat anglers provide income and jobs. This section will examine fishing trip characteristics of charter boats, expenditures incurred by charter boat customers, and the economic impact of charter boat fishing.

Survey of Charter Captains and Charter Anglers

The survey of charter captains was conducted using the personal interview method to collect data. Sample size and population for each location are shown in Table 21. As indicated, twenty captains were interviewed. A survey form was pre-tested and then employed by the interviewers.

Data from the charter boat anglers was obtained through telephone interviews. A sample of anglers to be interviewed were randomly chosen from charter boat captains' 1977 log books. The log books were used by the captains to record their customers' trip reservation. Captains who had kept log books were requested to provide a list of their customers names, telephone numbers, and addresses. A random sample of about 10 percent of the names was then drawn from each listing. Some samples selected contained incomplete information for telephone calls. These were excluded from the survey list and other names were selected as replacements. Seventy-five anglers were interviewed for the survey (Table 22).

Number of Charter Trips

Thirteen out of twenty charter boat captains surveyed indicated they used artificial reefs as fishing locations in their chartering business. Total annual fishing trips for these reef users were 54 trips, of which fifteen trips were chartered to fish over the artificial reefs (Table 23). The boats who did not use the artificial reefs averaged 98 fishing

Table 18. Estimated Total Trip Expenditures by Head Boat Anglers.

Type of Head Boat Fishing Trip	Estimated Annual Head Boat Anglers in S.C.	X	Average Expenditure per angler	=	Total Expenditure by Head Boat Anglers	Percent of Total
Reef	10,920		$ 23.30		$ 254,436	7.1
Non-reef	98,124		33.70		3,306,779	92.9
Total	109,044				$3,561,215	100.0

Table 19. Output Multipliers Relating to the Pattern of Expenditures by Head Boat Anglers.

Expenditure Items	Sector	Output a/ Multiplier	Expenditure Allocation (%)	
			Reef user	Non-Reef user
Food	Wholesale & retail trade	2.312	13.3%	11.0%
Lodging	Hotel & lodging place	1.372	22.3%	17.8%
Transportation	Transportation	2.099	6.9%	10.7%
Fishing fee	Business service	2.688	52.8%	56.0%
Other	Wholesale & retail trade	2.312	4.7%	4.5%
Weighted Output Multiplier b/			2.29	2.31

a/ from 1972 Input-output model of South Carolina economy
b/ The weighted output multipliers show what effect on the total output would be if offshore anglers had allocated their expenditures according to the indicated patterns.

Table 20. Economic Impact of Head Boat Fishing.

Type of head boat fishing	Total expenditure by head boat anglers	X	Multiplier	=	Total Economic Impact
Reef	$ 254,436		2.29		$ 582,658
Non-Reef	$3,306,779		2.31		$7,638,659
Total					$8,221,317

Table 21. Survey of Charter Boat Captains.

Location	Population	Number of samples in the survey
Horry County	7	7
Georgetown County	11	4
Charleston County	3	3
Beaufort County	11	6
Total	32	20

Table 22. Survey of Charter Boat Anglers by Month.

Month	Number of fishing trips surveyed	Number of anglers included in the survey
May	9	45
June	22	118
July	12	61
August	14	86
September	7	32
October	9	38
November	2	10
Total	75	390

trips annually. One reason why fewer fishing trips were made by reef users could be that the majority of these captains were not involved in charter work full time.

Data on the average number of fishing trips per boat were extrapolated to obtain the estimated total number of fishing trips by all charter boat anglers in South Carolina. Table 24 indicates that the total number of reef fishing trips was 315 while the number of trips for non-reef fishing was 1,897. Reef fishing trips accounted for approximately 14.2 percent of the total number of charter fishing trips in South Carolina.

Expenditures of Charter Boat Anglers

Based on data from the charter boat anglers survey, the average trip expenditures per reef angler was $84.90 (Table 25). The largest item was the fishing fee which averaged $45.00 and accounted for 53 percent of all trip expenses. The second largest expense category for reef anglers was lodging, which accounted for 17 percent of total trip expenses with a dollar amount of $14.30. Third in importance was the food category, with an average expenditure per angler of $9.70. Cost of food was almost 11 percent of trip expenditures.

It is interesting to note the non-reef users spent more money on fishing trips than reef users. The average trip expenses per non-reef angler was $135.00, with fishing fee accounting for over 45 percent of the total expenditures. Food cost, combined with lodging expenditures, accounted for almost 30 percent of the total expenses.

Economic Impact of Charter Boat Anglers Expenditures

The total trip expenditures incurred by charter boat anglers are shown in Table 26. This table is based on the estimated total number of fishing trips as shown in Table 24 and average trip expenditures in Table 25. Total expenditures related to reef fishing trips were $160,430 in 1977. However, total trip expenditures associated with non-reef fishing trips were $1,306,274. This indicates that reef fishing by charter boat anglers contributed 10.9 percent of total trip expenditures in the charter fishing industry. As indicated in Table 26, total direct economic impact by all charter boat anglers was about $1,466,704.

To estimate the total economic stimulation by the initial trip expenditures made by charter boat anglers, the magnitude of the multiplier for their trip expenditures must be known. It is assumed that charter boat anglers would allocate their trip expenditures according to the patterns indicated in Table 27. Thus, the weighted output multiplier for these types of trip expenditures is estimated to be about 2.33.

Applying the multiplier of 2.33 to the $1,306,274 total trip expenditures by charter anglers who engaged in non-reef fishing yields a total economic impact of $3,043,619 (Table 28). Similarly, the total economic impact of reef fishing by charter boat anglers was estimated to be $373,801. Thus, reef and non-reef fishing by charter boat anglers would provide a total economic impact of $3,417,420, to the state economy.

V. FISHING SUCCESS

Fishing Effort and Catches of Resident Private Boat Anglers

Average fishing effort and catch per trip by private boat anglers are shown in Table 29. The average private boat angler spent approximately 6 hours fishing per trip. The artificial reef anglers caught slightly more fish per trip and per hour fishing on the reef then did the anglers utilizing other habitat types. However, average pounds of fish caught by the reef angler was 11.70 (for all habitat types including reefs) while the average for the non-reef anglers was 22.80 pounds

Fishing Effort and Catches of Head Boat Anglers

On blackfish fishing trips, fishing effort per head boat was about 3 hours for both the reef and non-reef user groups (Table 30). Angling quality in terms of the number of fish caught per angler and per hour fished was about the same for anglers who fished over the reefs and those who did not fish over the reefs. However, when angling quality is measured in terms of the poundage of fish caught per fishing hour, the reef users caught slightly more.

On the snapper-grouper fishing trips, the average angler spent 4.6 hours actually fishing and caught 8 fish. The weight of total fish caught averaged 24.3

Table 23. Average Fishing Activities by South Carolina Charter Boats Which Used Artificial Reefs and by Those Which Did Not Use Artificial Reefs.

Item	Artificial Reef User	Non-reef User
Number of trips fished over the reefs	15	0
Total annual fishing trips	54	98
Monthly distribution of fishing trips:		
March	5	9
April	5	9
May	6	10
June	7	13
July	7	13
August	7	13
September	6	11
October	6	11
November	5	9
Number of anglers chartered per year	308	570

Table 24. Estimated Number of Fishing Trips by Charter Boat Anglers in South Carolina

Type of Fishing trip	Type of boats	Number of charter boats	X	Number of trips per boats	=	Total number of fishing trips
Reef	Reef user	21		15		315
Non-Reef	Non-reef user	11		98		1,078
	Reef user	21		39		819

pounds per angler.

Fishing Effort and Catches of Charter Boat Anglers

Eleven out of seventy-five sample anglers reported that they fished over the artificial reef sites on their charter trips. This indicates that the anglers fishing over the reefs accounted for about 14.7 percent of total anglers. Reef users spent 9 hours fishing during their charter trips (Table 31). The number of fishing hours for the non-reef users averaged about 8 hours per trip. Pounds of fish caught by the reef users averaged 28.03 while the non-reef users caught 36.34 pounds during their 8 hours fishing.

Catch per unit effort for the reef users was lower than that of the non-reef users. The average weight per fish caught for the reef users was also lower than that of the non-reef users. It is also observed that on the average, charter boat anglers caught bigger fish than head boat anglers.

VI. SUMMARY AND IMPLICATIONS

This study demonstrated the economic impact of offshore sport fishing on the

Table 25. Average Fishing Trip Expenses of Charter Boat Anglers Who Used the Reef and by Those Who Did Not Use the Fishing Reefs.

Type of Expenditure	Artificial Reef User		Non-reef User	
	Average trip expenses per fishing party	Average trip expenses per angler	Average trip expenses per fishing party	Average trip expenses per angler
Food	$ 58.20	$ 9.70	$ 103.30	$ 20.30
Lodging	85.90	14.30	106.20	20.80
Transportation	46.40	7.70	65.30	12.80
Fishing Fee	270.00	45.00	315.50	61.90
Others	48.80	8.10	98.30	19.30
Total	$509.30	$84.90	$ 688.60	$135.00

Table 26. Estimated Total Trip Expenditures by Charter Boat Anglers.

Type of charter fishing trip	Estimated number of fishing trips	X	Average expenditures per trip	=	Total expenditures by charter boat anglers	Percent of total
Reef	315		$ 509.3		$ 160,430	10.9
Non-reef	1,897		$ 688.6		$1,306,274	89.1
Total	2,212				$1,466,704	100.0

South Carolina economy. The purpose of this section is to summarize the total direct economic impact and total economic impact of offshore sport fishing and to present the implications for management and for future research.

Total Direct Economic Impact of Offshore Sport Fishing

There are three types of anglers engaged in offshore sport fishing in South Carolina (1) private boat, (2) head boat, and (3) charter boat. The total direct economic impact of all offshore sport fishing was the combined total of expenditures of the three types of anglers:

Resident Private boat anglers' trip expenses (boats ≥ 16 feet in length) = $9.31 million

Resident Private boat anglers' boat & fishing equipment expenses (boats ≥ 16 feet in length) = $7.96 million

Head boat anglers' trip expenses = $3.56 million

Charter boat anglers' trip expenses = $1.47 million

Total $22.30 million

Approximately 77 percent of the $22.30 million were contributed by resident private boat anglers utilizing boats measuring 16 feet or more in length (Table 32). Thus, offshore fishing by resident private boat anglers generated more income to the coastal communities than did other types of offshore fishing.

Table 27. Output Multipliers Relating to the Pattern of Expenditures by Charter Boat Anglers

Expenditure Items	Sector	Output a/ Multiplier	Allocation of the Expenditure Pattern	
			Artificial Reef User	Non-reef user
Food	Wholesale & retail Trade	2.312	11.4%	15.0%
Lodging	Hotel & Lodging place	1.372	16.9%	15.4%
Transportation	Transportation	2.099	9.2%	9.5%
Fishing fee	Business service	2.688	52.0%	45.2%
Others	Wholesale & retail Trade	2.312	9.5%	14.2%
Weighted output Multiplier b/			2.33	2.33

a/ from 1972 Input-output Model of South Carolina economy
b/ The weighted output multipliers show what effect on the total output would be if offshore anglers had allocated their expenditures according to the indicated patterns.

Table 28. Economic Impact of Charter Boat Fishing.

Type of charter trip	Total expenditure by charter boat anglers	X	Multiplier	=	Total economic impact
Reef	$ 160,430		2.33		$ 373,801
Non-reef	$1,306,274		2.33		$3,043,619
Total					$3,417,420

Offshore fishing can also be grouped into two categories: (1) reef and (2) non-reef fishing. In this approach the total direct economic impact of offshore sport fishing was obtained by combining the total expenditures for reef and non-reef fishing:

Reef fishing = $ 4.94 million

Non-reef fishing = $ 17.36 million

$ 22.30 million

Offshore sport fishing over the reefs accounted for 25 percent of the total direct economic impact and estimated total expenditures of $4.94 million in the coastal communities during 1977. A caution should be attached to this estimate. If the artificial reefs ceased to exist, total output of goods and services in South Carolina would not decline by $4.94 million. Most of the money would be spent for other goods and services. This change in spending patterns would surely affect certain industries and coastal communities within the state. The reef anglers would also suffer a loss.

Total expenditures by offshore sport fishermen in South Carolina were about $22.30 million in 1977. This figure should probably be considered as a conservative estimate. Private boat anglers from out-of-state who did not purchase a boat license from South Carolina were not included in the survey.

Total Economic Impact of Offshore Sport Fishing

The direct economic impact is only a component of the total economic impact that offshore sport fishing has on coastal communities. The expenditures of offshore anglers are re-spent and this becomes income to other persons. This is called the "multiplier" effect of "indirect" economic impact. The total economic impact of offshore sport fishing is summarized in Table 33.

For artificial reef fishing, the total economic impact was $10.04 million of which $4.94 million was directly spent by the anglers and the remaining $5.10 million generated as a result of the anglers' expenditures. For fishing other than on reef locations, the total economic impact was $36.99 million. The combination of reef and non-reef fishing would result in an estimated total economic impact of $47.03 million to the state of South Carolina per year when multiplier effects are included. These estimates should be considered minimum values, however, since they do not include data on private boats measuring less than sixteen feet in length or non-resident private boats. Participation in offshore fishing by this latter group is significant in certain areas of coastal South Carolina and consequently their economic impact on coastal communities is important. Thus, the reefs and the natural habitats utilized by offshore fishermen provide a significant income to the South Carolina economy.

Implication for Management

Artificial reefs have not only had a positive economic effect in South Carolina but they have also enhanced fishing activities by providing increased recreational fishing opportunities for many people. Total fishing trips off the coast of South Carolina during 1977 were estimated at 131,605 trips, of which approximately 25 percent occurred over the artificial reefs (Table 34). There are only ten artificial reefs located off the coast presently and the data in this study indicate that these reefs receive heavy fishing pressures. As a result of this fishing pressure, catch per unit effort for reef fishing generally declines over the fishing season. As indicated in Table 35, pounds of fish caught per hour for non-reef fishing averaged higher than that of artificial reef fishing. To reduce fishing pressure and improve angling quality on the artificial reefs, one alternative would be to expand the existing reefs or construct additional reefs.

Artificial reefs were infrequently used by charter and head boat operators in 1977. However, fuel is a major expense of charter and head boats. Thus, rising fuel costs will definitely reduce their profits, assuming other conditions remain unchanged. One remedy for this situation would be to reduce the distance to the fishing grounds by constructing larger or additional artificial reefs within a reasonable distance of shore for use by charter and head boat fishing operations.

Implication for Future Research

This study is a first attempt to estimate the extent of participation in offshore sport fishing and the economic impact of offshore anglers' expenditures in South Carolina. It is a cross-section analysis at one point in time and may not be applicable to other points in time. As the sport fishing population is likely to change over time, it may therefore be worthwhile to conduct a similar study in the future. It would provide estimates at another interval for comparison and permit one to determine the extent of change over time.

Estimated total expenditures by offshore anglers have provided an indication of the gross economic value of the South Carolina offshore sport fishery. To estimate net economic value of the resources will require more sophisticated statistical and econometric analysis. Specifically, it will be necessary to obtain accurate estimates of demand functions for various types of offshore anglers. Such an undertaking would have required far more time and resources than were available for this study and is an area for further research.

This research deals only with the impact of offshore sport fishing and does not address the inshore sport fishery. The economic impact of the inshore fishery is undocumented at this time but it is known to be very significant. Future research should be directed toward establishing the economic impact of the inshore sport fishery so that a more complete picture of the economic impact of salt-water sport fishing in South Carolina can be obtained.

Table 29. Average Fishing Effort, Catch, and Catch Per Unit Effort by Resident Private Boat Anglers per Day Fished for Artificial Reef Users and Non-reef Users. Sample Based on Anglers Utilizing Boats Sixteen Feet or More in Length.

Item	Artificial Reef Users	Non-reef Users
Fishing Effort and Catch per Angler:		
Hours fished by habitat type:		
Artificial reefs	3.2	0.0
Wrecks	0.4	0.8
Natural habitats	2.3	4.9
Number of fish caught by habitat type:		
Artificial reefs	4.5	0.0
Wrecks	0.5	0.4
Natural habitats	2.1	3.8
Total catch	7.1	4.2
Total pounds of fish caught	11.70	22.80
Catch per Hour Fished per Angler:		
Number of fish caught per hour by habitat type:		
Artificial reefs	1.4	0.0
Wrecks	1.3	0.5
Natural habitats	0.9	0.8
Pounds of fish caught per hour	1.99	4.00

Table 30. Average Fishing Effort, Catch, and Catch per Unit Effort by Head Boat Angler's per Day Fished for Reef Users and Non-reef Users.

Item	Artificial Reef User Blackfish Trip	Non-reef User		
		Blackfish Trip	Snapper-Grouper Trip	Both
Fishing effort and catch:				
Number of fishing hours per angler	3.2	2.9	4.6	3.73
Number of fish caught per angler	6.6	6.4	8.0	7.2
Pounds of fish caught per angler	7.4	4.8	24.3	14.3
Average weight per fish caught (lbs.)	1.1	0.7	3.0	2.0
Catch per unit effort:				
Number of fish caught per hour fishing	2.1	2.2	1.7	1.9
Total pounds of fish caught per fishing hour	2.3	1.7	5.3	3.8

Table 31. Average Fishing Effort, Catch, and Catch per Unit Effort by Charter Boat Anglers Per Day Fished for Reef Users and Non-reef Users.

Item	Artificial Reef User	Non-reef User
Fishing effort and catch:		
Number of fishing hours per angler	9.00	8.00
Number of fish caught per angler	2.87	3.10
Pounds of fish caught per angler	28.03	36.34
Average weight per fish caught (lbs.)	9.77	11.72
Catch per unit effort:		
Number of fish caught per hour fishing	0.32	0.39
Total pounds of fish caught per fishing hour	3.11	4.54

Table 32. Total Direct Economic Impact of All Anglers by Types of Fishing Activities in 1977.

Item	Artificial Reef Fishing	Non-reef Fishing	Total	Percent of Total
Resident private boat anglers' expenses for boating and fishing equipment(Boats≥16 feet in length)	$2,277,419	$5,677,740	$7,955,159	35.68
Resident private boat anglers' trip expenses (Boats≥16 feet in length)	2,243,791	7,067,650	9,311,441	41.77
Head boat angler's trip expenses	254,436	3,306,779	3,561,215	15.97
Charter boat anglers' trip expenses	160,430	1,306,274	1,466,704	6.58
Total	4,936,076	17,358,443	22,294,519	100.00
% of Total	22.14	77.86	100.00	

Table 33. Total Economic Impact of All Offshore Anglers' Expenditure by Types of Fishing Activities in 1977.

Item	Artificial Reef Fishing	Non-reef Fishing	Total	Percent of Total
Resident private boat anglers' trip expenses (boats ≥ 16 feet in length)	$4,599,771	$15,124,770	$19,724,541	41.94
Resident private boat anglers'expenses for boating and fishing equipment(boats≥ 16 feet in length)	4,486,515	11,185,148	15,671,663	33.32
Head boat anglers' trip expenses	582,658	7,638,659	8,221,317	17.48
Charter boat anglers' trip expenses	373,801	3,043,619	3,417,420	7.26
Total	10,042,745	36,992,196	47,034,941	100.00
% of Total	21.35	78.65	100.00	

Table 34. Total Fishing Trips of All Offshore Anglers by Types of Fishing Activities in 1977

Item	Artificial Reef Fishing	Non-reef Fishing	Total
Resident private boat anglers' (boats ≥16 feet in length)	33,549	93,549	127,098
Head boat anglers	210	2,085	2,295
Charter boat anglers	315	1,897	2,212
Total	34,074	97,531	131,605
% of total	25.89	74.11	100.00

Table 35. Catch per Unit Effort by Offshore Anglers by Types of Fishing Activities, 1977.

Catch per unit effort	Artificial Reef Fishing			Non-reef Fishing		
	Private boat anglers	Head boat anglers	Charter boat anglers	Private boat anglers	Head boat anglers	Charter boat anglers
Number of fish caught per hour fishing	1.4	2.1	0.3	0.8	1.9	0.4
Total pounds of fish caught per hour fishing	2.0	2.3	3.1	4.0	3.8	4.5

ACKNOWLEDGMENTS

We are grateful to Robert Grooms, Thomas Murray, Don Hammond and Walt Pittam for their assistance in the survey. We also wish to thank Mary Alice Schramm, Christina Watahovich, and Maria Latto for typing the project report and the manuscript.

Drs. Dale Calder, Theodore Smith, and Paul Sandifer are thanked for their review of the final manuscript. Drs. Edwin Joseph and Victor Burrell are acknowledged for their support.

This study was supported largely by funds from Coastal Plains Regional Commission. However, our primary acknowledgment is to the many sport fishermen, charter boat captains, and party boat captains who participated.

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