

# **The Economic Impacts of Sport Divers Using Artificial Reefs in Texas Offshore Waters**

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## **ABSTRACT**

Dive charter boat operators along the Texas coast were asked to provide names and addresses for a representative sample of their diving customers. A random sample of 1,059 sport divers was selected from dive charter boat records; 614 divers took trips to the Flower Gardens Banks National Marine Sanctuary and 445 divers in proportion to the known number of non-Flower Gardens trips by coastal region. An 11-page mail questionnaire was used to collect social and economic data from the sample of divers. Of the 1,059 questionnaires mailed, 528 were returned usable for an overall effective response rate of 56.2%. About 256 (56% of those who went diving in Texas marine waters in the previous 12 months) indicated they took one or more trips in the previous 12 months to artificial reefs in Texas offshore waters. This paper will focus on the group of sport divers who used artificial reefs. Artificial reefs included manmade materials deployed as bottom reefs, wrecks, and standing oil and gas platforms. Most divers participated in activities such as night diving (81%), underwater photography (53%), wreck diving (52%), and marine identification (52%); only 25% participated in spear fishing. Two estimates of sport diver offshore trip days (1,985 and 5,953) were multiplied by the average per trip expenditure for Texas residents (\$162) yielding estimated total expenditures (direct economic impact) in coastal communities of \$261,439 to \$784,106. Total expenditures in coastal communities by non-residents of Texas were considerably less (\$58,885 to \$176, 606). The overall economic impacts of artificial reef diving in Texas where dive charter boats were used to access offshore reefs are presented in terms of changes in total output, income, and total employment. This paper excluded private boat divers who used artificial reefs offshore and charter and private boat divers accessing the Flower Gardens Banks National Marine Sanctuary. The overall economic impact of sport diving in Texas would be higher if these other segments were included. Finally, the paper will emphasize methods and address methodological difficulties involved in studying this particular group of marine resource users and their activities.

**KEY WORDS:** Artificial reefs, economic impact, sport diving

## INTRODUCTION

The total number of sport divers worldwide was expected to be 14 million by the year 2000 (McCawly and Teaff 1995). As the number of divers increases, the need for additional dive sites also can be expected to increase. Natural reefs can only account for a certain amount of diving activity where allowed due to carrying capacity concerns for sustainability. Not all shipwrecks are sited to facilitate sport diving use. Offshore oil and gas platforms in the Gulf of Mexico provide temporary diving resources so long as hydrocarbon production continues. These structures must be removed once production ceases. In many areas of the world, the construction and maintenance of artificial reefs is an effective means for increasing the number of dive sites, particularly where opportunities to satisfy diver demands are otherwise limited. Instead of losing diver clientele to other markets in the region, the Texas Artificial Reef Program administered by the TPW has sought to create additional diving sites along the Texas coast. This is seen as having a positive impact on the charter dive boat industry, related infrastructure, as well as coastal communities. The Texas Artificial Reef Program was authorized by the Texas Artificial Reef Act of 1989 and is implemented as per the Texas Artificial Reef Plan. In this paper, artificial reefs included man-made materials deployed as bottom reefs, ship wrecks, and standing oil and gas platforms.

Previously, artificial reefs have been created and sited primarily to increase fish biomass. Siting is typically carried out to meet state and federal statutory requirements in the most cost-effective way (Gordon and Ditton 1986). Where fishing and diving use was intended, it was usually assumed that dive sites with high fish biomass and diversity will meet the needs of and attract participants to the reefs. In other words, "If we build it, they will come". Recently, however, there has been a paradigm shift toward understanding and planning for users and their recreation experiences rather than simply being concerned with biological improvements. Accordingly, reef siting is being linked with human population and tourism densities and the expressed demand for scuba diving -related resources. The reasoning is that if artificial reefs are well sited from a market perspective, use will be encouraged, and social and economic benefits will be forthcoming. Understanding direct and indirect economic impacts of expenditures by resident and non-resident sport divers using artificial reefs provides decision makers with useful feedback on previous reef deployments and a baseline for future reef deployment.

The economic impacts of artificial reef diving use need to be described in terms of changes in total output, income, value-added, and total employment. Total output is the dollar value of goods and services produced to satisfy final demand for goods and services associated with sport diving and the inter-industry transactions to produce them. Final demand is the dollar value of purchases from producing industries for final consumption. Value-added is equivalent to gross regional product, namely, payments to labor, capital, and taxes or the value of total output minus input purchases.

The goal of this paper was to characterize the sport diver constituency that use dive charter boats to access Texas offshore waters and to provide estimates of their

direct and indirect economic impacts on coastal communities and at the state level. We discuss methodological difficulties associated with diver studies and the implications of results for future artificial reef development and management in Texas.

#### METHODS

We used a stepwise approach to better understand the human dimensions of the offshore sport diving industry in Texas. First, the population of dive boats and operators was identified in an effort to know more about the extent of their offshore diving activity and use of artificial reefs (Ditton et al. 1995). Next, we invited dive boat operators to provide us with access to their customer names and addresses for sampling purposes. A social survey research protocol was then used to collect data from dive boat customers using a mail questionnaire.

In 1997, charter dive boat operators on the Texas coast reported 289 offshore trips in the previous 12 months where artificial reefs were used; these trips accounted for 1,985 diver trip days. For comparison purposes, the Flower Garden Banks National Marine Sanctuary (FGBNMS) accounted for 77 trips and 2,350 diver trip days. This information was derived directly from logs or data bases maintained by the operators.

Our goal was to sample 1,200 sport divers: 600 divers from boats known to take divers to the FGBNMS and another 600 divers in proportion to the known number of charter boat dive trips offshore in the previous 12 months by region of the Texas coast. We were able to achieve our sampling goals with regard to FGBNMS divers, but we were unable to achieve sampling goals with the other group of divers due to a lack of cooperation by dive boat operator. Planned and actual numbers of divers in the sample for South Padre Island were 148 (222), Port Isabel 15 (0), Corpus Christi/ Port Aransas 99 (97), Port O'Connor 45 (57), Freeport 173 (69), Galveston 83 (0), and Port Arthur 37 (0), respectively. Overall, cooperation was greater on the lower coast from Port O'Connor south. To maintain adequate sample size, we over-sampled in other areas where operators were willing to cooperate. Accordingly, we over-represented divers taking trips with operators on the lower Texas coast and under-represented divers taking trips with dive boat operators on the upper Texas coast. The study focuses on sport divers who had gone diving in Texas offshore waters using a charter dive boat in the previous 12 months. Therefore, this study excludes those divers making trips offshore on privately-owned boats because we could not identify a sampling frame of boats used one or more times a year for sport diving purposes.

An 11-page self-administered mail questionnaire was developed to collect data from sport divers. The questionnaire contained questions proven effective in previous studies of sport divers, birders, and anglers conducted by the Texas A&M University (TAMU) investigators. The questionnaire was pre-tested with sport divers from the TAMU Scuba Diving Club and several questions were modified as a result. In addition to questions about overall diving activity and experience, we

asked divers about their overall diving participation in Texas offshore waters and specifically about their "last dive trip" to the Texas coast, including their personal trip expenses by category and by location of expenditure made (in coastal communities, elsewhere in Texas, and out of state. Finally, a social and economic profile of sport divers was sought using questions regarding age, gender, race, ethnicity, education, income, and residence location.

The Salant and Dillman (1994) survey methodology was used. The first mailing explained the study purpose and solicited their cooperation. This was followed with a questionnaire one week later, followed by a reminder/ thank you post card the next week. Two weeks later, non-respondents were sent a second questionnaire. Mailings were sent using TPW letterhead and envelopes with postage-paid envelopes addressed to TAMU.

Of the 1,059 questionnaires mailed to divers, 528 were returned usable. An overall effective response rate of 56.2% was achieved; this takes into account questionnaires returned but non-usable (9) and non-deliverable addresses (103). The response rate achieved was below what Dillman (1978) reports should be achieved using his "Total Design Methodology" and well below the range (61.5% - 71.8%) achieved previously by the Human Dimensions of Fisheries Lab in angler surveys completed for TPWD. There were several possible reasons for the lower than expected response rate:

- i) Divers may not have been artificial reef users and hence did not understand why the TPW wanted their survey input,
- ii) Divers may have felt that TPW shouldn't be involved in what is generally considered a private sector recreation activity,
- iii) The sampling frame contained the names and addresses of persons other than those taking dive trips in the previous 12 months, and
- iv) The survey was conducted during the summer months due to difficulties in acquiring diver names and addresses from operators. This is not one of the best time periods for conducting mail surveys because people are busy with recreation activities during the summer vacation period (Brown et al. 1989).

Surveys can yield inaccurate results when the effects of non-respondents are not accounted for in mail surveys (Fisher 1996). An 11-item telephone interview was developed so we could test for statically significant differences between respondents and non-respondents on the selected items. Since no phone numbers came with diver addresses, we used the internet to get telephone numbers for non-respondents, telephone numbers were located for only 254 non-respondents. After two attempts to reach these individuals, only 13 interviews could be completed. Besides divers not being home and occasional refusals, many numbers were out of order or had answering machines. The number of completed interviews was insufficient for ascertaining the extent of non-respondent bias in the data set. From previous studies, we would expect non-respondents to have fewer years of experience and participate less frequently than respondents; accordingly, the activity probably has less salience to the former group explaining their non-response to the mail survey

(Filion 1980). Based on this, we would expect survey respondents to report more days of diving participation in the previous 12 months, more years of diving experience, and more dive boat trips in the previous 12 months than non-respondents. Because of the likely differences between respondents and non-respondents, we cannot generalize from respondents to the population of divers who use charter dive boats to access offshore waters. In the following analysis, we are assuming no difference between groups in charter boat trip costs. No matter how salient diving may be to individuals, or how frequently they participate in diving, per person trip costs are likely to be the same for each group.

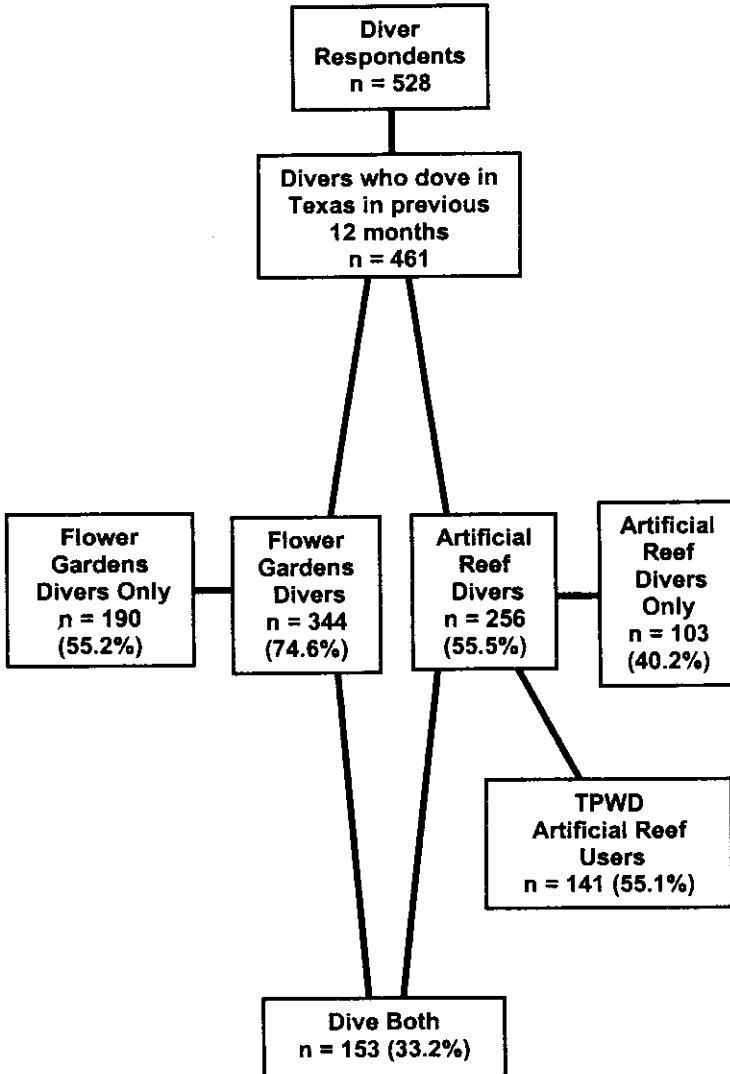
Direct economic impact was estimated at the coastal community and state levels. Trip expenditures by respondents were extrapolated to the population of sport divers using charter dive boats on the Texas coast in 1997. Economic impact multipliers for the Texas coast derived by Tanyeri-Abur et al. (1998) were applied to estimate the economic impacts of sport diving in coastal communities or at the state level. They used IMPLAN to calculate these multipliers, which show the impact of an increase in output in one sector on other sectors of the economy. From their understandings of the total impacts of recreation activities on the Texas coast, they concluded on average that each dollar of expenditure resulted in \$1.81 of total input, \$0.75 in personal income, and \$1.15 in value added on the Texas coastal economy. They reported an employment multiplier of about 37 jobs per \$1 million of expenditures. At the state level, the economic impact multiplier was slightly higher at \$1.90 of total economic output, \$0.78 in personal income, and \$1.20 in value-added on the state's economy. Total economic impact was estimated for the entire Texas coast and not on a community by community basis due to lack of sample size at the community level and because there was no data for communities on the Texas coast.

## RESULTS

Of the 528 diver respondents, 461 reported diving activity in the previous 12 months (Figure 1). Of these, 256 (55.5%) had taken one or more diving trips using artificial reefs in Texas offshore waters in the previous 12 months. A larger percent of these divers (74.6%) had taken one or more diving trips to the Flower Gardens National Marine Sanctuary in the previous year. This is a natural reef area approximately 110 miles offshore from Texas made up of bioherms, or salt domes, with corals growing on top. The remainder of results presented in this paper will be from the 256 (55.5%) diver survey respondents who reported using artificial reefs on one or more trips in the previous 12 months.

Most (75%) artificial reef divers were male. Most (90%) categorized themselves as Anglo or white, while only 9% reported themselves to be of Spanish/Hispanic origin. Divers averaged 39 years of age, with most between 21-40 years of age. Most (81%) sport divers reported a current Texas residence. Of these, most (70%) lived in five urban metropolitan areas: Houston (32%), San Antonio (11%), McAllen (11%), Austin (10%), and Corpus Christi (6%). For non-resident sport

divers, whether they were attracted to dive in Texas offshore waters or came to vacation in Texas and went diving while they were here is not known. Fifty-three percent of divers had household incomes before taxes of between \$10,000 and \$69,000; the median household income category was \$60,000- \$69,999. Most (64%) sport divers had four or more years of college education.



**Figure 1.** Distribution of diver respondents by location of charter boat diving trips (one or more trips) in the Gulf of Mexico offshore from Texas in 1996.

Most artificial reef divers reported they participate in night diving (81%), underwater photography (53%), wreck diving (52%), and marine identification (52%). Only 26% of this group participated in spear fishing (Table 1). When divers were asked to indicate which of the identified diving activities they participated in most often in the previous 12 months, they indicated a tie between underwater photography and marine identification.

**Table 1.** Number and percent of artificial reef divers by the diving activities they participate in and those they participated in most over the previous 12 months.

Activity	Participate		Participate Most	
	N	%	N	%
Underwater photography	135	52.7	61	26.1
Marine identification	133	52.0	61	26.1
Cave diving	31	12.1	2	0.9
Wreck diving	134	52.3	18	7.7
Spear fishing	65	25.4	24	10.3
Decompression/NITROX diving	56	21.9	9	3.8
Night diving	207	80.9	33	14.1
Other <sup>1</sup>	43	16.8	26	11.1
Total			234	100.1
Missing Cases				22

In order to establish a frame of reference for dive trip expenditures, divers were asked about their last trip to the Texas coast where they went scuba diving and used a charter dive boat to do so. Most indicated this trip took place between July 1-December 31, 1996 (58%) with a one-way travel distance of 200 miles or less (69%) from home. There was an average of 21 people onboard (excluding captain and mate) the dive charter boat on this last trip. Most of the trips described by divers were devoted almost exclusively to sport diving activity. Their last trip to the Texas coast for sport diving where they used a dive charter to access offshore waters averaged 2.8 days; of this, they reported they spent an average of 2.2 days diving.

Overall, artificial reef divers reported spending an average of \$287 in the coastal community they visited to go scuba diving (and used a charter dive boat to access offshore waters) plus an additional \$116 "elsewhere in Texas" in preparation for or during their last trip to the coast (Table 2). Their total average trip expenditure was \$403. Since their last trip averaged 2.8 days with 2.2 days of diving, each diver's trip consisted of 2.2 charter dive boat trips from shore. Accordingly, divers spent an average of \$131 per person per day diving in coastal communities in Texas. As expected from previous expenditure studies of other outdoor recreation activities, most (73%) of the sport divers' expenditures in destination communities were for charter fees, lodging, and restaurant meals (Table 2). Most (53%) expenditures "elsewhere in Texas" were for automobile transportation costs and dive boat fees paid to dive shop providers (some of which finds its way back to the charter dive boat operator and the coastal community); food and lodging expenditures could have been made in route to the diving destination community or else divers may have chosen to stay elsewhere to reduce their trip costs (Table 2).

**Table 2.** Number and percent of artificial reef divers making dive trip related expenditures on their last dive trip to the Texas Coast; average expenditures for those making each expenditure and overall.

<b>Expenditure Category</b>	<b>n</b>	<b>Percent of Divers with Expenditure on Item</b>	<b>Average Expenditure per Diver Who Purchased Item</b>	<b>Average Expenditure for Item for All Divers</b>
<i>Amount In the Coastal Community:</i>				
Automobile transportation to the Texas coast (fuel, rental car, taxi, etc.)	207	83.8	\$23.10	\$19.40
Other transportation to the Texas coast (airplane, etc.)	160	64.7	18.30	11.90
Dive boat fees	209	84.6	178.30	150.90
Tips	207	83.8	20.90	17.50
Lodging	186	75.3	41.90	31.50
Restaurant meals	199	80.6	34.30	27.70
Groceries, drinks, ice	196	79.4	18.00	14.30
Rental of diving gear	187	75.7	8.30	6.30
Anything else for this diving trip	35	14.2	54.70	7.80
<b>Total</b>			<b>\$397.60</b>	<b>\$287.30</b>
<i>Amount Elsewhere in Texas:</i>				
Automobile transportation to the Texas coast (fuel, rental car, taxi, etc.)	159	64.4	\$35.90	\$23.10
Other transportation to the Texas coast (airplane, etc.)	123	49.8	18.30	9.10
Dive boat fees	116	46.9	80.20	37.70
Tips	111	44.9	8.20	3.70
Lodging	120	48.6	25.10	12.20
Restaurant meals	137	55.5	26.30	14.60
Groceries, drinks, ice	127	51.4	12.50	6.40
Rental of diving gear	130	52.6	12.40	6.50
Anything else for this diving trip	24	9.7	23.60	2.30
<b>Total</b>			<b>\$242.50</b>	<b>\$115.60</b>



To understand the economic impacts of diving activity on local and state level economies, it is necessary to know where divers reside. We separated expenditures by Texas divers from those from other states to estimate the state level impact of artificial reef diving. State level expenditures are determined by new monies coming into the state and being re-spent. Similarly, expenditures made by divers from coastal communities in Texas need to be separated from those of other Texas divers. Only three of the 256 divers in the sample were from Texas coastal communities. The assumption here is that they would have made other expenditures locally if they were not able to go diving. Thus, local economic impacts were determined by new monies coming into coastal communities and being re-spent there.

Texas resident divers spent an average of \$255 in coastal communities on their last trip to the Texas coast. When divided by the mean number of days diving on this last trip (1.57), this yields an average of \$162 spent in coastal communities per sport diving trip day. They spent an additional \$49 per sport diver trip day elsewhere in Texas traveling to or from the coast. Non-residents spent about \$459 in coastal communities on their last trip (2.70 days of diving) for an average of \$170 per sport diver trip day. While non-residents spent nearly \$200 more than state residents on their last trip to the Texas coast, they spent about the same per person per diving day on these trips. Non-residents spent an additional \$81 per sport diver trip day elsewhere in Texas on their trip to the coast.

We made two estimates of sport diver trip days taken offshore. A low estimate (1,985) was based on dive charter boat operator self-reports of the number of trips made times the number of divers onboard (mean = 6.8); a higher estimate (5,953) was based on the average number of divers (excluding captain and mate) on board charter dive boats (20.6) as reported by sport divers in their questionnaire responses times the number of trips reported by dive boat operators.

When these two estimates of sport diver trip days for the Texas coast are multiplied by the average per trip expenditures for Texas residents, estimated total expenditures (direct economic impact) in coastal communities ranged between \$261,439 to \$784,106 (Tables 3 and 4). Total expenditures in coastal communities by non-residents were considerably less. Overall, non-residents spent between \$87,121 and \$261,293 on their last trip to the Texas coast to go diving; these were new monies to the Texas economy.

The estimated \$320,323 to \$960,713 in direct expenditures made by non-residents of coastal communities for local goods and services generated an additional 259,738 to \$779,026 in economic output, resulting in a total output of \$581,994 to \$1,745,559 with 12 to 35 jobs in this sport diving sector (Table 5). The total value-added associated with this increased level of output is estimated at between \$371,561 and \$1,114,413. This is smaller than the level of total output because it represents only the amount of income and taxes retained in the coastal communities where charter dive boats operate. Many of the inter-industry inputs such as labor, capital, wholesale supplies, etc. must be purchased outside of the coastal margin. Each of these purchases represents a leakage from the local economy. The more leaks in the economy, the smaller will be the overall economic impacts from changes

in final demand. A component of the total value added impact of sport diving activity is the impact on total income, which was estimated to range from \$242,169 to \$725,866.

**Table 3. Total Expenditures (Direct Economic Impact) made by artificial reef divers by residence location using data provided by dive boat charter operators**

<b>Residence</b>	<b>Dollars spent in coastal community</b>	<b>Dollars spent elsewhere in Texas</b>	<b>Total</b>
Coastal community residents	1,941	0	1,941
Texas residents (not coastal community)	261,439	78,351	339,790
Non-residents	58,885	28,237	87,121
<b>Total</b>	<b>320,324</b>	<b>106,588</b>	<b>426,911</b>

Calculated based on data provided by 12 dive charter boat operators for number of trips taken offshore for sport diving and number of divers carried offshore in 1996.

**Table 4. Total Expenditures (Direct Economic Impact) made by artificial reef divers by residence location using data provided by divers and dive boat charter operators**

<b>Residency</b>	<b>Dollars spent in coastal community</b>	<b>Dollars spent elsewhere in Texas</b>	<b>Total</b>
Coastal community residents	5,821	0	5,821
Texas residents (not coastal community)	784,106	234,990	1,019,096
Non-residents	176,606	84,687	261,293
<b>Total</b>	<b>960,713</b>	<b>319,677</b>	<b>1,280,389</b>

Calculated based on data provided by 12 dive charter boat operators for number of trips taken offshore for sport diving in 1996 and diver questionnaire responses regarding the number of persons on board (excluding captain and mate) on their last trip to the coast where they went scuba diving and used a charter dive boat.

State level economic impact results are notably different because only a small number of non-residents come to Texas to go diving and make use of artificial reefs using dive charter boats. The total output (direct and indirect impacts) associated with this group of sport divers ranged between \$166,349 and \$498,913 with 3 to 10 jobs. Total statewide effects from indirect and induced spending are likely spread over a wider range of sectors including manufacturing, retail, and services sectors. The total value-added dollars generated by the increased level of output is estimated to be between \$104,563 and \$313,604.

**Table 5. Coastal community and statewide impacts of artificial reef divers by economic impact variable**

Economic Impact Variable	Total Impacts			
	Local		State <sup>1</sup>	
	Low	High	Low	High
Direct Impact	\$322,256	\$966,533	\$87,121	\$261,293
Output	\$581,994	\$1,745,559	\$166,349	\$498,913
Personal Income	\$242,169	\$725,866	\$67,769	\$388,104
Value-added	\$371,561	\$1,114,413	\$104,563	\$313,604
Employment (jobs)	12	35	3	10

<sup>1</sup> State level economic impacts are derived from local as well as statewide direct expenditures by non-resident sport divers. They are usually larger in magnitude because they include secondary and tertiary impacts outside of coastal communities but within the state of Texas.

## DISCUSSION

Artificial reefs are provided by the TPW in an effort to enhance offshore diving experiences. Since divers and dive boat services are not required to pay for using offshore artificial reefs, there is a general expectation there will be a positive economic impact on coastal communities and even statewide from reef deployment. Economic impact assessments are useful to agency decision makers for determining whether local and statewide economic development goals are being met. As a result of this analysis, community leaders have a baseline understanding of local impacts associated with this outdoor recreation and tourism sector. With additional private sector promotion of offshore artificial reef diving, particularly in out-of-state markets, we are likely to see substantial increases in the impact figures presented here. The situation mirrors a similar case with the Texas charter sport fishing industry where only 3% of their customers come from other states (Sutton et al. 1999). In Mississippi, Alabama, and Louisiana, charter boats derived 62%, 57%, and 33% of their fishing customers from other states, respectively. If increasing local and state level economic impacts are important components of the Texas Artificial Reef Program, then private sector educational and outreach efforts need to be encouraged.

It should be remembered that this study focused on the expenditures and total economic output of only one segment of the Texas sport diving industry. Not included here are those who used private boats to go diving offshore artificial reefs or those who use private or charter boats to dive the FGBNMS. Nevertheless, sport diving is probably only a small portion of the coastal and marine recreation sector which is estimated to involve expenditures of about \$866.65 million with a total economic output of \$1.56 billion (Tanyeri-Abur et al. 1998). This doesn't mean that sport diving is unimportant but rather a reflection of the low rate of participation

(percent that participate) in diving compared to other outdoor recreation activities which cost less and hence are more popular.

This paper focuses on the coastal community and state level economic impacts of sport divers using dive charter boats to reach offshore artificial reefs in Texas offshore waters. This perspective is but one of several studied in this overall research project (Ditton et al. 1999). Overall, we found little available literature on the social and economic aspects of sport diving use of artificial reefs, not to mention on the offshore dive charter boat industry or sport diving in general. There are several possible reasons for this:

- i) Sport diving has fewer participants than many other outdoor recreation activities and hence has not yet received the same research attention from public sector marine resources management agencies,
- ii) Since sport diving is by and large a private sector outdoor recreation activity, previous research has been completed but it is proprietary,
- iii) Lists of diver names and addresses are maintained by dive certification organizations and are not available for sampling purposes by public sector natural resource management agencies, and
- iv) Artificial reefs appear to have been planned more for recreational fishing than for diving. If public-sector agencies are to be responsive to the wants and needs of divers as well as effective in managing their marine resource impacts, there will need to be many more social and economic studies of statewide, area, and mode-specific diver populations.

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