Chapter 4: Socioeconomic Values of Reefs in Broward County

This chapter describes the Socioeconomic Value of Artificial and Natural Reefs in Broward County to residents and visitors. For both groups this chapter discusses the following topics.

- Volume of user activity on both artificial and natural reefs off Broward County;
- Economic Contribution of artificial and natural reefs to the county's economy;
- Resident and visitor "use value" associated with recreating on artificial and natural reefs in Broward County; and,
- Demographic and boater profile of reef users in Broward County.

For residents, their opinions regarding the existence of "no-take" zones as a tool to protect existing artificial and natural reefs are provided.

4.1 Residents

This section presents the estimated socioeconomic values associated with resident boater use of the reefs off the coast of Broward County. Resident boaters are those individuals who live within Broward County and who use a boat that is owned by a resident of the county to visit the reef system. Resident boats used to visit the reef system are defined as those greater than 16 feet in length and registered with the Florida Department of Highway Safety and Motor Vehicles.

4.1.1 User Activity

This chapter first considers the volume of resident user activity associated with the artificial and natural reefs off Broward County. User activity is expressed in terms of the number of boating days or "party-days" since each boat usually carries one or more individuals. Also, user activity will be analyzed in terms of the kinds of recreational activities (e.g., snorkeling) that parties take part in when they visit the reef system.

To measure party-days for any recreational resource, it is important to define what universe the research is intended to measure. In this study, we wish to measure the number of party-days spent on artificial and natural reefs in the Atlantic Ocean off the coast of Broward County. Most residents use their own boats to visit and use the reefs. The use of party boats and charter rentals by residents was not estimated.

In 1999-2000, there were 61,124 registered pleasure boats in Broward County according to the Florida Department of Highway Safety and Motor Vehicles (2001). These pleasure craft were divided into the following size classes:

Boat Size Category (Length of Boat in Feet)	Number of Boats	Percentage of Total	Cumulative Percentage
Less than 12 feet	12,579	20.6%	20.6%
12 feet to 15'11"	8,917	14.5%	35.1%
16 feet to 25'11"	27,917	45.6%	80.7%
26 feet to 39'11"	9,413	15.4%	96.1%
40 feet to 64'11"	2,109	3.5%	99.6%
65 feet to 109'11"	173	0.3%	99.9%
Greater than 110 feet	16	0.1%	100.00%
Total	**61,124**	**100.00%**	

The largest boat size category of pleasure craft in Broward County is between 16 and nearly 26 feet in length (46 percent).

Three adjustments were made to reach the target population of resident boaters in Broward County who may visit the reef system. First, sampling was restricted to pleasure craft at least 16 feet in length. This was in response to expert opinion that very few pleasure craft under 16 feet could reach the reef system. Thus, the mail survey was targeted at pleasure craft at least 16 feet long so that non reef users could be avoided and to increase the sample size on that segment of the boating population with the highest propensity to use the reef system. This reduced the target boat population in Broward County to 39,628 pleasure craft.

In addition, not everyone with a relatively large boat would use an artificial and/or natural reef in the last twelve months. In fact, the results of the survey indicated that 61 percent of these larger vessels used the Broward County reef system in the last 12 months or 23,975 pleasure craft. Finally, we found that about one-half of one percent of registered boats in our target population had a residence somewhere outside Broward County. Thus, the target population was again reduced to 23,855 pleasure craft to reflect only resident boat owners who used the reefs in the past twelve months.

On average, respondents indicated that over a 12-month period (1999-2000) they used the reef system on 39 separate days while engaging in three main recreational activities including fishing, snorkeling and scuba diving. Remember, these boaters have the highest propensity to use the reef system compared to smaller vessels. Based upon this information, it was estimated that over this 12-month period, 930,319 "party- days" were spent on the reef system (39 party days times 23,855 pleasure craft) by Broward County residents.

In conducting the mail survey, we asked reef-users from Broward County to distribute their 39 party-days in two ways. First, they were asked to distribute their reef usage among three recreational activities as follows: (1) Fishing, (2) Snorkeling and (3) Scuba Diving. Second, respondents were asked to distribute each of these recreational activities between artificial and

natural reefs. Table 4.1.1-1 shows the distribution of party-days by resident boaters in Broward County.

Broward county residents spent an estimated 55 percent of their party-days fishing on the artificial and natural reefs followed by scuba diving (26 percent) and snorkeling (19 percent). For all the recreational activities on reefs, 66 percent of the party-days were spent visiting natural reefs. The strongest intensity of natural reef use was for snorkeling where 78 percent of the respondents used the natural reef for this activity.

In the right-hand side of Table 4.1.1-1, user activity measured in "person-days" is provided. A "person-day" is equivalent to an individual traveling to use the reef system for part or all of one day. The number of person-days can be calculated by multiplying the average size of the party (i.e. number of individuals per party) by the number of party-days. However, one important adjustment to average party size was necessary to calculate residential person-days. Here the average party size was reduced by subtracting out those individuals that are considered to be visitors (i.e. non-residents of Broward County). About 20 percent of the average boating party is a nonresident. Thus, Table 4.1.1-1 utilizes the average resident party size to calculate resident person-days. The average resident party size does not vary appreciably among the various reef-related recreational activities and averages about 3.9 residents per party. Because of this, the distribution of person-days among the activities is similar to the distribution of party-days among the activities. For example, saltwater fishing on reefs garnered 2.2 million person-days or 58 percent of all person-days during the 12-month period (December 1999 to November 2000). The total number of person-days for residents using the reef system off Broward County over a 12-month period was estimated at 3.7 million.

While party-days gives a "boater dimension" to user activity in and around the reef system, person-days yield a "people dimension" to use of the reef system. The former is especially useful in judging the adequacy of the boating infrastructure such as marinas and boat ramps while the latter is used in calculating recreational use value which will be discussed below.

Table 4.1.1-1 (Residents)
Estimated Resident User Activity As Measured by Party-Days and Person-Days on Artificial and Natural Reefs off Broward County, Florida, 2000

Activity/ Type of Reef	Number and Distribution of Party-Days by Activity and Reef Type			Number and Distribution of Person-Days by Activity and Reef Type			
	Number of Party-Days	Percentage of Party-Days Per Activity by Reef Type	Percentage of Total Party-Days Per Activity	Resident Party-Size by Activity	Number of Resident Person-Days[1] by Activity by Reef Type	Percentage of Person-Days Per Activity by Reef Type	Percentage of Total Person-Days Per Activity
Fishing			55%	4.21			58%
Artificial	204,670	40%			861,661	40%	
Natural	307,005	60%			1,292,491	60%	
Subtotal	511,675	100%			2,154,152	100%	
Snorkeling			19%	4.14			20%
Artificial	38,887	22%			160,992	22%	
Natural	137,873	78%			570,794	78%	
Subtotal	176,760	100%			731,786	100%	
Scuba Diving			26%	3.44			22%
Artificial	74,985	31%			257,948	31%	
Natural	166,899	69%			574,133	69%	
Subtotal	241,884	100%			832,081	100%	
All Activities				4.00			
Artificial	318,542	34%			1,280,601	34%	
Natural	611,777	66%			2,437,418	66%	
Total	930,319	100%	100%		3,718,019	100%	100%

[1] *Resident person-days is calculated by multiplying the number of party-days by the average resident party size.*

4.1.2 Economic Contribution

To fully understand the economic contribution of reefs to Broward County it is first important to recognize what factors influence the demand for boating in this area. This will help in understanding the nature of boating in the county and how it relates to the use of artificial and natural reefs. In a study by Bell and Leeworthy (1986), the authors found that the demand for boats by individuals was related to boat prices, population and per capita income. Therefore, we would expect a higher number of registered pleasure craft in counties that are large as measured by population and are relatively affluent as measured by real per capita income.

The number of registered boats in any county is critical in assessing the adequacy of the boating infrastructure such as boat ramps and, of course, artificial and natural reefs. This topic has recently been addressed in the 2000 State Comprehensive Outdoor Recreational Plan (2001) issued by the Division of Recreation and Parks, Florida Department of Environmental Protection. However, this report did not include an assessment of the reef system in various regions of Florida.

This section considers the demand for boating in Broward County, not the adequacy of the boating infrastructure. This will give the reader an overview of boating characteristics in Broward County and valuable information necessary to assess the adequacy of the boating infrastructure. The overview includes a discussion of the county's population, per capita income, industrial structure and its infrastructure related to saltwater boating. This will also give a background by which to assess the results of this study.

Broward County is on the southeast coast of Florida bordering the Atlantic Ocean with Fort Lauderdale as its largest city. In 1999, the county was Florida's second largest with 1.49 million residents. Over the last ten years, population in this county grew by 18.7 percent making it the 48th fastest growing county in Florida (out of 67 counties). Broward County has 1,233 persons per square mile as compared to 284 for Florida as a whole, making it the second most densely populated county in the State. This county's population has a median age of 39.8 years which is comparable to the general population of Florida which has an median age of 39 years.

The University of Florida, Bureau of Economic Research projects the county's population to reach 1.8 million by 2015 or a 26 percent increase. In-migration to Broward County, as in the past, will account for over 84 percent of this growth. Thus, this county's population growth will depend heavily on individuals moving into the county. The size of Broward County's population coupled with its projected future growth makes this county a potentially large market for resident recreational boating along its coasts.

In 1998, Broward County had a per capita income of $28,546 placing it eleventh among the 67 counties in the State of Florida. However, this per capita income was only 6.3 percent above the state average of $26,845. The higher per capita income in Broward County is largely due to higher earnings per job in the local economy combined with a higher work participation rate. [1]

[1] *The workforce participation rate in Broward County is 85.1 percent compared to 78.5 percent for the general population of Florida.*

In 1998, there were 675,558 persons employed in Broward County earning $19.92 billion in wages and salaries. Over the last ten years, employment grew by 17.7 percent which corresponds to the rate of growth in population as discussed above. Measured by employment earnings, the largest industries in 1998 were services (33.4 percent); state and local government (12.8 percent); and retail trade (12.6 percent). Of particular note, this county provides a lot of tourist-related services such as lodging, amusement and recreation. Nearly 20,000 workers were involved in these industries in Broward County in 1998. The attraction of tourists provides part of the economic base for this county.

In 2000, there were 61,124 recreational boats (FDHSMV, 2001) registered in Broward County or 1 boat for every 25 people. For the State of Florida, there is 1 registered pleasure boat for every 14 residents. The infrastructure supporting various coastal or saltwater forms of boating recreation in Broward County include the following (FDEP, 2000)(Pybas, 1997):

1. Boat Ramps: 47 with a total of 56 boating lanes;
2. Marinas: 126 with 3,467 wet slips and moorings;
3. Other Facilities: 2,804 boat dry storage;
4. Artificial Reefs: 104 artificial reefs ranging from 0.5 to 2.5 nautical miles from shore.

Despite the relatively large population and high per capita income in Broward County, the demand for recreational boating is less than the demand for boating throughout Florida as measured by the ratio of registered boats per person. These demand factors combined with the saltwater coastal nature of this county would lead one to predict a much higher ratio of registered boats per person. The explanation for this finding is usually found on the supply side where there is crowding or congestion at the access points (e.g., boat ramps) to the water and access points to the recreational resources such as artificial and natural reefs once off shore. This increases the cost of recreational boating and reduces the demand for pleasure boats. This is just a "working hypothesis" of potential supply side problems. Other factors may also be affecting recreational boat ownership in Broward County.

Using a mail survey, 3,000 registered boaters in Broward County were contacted at random using the survey instrument provided in Appendix A. Boat owner addresses were obtained from a registered boater database compiled by the Florida Department of Highway Safety and Motor Vehicles. A total of 616 registered boaters responded to the mail survey and 53.6 percent indicated that they used their pleasure crafts to visit the reefs offshore of Broward County during the past twelve months (December 1999 to November 2000). The results of the survey were used to estimate a total of 1.28 million person-days spent by residents of Broward County on artificial reefs in a 12-month period. This amounts to an average of 17,305 person-days per year for each reef or 47 persons per day. This, of course, does not include visitors from outside Broward County, which are discussed in the next section of this chapter.

To estimate the economic contribution of resident spending associated with reef use in the Broward County economy, we asked the respondents to estimate their party's spending during their last reef-related boating activity. It was assumed that each boating trip would involve one day since the residents are in their county of residence. Residential expenditures per party were distributed by type of recreation activity and the results are presented in Table 4.1.2-1.

Table 4.1.2-1 (Residents)
Average Resident Spending per Party by Broward County Reef-Users

Activity	Estimated Spending per Party per Day	Percentage of Residents per Party	Estimated Spending per Resident Party per Day
(1)	(2)	(3)	(4) = (2) * (3)
Fishing	$330.41	79%	$261.02
Snorkeling	$375.18	79%	$296.39
Scuba Diving	$407.85	85%	$346.67

Scuba divers spent the most amount of money and fishers spent the least amount of money per day. Expenditures for marina fees, equipment rentals and restaurants made the former activity a more expensive recreational activity than the latter. Detailed expenditures on particular items will be discussed below while additional information and analysis is provided in the Technical Appendix to this report.

Note that an adjustment was made to the size of the boating party in order to calculate estimated expenditures by residents as summarized above. About 15 to 21 percent of the typical party includes individuals who were apparently guests of the Broward County residents. We made the simplifying assumption that these visitors would pay their fair share of the trip cost. For instance, visitors would pay a proportion of the trip costs such as boat fuel, restaurants and bait. We believe that residents probably pay for a larger share of total party costs than used in this study. However, we shall be conservative and assume an equal sharing of cost between residents and their visitors.

To derive the economic impact of a particular reef-related recreational activity, one must briefly return to Table 4.1.1-1. This table shows the number of residential party-days and person-days associated with reef use over a 12-month period off the coast of Broward County. For example, recreational fishers spent 511,675 resident party-days on all reefs off Broward County. According to our resident spending per party discussed above, fishers spent $261.02 per trip. Thus, annual expenditures for reef-related fishing was estimated at $133.6 million dollars ($261.02 times 511,675).

Based upon the distribution of party-days per reef type, about $53.4 million was spent while using an artificial reef while the balance or $80.2 million was spent in conjunction with the use of natural reefs by recreational fishers. There did not appear to be much difference between

party spending by fishers who used either type of reef. This held for the other two recreational activities as well.

Table 4.1.2-2 presents the economic contribution of all reef-related recreational pursuits off the Broward County coast. Residents spent an estimated $269.8 million during the 12-month period December 1999 through November 2000. About two-thirds of this amount was spent while using natural reefs ($178.9 million) while the balance ($90.9 million) was spent in conjunction with the use of artificial reefs. Nearly 50 percent of total spending or $133.5 million was spent on reef-related recreational fishing while $83.9 million (31 percent) was spent on reef-related scuba diving and $52.4 million (19 percent) was spent on reef-related snorkeling.

Table 4.1.2-2 (Residents)
Reef-Related Expenditures, Wages and Employment Generated by Resident Boating Activities in Broward County, Florida, 2000

Type of Activity/ Type of Reef	Expenditures (Million $)	Wages (Million $)	Employment (Number of Full and Part-Time Jobs)
Artificial Reef			
Fishing	$53.4	$6.8	438
Snorkeling	$11.5	$1.9	132
Scuba Diving	$26.0	$3.8	242
Subtotal	$90.9	$12.5	812
Percentage Attributed to Artificial Reefs	34%	33%	33%
Natural Reef			
Fishing	$80.1	$10.1	656
Snorkeling	$40.9	$6.7	467
Scuba Diving	$57.9	$8.4	539
Subtotal	$178.9	$25.2	1,662
Percentage Attributable to Natural Reefs	66%	67%	67%
Total All Reefs			
Fishing	$133.5	$16.9	1,094
Snorkeling	$52.4	$8.6	599
Scuba Diving	$83.9	$12.2	781
Total All Reefs/All Activities	**$269.8**	**$37.7**	**2,474**

It is important that we clarify the economic contribution of resident boaters from Broward County. The engine of economic growth for any region such as Broward County is found in its export industries such as tourism in Broward County. As export income flows through the region, it creates local income (e.g., money paid for haircuts by residents) and a demand for imports (e.g., TV sets since Broward County does not have such a manufacturer). The local income is spent on everything from marina services to dining out at a local restaurant to grocery purchases to rent or mortgage payments. Thus, residents use local income to pay for goods and

services in conjunction with reef use. This spending represents the choice between recreating locally and leaving the area to recreate elsewhere.

The reef system keeps the "locals" in the county and enlarges the economy by about $269.8 million in local spending. In contrast to visitors entering the county, there is no multiplier effect. Generally, the more money kept in the local economy, the larger is the regional multiplier because there is less "leakage" through the purchase of imports, including residents leaving the area for recreational pursuits in places such as Key West or Orlando. Just how much the regional multiplier is enlarged from resident use of the reef system is beyond the scope of this study. However, it is safe to say that protection and maintenance of the reef system has the potential to keep more business in Broward County. For ardent reef-users, the absence of reefs off the coast of Broward County would certainly divert more of these residents to reef systems in counties north and south of this area to the economic detriment of Broward county.

Reef-related local spending discussed above is, in itself, only a vehicle to create jobs and wages in the local community. To evaluate which industries benefit from residential reef use, reef-users were asked to break their expenditures into 12 categories for items such as boat fuel, ice, tackle and marina fees. For each of the twelve categories, resident expenditures were matched to total county expenditures published in the 1997 U.S. Census of Business (1997). For example, spending on boat fuel was matched up with total expenditures at gasoline stations in Broward County. It was found that each gasoline station employee "sells" $331,382 per year out of which the employee is paid about $15,244 or about 4.6 percent of sales. The annual salary may seem low, but this figure is for full and part time employees with a relatively low skill level. Thus, every $331,382 in gasoline purchased for reef-related recreation by local users, generates one job paying about $15,244 per year.

This rather simple procedure was followed for each of the 12 expenditure categories that vary greatly in labor intensity. The higher the sales-to-employment ratio, the less labor intensive the activity. For example, restaurants are relatively labor intensive (i.e., cooks and servers) while gasoline stations discussed are highly automated and consequently need relatively few employees per $100,000 dollars in sales.

Table 4.1.2-2 shows the estimated wages and employment generated by resident spending on reef-related recreational activities in Broward County. The $269.8 million in annual spending generated about $37.7 million dollars in annual wages supporting 2,474 jobs.

It is also important to look at what industries benefit from reef-related resident spending. Table 4.1.2-3 presents the 12 spending categories of resident boaters. We would expect that expenditures would be concentrated on running and storing a boat and the results support this assumption. Expenditures on boat oil and gas constituted 25 percent of all spending followed by spending on marina slip rentals and dockage fees (18 percent) and food and beverages from restaurants (13 percent) and stores (8 percent). In terms of dollar figures, resident reef-users spent over $47 million annually on the marina industry. According to the U.S. Census of Business (1997), the marina industry in Broward County grossed about $99 million in sales.

Thus, resident reef-users may account for about one-half of these sales. Marina industry sales would also come from resident non-reef users and visitors keeping their boats in local marinas. The role of visitors will be discussed in the next section.

In terms of employment, reef-related resident spending created proportionately more employment in marinas and restaurants than the other industries since, as discussed above, these industries are relatively labor intensive. Although gasoline stations ranked number one as a component of spending, this industry is capital-intensive and provides relatively lower employment per $100,000 in sales. Spending on boat oil and gas accounted for one-fourth of all spending, but only one in ten jobs. As might be expected, wages follow employment. That is, the higher the percentage of spending on labor intensive industries, the higher the total wages generated. However, some industries employ highly skilled persons such as marinas where the wages paid are proportionately higher than employment as indicated in Table 4.1.2-3.

Table 4.1.2-3 (Residents)
Detailed Expenditure Pattern Supporting Employment and Wages by All Resident Reef-Users in Broward County, Florida, 2000

Expenditure Item	Expenditures (Million $)	Percentage of Total Expenditures	Employment (Number of Full and Part-Time Jobs)	Percentage of Total Employment	Wages (Million $)	Percentage of Total Wages
1. Boat gas and oil	$67.28	25%	203	8%	$3.06	8%
2. Marina slip rentals and dockage fees	$47.17	17%	477	19%	$11.49	31%
3. Food and beverages from restaurants/bars	$35.99	13%	951	39%	$9.39	25%
4. Food and beverages from stores	$22.47	8%	172	7%	$2.41	6%
5. Tackle	$24.68	9%	165	7%	$3.04	8%
6. Bait	$12.35	5%	83	3%	$1.52	4%
7. Gas for auto	$10.47	4%	32	1%	$0.48	1%
8. Ice	$6.11	2%	19	1%	$0.28	1%
9. Equipment rentals	$6.78	3%	69	3%	$1.70	4%
10. Boat ramp and parking fees	$4.61	2%	51	2%	$1.12	3%
11. Sundries (e.g. Sun screen, sea sickness pills, etc.)	$6.56	3%	84	3%	$0.64	2%
12. All other	$25.31	9%	170	7%	$2.46	7%
Total	**$269.78**	**100%**	**2,476**	**100%**	**$37.59**	**100%**

4.1.3 Use Value

Natural and artificial reefs contribute to the recreational experience of residents (i.e. fishing, snorkeling and scuba diving). Traveling to and enjoying a reef system involves economic costs including the cost of boat fuel, bait and tackle. This was discussed above. However, the market does not measure the total economic value of reef systems. There is no organized market in which to buy and sell the use of reefs because these resources are not owned by one individual but by society as a whole. Thus, the absence of private property rights creates a challenge in valuing natural and artificial reefs.

Yet, the general public does pay for the deployment of artificial reefs and the protection of natural reefs. So, there must be some unmeasured value of providing the reef system to the general public. Because reef-users are attracted to the reefs for recreation, we call this unmeasured value "use value". For example, one could engage in scuba diving without the benefit of a natural or artificial reef. The addition of a reef presumably adds some "value" to the scuba diver's recreational experience. This section examines the incremental use value of having a reef system off the coast of Broward County.

The contingent valuation (CV) method asks users about their willingness to pay for a reef system contingent on specified conditions (e.g., use of funds for various reef related improvements). This CV method has been employed in numerous studies of use value from deep-sea fishing to deer hunting.[2] The reef-using respondents were asked a series of CV questions dealing with their willingness to pay for the reef program. The respondents were asked to consider the total cost for their last boating trip to the reefs including travel expenses, lodging, and all boating expenses. Then, the respondent was asked

> "If your total cost per trip would have been $_____ higher, would you have been willing to pay this amount to maintain the (kind of reef – artificial or natural or both) in their existing condition."

Payment amounts or cost increases ($10, $50, $100, $200 and $500) were inserted in the blank space and the amounts were rotated from respondent to respondent. Thus, some respondents received questions asking about a $10 increase while others were asked about a $50, $100 or even $500 increase in trip cost. The purpose of these questions was to establish the user value per day for artificial and natural reefs.

The above willingness to pay question was asked of each respondent in three forms: (l) natural reefs separately; (2) artificial reefs separately and (3) a combination of natural and artificial reefs. Because the primary spending unit is the "party", the willingness to pay response to an increase in trip cost was considered to be the willingness to pay of the entire party.

To estimate values per party per trip (a day and a trip are equal for residents), the data were pooled for all counties. A logit model was used to estimate the values per-party-per-trip. The

[2] *See Clawson and Knetch (1966).*

logit model tested for differences by county, activity, household income, age of respondent, years of boating experience in South Florida, race/ethnicity, sex, length of boat owned, and whether the respondent is a member of a fishing or diving club.

Separate models were estimated for each of the four reef programs (e.g., natural reefs, existing artificial reefs, natural & artificial reefs combined and new artificial reefs). For the natural reef, existing artificial reefs and the combined programs, the only significant differences found were for those with income greater than $100,000. This group had a higher willingness to pay than other reef users. There were no other differences found. The logit model did not produce different per party per trip values by county, and because party sizes were not significantly different by county the estimated values per person-trip were also the same across counties for each of the reef valuation programs. The estimated per party per trip (day) values were $32.55 for the natural reefs, $11.31 for the artificial reefs and $12.94 for the combined program.

To estimate total annual use values for each county, we multiplied the number of party-days times the estimated values per party per day. We then estimated the value per person-day by dividing the total annual use value by the total number of person-days. This normalized value per person-day can be compared with results from other studies.

The results are consistent with the idea that natural reefs are preferred to artificial reefs. For Broward County residents, the average per person-day value of the natural reefs was $8.17 versus $2.81 for artificial reefs. Total use is also higher for natural versus artificial reefs. Broward County residents' natural reef use was about 2.4 million person-days versus about 1.3 million person-days for artificial reefs. This translated into an estimate of total annual use value of about $19.9 million for natural reefs and $3.6 million for artificial reefs. Capitalizing the annual use values, using a three percent interest rate, yields asset values of about $663.8 million for the natural reefs and $120.1 million for the artificial reefs. All of these results are summarized in Table 4.1.3-1.

Annual use value represents the annual flow of total use value (i.e., the recreational benefits) to the reef-using public. From a public policy point of view, government spends money on the protection and management of the valuable resources of the natural and artificial reefs including investments for deploying new artificial reefs and enhancing of natural reefs. In addition, government entities incur variable costs each year to support marine patrol, biologists, planners and even contracts with economists to help carry out the mission of protecting the existing reef system. These costs can be compared with the annual flow of total use value of the reef to determine if this is indeed a wise investment.

The question combining the natural and artificial reef programs yielded estimates of value lower than that derived by adding-up the values of the natural and artificial reef programs separately. This result is consistent with past research. Some respondents are not willing to pay the sum of the values of the individual programs to finance the combined programs. This is largely due to the income constraints as higher bid values are provided to the respondents under the combined

programs. The value of the combined programs or $12 million per year would provide a conservative or lower bound estimate of the total natural and artificial reef values.

Table 4.1.3-1 (Residents)
Estimated Use Value of Artificial and Natural Reefs off the Coast of Broward County, Florida, 2000

Reef Type/Activity	Person-days (millions)	Annual User Value (Millions $)	User Value Per Person-day ($)	Asset Value at 3% (Millions $)
Natural Reefs	**2.437**	**$19.91**	**$8.17**	**$663.8**
Snorkeling	0.571	$4.49	$7.86	$149.6
Scuba Diving	0.574	$5.43	$9.46	$181.1
Fishing	1.292	$9.99	$7.73	$333.1
Artificial Reefs	**1.281**	**$3.60**	**$2.81**	**$120.1**
Snorkeling	0.161	$0.44	$2.73	$14.7
Scuba Diving	0.258	$0.85	$3.29	$28.3
Fishing	0.862	$2.31	$2.69	$77.2
Natural & Artificial Reefs	**3.718**	**$12.04**	**$3.24**	**$401.3**
Snorkeling	0.732	$2.29	$3.13	$76.2
Scuba Diving	0.832	$3.13	$3.76	$104.3
Fishing	2.154	$6.62	$3.07	$220.7
New Artificial Reefs	**1.281**	**$0.76**	**$0.60**	**$25.4**
Snorkeling	0.161	$0.14	$0.87	$4.7
Scuba Diving	0.258	$0.27	$1.05	$9.0
Fishing	0.862	$0.35	$0.41	$11.7

Measuring the economic benefits of natural reef systems to policy makers is useful in justifying public budgets for such programs. If protected, the use value for natural reefs will flow into perpetuity. Using a real discount rate of 3 percent, it is estimated that the capitalized value of the natural reefs off Broward County is $663.8 million. Why is this important? Natural reef systems are not privately owned, but are common property resources. If a region or a nation were preparing a balance sheet showing its assets and liabilities, the asset value of the reef system would need to be included. This analysis provides an estimate of the capitalized value (or asset value) of the natural reef system to reef users. Bear in mind that this value only includes the value that reef users place on the reefs and does not include the values that non-reef-users place on the reefs or the economic contribution of the reefs. *The estimation of the value of the reefs to non-reef users was not part of this study.*

In addition, asset value comes into play when there is an environmental disaster that damages the reefs such as an oil or hazardous waste spill. If the polluter destroyed for the foreseeable future

20 percent of the natural reef system off Broward County, then the government could ask for $133 million (i.e., 0.20 times $663.8 million) in compensatory damage. An example of this problem is in the Florida Keys, where ships that destroy natural reefs are required to pay the loss of use value as a result of legal proceedings. Numbers provided here are quite real and useful especially in the case of environmental damage assessment.

As discussed above, artificial reefs had a use value per person less than that of natural reefs as one would expect. However, preservation of the existing artificial reef system of Broward County produces an annual use value of about $3.6 million. Again, this is for the maintenance of these reefs. The capitalized value of the artificial reef system off Broward County is estimated to be $120.1 million. If users were obstructed from getting to Broward County's artificial reefs, an estimate of damages to the reef users would be either the annual use value lost if users are temporarily obstructed or the capitalized value if users were permanently cut-off from using the artificial reefs.

The logit model estimated for the new artificial reef program found statistically significant differences in willingness-to-pay depending on county, activity and income. Those from Palm Beach and Broward counties had higher willingness to pay than those from Miami-Dade and Monroe counties. Snorkelers and scuba divers had higher values than those who participated in fishing activities. The only other statistically significant variable was household income. As household income levels increased so did willingness-to-pay for new artificial reefs. On a per party per day basis, the estimated values ranged from a high of $3.60 for snorkelers and scuba divers from Broward County to a low of $1.72 for those who participated in fishing activities off Broward County.

As with the other three programs, the estimated per party per day values were multiplied by the total party-days spent on artificial reefs by artificial reefs users in the county to get total annual use value for the county. The total annual use values were then divided by the total annual person-days of artificial reef use in the county to get an estimate of the value per person-day. Again, this normalized value per person-day can be compared with results from other studies.

On a per person-day basis, the estimated values ranged from a low of $0.41 for those fishing to a high of $1.05 for those that participated in scuba diving off Broward County. Across all activities, the average was 60 cents per person-day.

In terms of total annual use value, fishing is the highest valued use for new artificial reefs. The total person-days of artificial reef use while fishing more than compensates for the lower value per person-day. Across all activities, total annual user value associated with a new artificial reef program is almost $762 thousand with an asset value of $25.4 million.

The relatively low marginal willingness to pay of $0.60 per person-day for artificial reef expansion in comparison to artificial reef maintenance discussed above is somewhat expected. If present users do not feel that congestion on artificial reefs is a problem, they would be expected to value expansion lower than maintenance of the existing artificial reefs. However, their

willingness to pay anything for expansion demonstrates some level of unhappiness with the existing number of artificial reefs off Broward County. Perhaps, residents are competing with visitors for choice spots or just getting in the way of fishing and diving when arriving at an artificial reef.

4.1.4 Role of "No-Take" Zones

Both the economic contribution and the use value of the reef system are based upon the management or lack thereof of these resources. There have been controversies about the wisdom of deploying, for example, artificial reefs. Opponents argue that this encourages over fishing since artificial reefs tend to concentrate fish in a smaller number of places and they become easier targets for fishers. Others find that artificial reefs serve as added habitats and thereby increase the overall biomass available to fishers. The Bell et al., study (1999) of artificial reefs in northwest Florida found that most people fell into the latter group believing that the pie got larger with the deployment of more reefs. However, other studies such as Bolnsack et al., (1997) and Grossman et al., (1997) report results that support opinions of opponents regarding additional artificial reef systems.

In this section, we examine "no take" zones in the Florida Keys and other counties in southeast Florida. "No-take" zones are defined as areas where reef-users can visit but nothing can be removed from an artificial or natural reef area. The existing reef system is coming under increased pressure to yield stable catch rates for fishing and a pristine environment for snorkeling and scuba diving. Also, the reefs play a vital role in the entire oceanic ecosystem by providing habitat and protection for young fish and other creatures. To provide a net benefit, it is argued that "no-take" zones would actually increase recreational benefits even though takings would be banned in certain areas.

Supporters of "no-take" zones point to the overuse of common property resources such as ocean fishing both by recreational and commercial interests. In effect, "no-take" zones would vest the property right with the government. Although the carrying capacity of a reef system is not evaluated in this study, the concept has widespread validity. This concept has been examined by many natural resource economists with the finding that congestion and declining yields of fish create a decline in use value per day.[3] Bell (1992) found that tourists visiting Florida would go elsewhere if fishery catch rates declined to a certain point from the existing level. No one knows exactly where and to what degree "no-take" zones must be employed to increase the net benefit available to recreational interests. Like the deployment of artificial reefs, "no-take" zones have become a controversial issue. Therefore, as part of this study, respondents were asked their opinions regarding the use of "no-take" zones as a management tool for artificial and natural reefs in southeast Florida.

In each of our four counties, resident reef-users were asked questions regarding "no-take" zones. The results for Broward County are summarized in Table 4.1.4-1. In 1997, the Florida Keys National Marine Sanctuary created 23 areas or zones (13.37 square miles) in which the taking of

[3] *See Green (1984) and Bell (1992).*

anything including fish and shellfish is prohibited. It is reasonable to believe that residents of Broward County may have formed an opinion about this management effort and indeed, about three quarters of the Broward County respondents supported this experimental management effort. However, the "not in my backyard view" also had to be tested so respondents were asked for their opinions regarding "no take" zones in Broward County. About 63 percent of the respondents were willing to have "no take" zones off the shore of their county. Respondents were also willing to extend this concept southward to Miami-Dade County and northward through Palm Beach County with about 64 percent supporting this expansion according to the results shown in Table 4.1.4-1.

Finally, respondents were asked for their opinion regarding the percent of the reef system that should be included in "no take" zones. Respondents, on average, would be willing to have "no take" zones cover about 35 percent of the natural reefs off Broward County. Because the average may be skewed by exceptionally high answers, we also looked at the median percent of natural reefs respondents felt might be managed by the use of "no-take" zones. The median, or the midpoint between the highest and lowest answer, was 25 percent of the natural reef system. Such results provide the public with important information regarding resident opinions of "no take" zones in Broward County.

Table 4.1.4-1 (Residents)
Opinion of Broward County Residents on
"No Take" Zones for Artificial and Natural Reefs, 2000

Survey Question	Percentage of Respondents Answering "Yes"	Percentage of Respondents Answering "No"	Percentage of Respondents Answering "Don't Know"	Sample Size
(1)	(2)	(3)	(4)	(5)
Support existing "NO TAKE" Zones in the Florida Keys	75%	18%	7%	369
Support "NO TAKE" Zones on some reefs off shore of Broward County	63%	27%	10%	369
Support "NO TAKE" Zones on some reefs off shore of Palm Beach, Broward and Miami-Dade Counties	64%	24%	12%	369
	Average for All Response	**Median of All Responses**		
What Percent of Natural Reefs in Broward County Should be Protected with "NO TAKE" Zones	35%	25%		369

Given the short experience of the Keys "no-take" zones, it is quite remarkable that present reef-users would be willing to establish "no-take" zones in their county. Combined with the results from the Florida Keys (Monroe County) resident survey, these statistics indicate a willingness to

support management efforts in the direction of "no-take" zones. Such results are important to public officials in charge of managing the natural reef system off Broward County.

4.1.5 Demographic Information

The mail survey administered to Broward County residents included questions regarding demographic characteristics. The reason for collecting such information was to determine what segment of the population will gain by protecting and maintaining artificial and natural reefs and/or designating "no-take" zones as discussed in the very last section. Respondents were asked to provide some background on both themselves and their boating experiences. Thus, the survey was used to collect demographic information as well develop a boater profile to better understand these people called "reef-users" in Broward County. Table 4.1.5-1 presents the results from the mail survey combined with comparable information on the entire Broward County population.

Table 4.1.5-1 (Residents)
Demographic Characteristics and Boater Profile of Reef-Users in Broward County Florida, 2000

Demographic Characteristics of Respondents to Mail Survey	Reef Users	Broward County Population
Median Age	48	39.8
Sex		
Male	92%	48%
Female	8%	52%
Race		
White	93%	71%
Black/African American	2%	21%
Hispanic/Latino	5%	15%
Other	5%	9%
Education		
Percentage that completed College Degree or More	50%	13%
Median Household Income	$72,310	$37,431
Boater Profile		
Average Years of Residence in Broward County	26	N/A
Average Years of Boating in South Florida	22	N/A
Average Length of Boat Used for Saltwater Activities (ft)	25	N/A
Percentage of Respondents that belong to fishing and/or diving clubs	18%	N/A
Sample Size		**374**

[1] *Latest year that educational level attained by county is available is for 1990 from the U.S. Census Bureau.*

Source: Florida State University and the U.S. Bureau of the Census (1990, 2000).

The owners of reef-using registered boats are slightly older than the general population of Broward County. The median age of reef-users is 48 years compared to 39.8 years for the general population. Statistically speaking, there is a real age difference between these two groups. Further, reef-related boating appears to be a male dominated activity as about 92 percent of the respondents indicated they were male compared to 48 percent in the general population. Of course, we have no way to control who fills out the survey instrument once it reaches the boat owner's residence. The survey is directed at the person to whom it is registered.

With respect to race, white individuals in Broward County dominate boat ownership. About 93 percent of the respondents characterized themselves as white compared to 71 percent in the general population of Broward County. Further, a lesser percentage characterized themselves as Hispanic/Latino (5 percent) as compared to the general population (15 percent).

Nearly 50 percent of the respondents indicated they had at least a college degree compared to 13 percent for the general population in 1990.[4] The education level of the general population is probably much higher today than ten years ago, but may not reach the levels reported by the respondents.

Since education and income are positively correlated, it is expected that the median household income reported by reef-users would be higher than the general population. This is indeed the case as confirmed by the last demographic statistic in Table 4.1.5-1 where respondents reported a median household income of $72,310 compared to $37,431 for the general population. Of course, the purchase of a relatively large pleasure craft is also associated with higher income as found by Bell and Leeworthy (1986) and discussed earlier in this chapter. So, this finding is not unusual.

Using the information gathered from the first section of this Chapter on user activity, we can estimate that a minimum of 93,035 residents engaged in at least one reef-using recreational activity during the period December 1999 to November 2000. This was obtained by multiplying the number of registered boats that are estimated to be involved in reef use (23,855) by the average number of residents per party (3.9 individuals). The reason we say minimum is that the turnover rate of the party is unknown. That is, the same residents may not go on every boat outing. There are over 1.2 million residents in Broward County that are over 14 years of age (i.e. about that age at which they could become boaters). The boating population that uses the reef system constitutes a minimum of 7.7 percent of the county's population (93,035/1.2 million). The boating population that uses the reef system would probably be higher if the party turnover rate (i.e. different individuals on each boat outing) were considered. The information presented here provides some insight on what segments of the Broward County population are being served by artificial and natural reefs off its coast. This should be valuable information for policy makers at the local and state levels.

[4] *The U.S. Census Bureau has not yet released the educational levels for counties as part of the 2000 Census.*

Finally, a boater profile for Broward County was developed from the survey results as follows. The typical reef-using boater has lived in Broward County for 26 years and boated for 22 years. The reef-using boaters in our sample own a pleasure craft of 25 feet in length on average. The weighted average of registered boats 16 feet and over in Broward County is also 25 feet so it appears that our sample is particularly reflective of the population based on average boat length. About 18 percent of the respondents were members of fishing and/or diving clubs. This indicator gives some idea of the intensity and degree of interest in recreational fishing, snorkeling and scuba diving off Broward County, Florida.

4.2 Visitors

The focus of this section is the socioeconomic value of the reefs associated with visitors to Broward County. As presented in Chapter 1, Introduction, visitors to a county are defined as nonresidents of the county that they are visiting. For example, a person from Miami-Dade County visiting Broward County is considered to be a visitor to Broward County. Likewise, a person from New York visiting Broward County is considered to be a visitor to Broward County.

This section provides the following values regarding visitors to Broward County: reef user activity, economic contribution of the reefs, use value of the reefs and demographic information. Detailed explanations of the methods and data used to estimate these values for Broward County are provided in Chapter 1: Introduction and Chapter 2: Socioeconomic Values of Reefs in Southeast Florida.

4.2.1 User Activity

The activity of reef users is summarized in person-days of reef use. For visitors, the number of person-trips to use the reefs is also of interest. In order to measure person-days and person-trips associated with reef use, the total number of person-trips by all visitors to Broward County must be estimated. Total visitation includes visits to Broward County by non-residents of Broward County to participate in any activity be it recreation, business or family matters. The total number of person trips by all visitors to the county was estimated using the Capacity Utilization Model as described in Chapter 2. This model uses a variety of information obtained from the counties and the responses to the General Visitor Survey. The number of person-trips was then converted to the number of person-days spent by all visitors to Broward County using information from the General Visitor Survey.

The number of person-trips taken by all visitors to Broward County and the number of person-days these visitors spent in the county during the year 2000-2001, developed in Chapter 2, are summarized in Table 4.2.1-1.

Table 4.2.1-1 (Visitors)
Number of Person-Trips and Person-Days
All Visitors to Broward County
June 2000 to May 2001 – in millions

Measure of Visitation	Summer 2000	Winter 2001	Total
Number of Person-Trips	3.31	6.09	9.40
Number of Person-Days	25.94	58.69	84.63
Note: Summer 2000 is from June 2000 to November 2000. Winter 2001 is from December 2000 to May 2001.			

Visitors took 9.4 million person-trips to Broward County from June 2000 to May 2001 and spent 85 million person-days in the county.

The number of person-trips by all visitors was used as the basis for estimating the number of person-days visitors spent using the artificial and natural reefs in each county. For each season, the number of boating person-trips is equal to the total number of person-trips by all visitors times the proportion of person-trips taken by visitors who participated in saltwater boating in the county in the past twelve months. This proportion was taken from the General Visitor Survey answer to Question 13 (Which activities and boating modes did you participate in over the past 12 months in this county?). The proportion is equal to the number of respondents who participated in at least one boating activity divided by the total number of respondents to the General Visitor Survey.

To get the number of boating person-trips when the person used the reefs, the number of boating person-trips is multiplied by the proportion of boating person-trips when the respondent used the reefs. This proportion was obtained from the Visitor Boater Screening Tally sheets. These sheets indicated the proportion of boaters intercepted who used the reefs at least once in the past 12 months. The results for the summer, winter and the year are summarized in Table 4.2.1-2.

Table 4.2.1-2 (Visitors)
Person-Trips of Visitors Who Boated
And Visitors Who Used the Reefs in Broward County Over the Past 12 Months

Season	Total Person Trips to County - All Visitors	Proportion of Person Trips Taken By Visitors Who Boated[a]	Boating Person Trips	Proportion of Boating Person Trips When the Reef was Used for Recreation[b]	Boating Person Trips When the Reef was Used for Recreation
Summer - June 2000 to Nov. 2001	3,314,292	0.20	668,204	0.99	663,312
Winter – December 2000 to May 2001	6,088,714	0.19	1,145,612	0.99	1,137,225
Year Round - June 2000 to May 2001	9,403,006		1,813,816		1,800,537

[a] *Saltwater Boating Only. From General Visitor Survey Answer to Question 13 (Which activities-modes did you participate in over the past 12 months in this county). The proportion is equal to the number of respondents who participated in at least one boating activity divided by total number of respondents to the General Visitor Survey.*

[b] *From the Visitor Boater Tally Sheets: = 1 - (Q6/(Q6+Q7+Q8+Q10))*

Of the 9.4 million person-trips visitors took to Broward County from June 2000 to May 2001, 20 percent of these trips involved saltwater boating activities in the summer and 19 percent involved saltwater boating activities in the winter. Of the resulting 1,813,816 boating person-trips by visitors to Broward County, 99 percent of those trips involved recreational reef use. Thus, visitors who used the reefs for recreation in Broward County made about 1.8 million person-trips to the county from June 2000 to May 2001.

Next, the total number of person-days that visitor boaters who used the reefs spent visiting the county was estimated. This estimate is the total boating person-trips when reefs were used times the average days per visit by boaters who use the reefs. The average days per visit by boaters who used the reefs was obtained from Question 10 of the Visitor Boater Survey (How many nights are you spending on this trip?) where each response was increased by one unit to convert nights to days. The average number of days and the total person-days reef users spent in Broward County in 2000-2001 are provided in Table 4.2.1-3.

Table 4.2.1-3 (Visitors)
Average Number of Days Visiting Broward County
And Total Person-Days in Broward County
By Visitor Boaters Who Used the Reefs
June 2000 to May 2001

County	Average Days Visiting the County Per Trip	Total Person Days Spent Visiting the County
Broward	8.47	15,252,053

Reef-using boaters who visited Broward County spent an average of 8.47 days in the county during their trip. As a result, these visitors spent 15.2 million person-days in Broward County from June 2000 to May 2001.

To allocate the total person-days spent visiting the county to actual days using the artificial and natural reefs, the daily participation rates of the different boating activities were calculated using the responses to Questions 12, 15, 16 and 17 of the Visitor Boater Survey. Participation rate is the proportion of total days that respondents spent in the county in the last 12 months when the respondent actually participated in a saltwater activity and boat mode. It represents the probability that a visitor boater who uses the reefs will participate in a particular saltwater boating activity and boating mode on any given day.

Question 12 asked the respondent to examine a list of saltwater boating activities and boat modes and read the number corresponding to the activity-boat mode that he/she or someone in his/her party participated in over the past 12 months. The saltwater activity-boat mode list is provided in Appendix B with the Visitor Boater Survey. Question 13 asked if the respondent participated in the activity and boating mode. Question 15 asked how many days in the past 12 months that the respondent participated in the activity-boat mode. From the responses to these questions, the

proportions of total visiting days respondents actually spent participating in the activity-boat mode were obtained.

To allocate the total number of days in an activity-boat mode to the use of artificial reefs versus natural reefs versus no reefs, the proportion of fishing days and the proportion of dives spent on each reef/no reef was calculated from the Visitor Boater Survey responses. Question 16 asked the respondent how many days he/she spent on the artificial reef and Question 17 asked the respondent how many days he/she spent on the natural reef. For scuba divers and snorkelers, Question 18 asked for the total number of dives and Questions 19 and 20 asked for the number of dives on artificial versus natural reefs. A dive is defined as exiting and reentering the boat and applies to both divers and snorkelers. From the responses to these questions, the proportions of fishing days spent on artificial, natural and no reefs and the proportions of dives spent on artificial, natural and no reefs were obtained. For fishing charter and fishing party boats, the proportion of days spent on artificial versus natural versus no reefs was taken from the fishing-related responses to the charter/party boat operator survey for Broward County.

The proportion of visitor days that visitor boaters who use the reefs participated in fishing and diving/snorkeling and the proportion of fishing days and scuba/snorkeling dives that visitor boaters spent on the artificial, natural and no reefs for Broward County are presented in Table 4.2.1-4.

Table 4.2.1-4 (Visitors)
Percent of Visitor Person-Days That Reef-Using Boaters Participated in the Saltwater Recreation Activity And Percent of Fishing Days or Dives Spent on Artificial, Natural and No Reefs From Visitor Boater Survey
Broward County

Activity	Total Respondents	Percent of All Visitor Days	Percent of Activity Days or Dives On:			
			Artificial Reefs	Natural Reefs	No Reefs	Sum of Percentages
Fishing[a]	252	27%	47%	52%	1%	100%
Scuba Diving/ Snorkeling[b]	252	22%	51%	48%	1%	100%

[a] *Percent of fishing days on each reef type is reported.*
[b] *Percent of dives on each reef type is reported. A dive is a boat exit and re-entry.*
Note: Boating Modes are Charter, Party, Rental, and Private (Own or Friend's) Boat.

Visitor boaters who came to Broward County to use the reefs spent 27 percent of their visiting days participating in saltwater fishing from either a charter, party, rental or private boat. Of these fishing days, 47 percent of days were spent fishing near artificial reefs, 52 percent of days were spent fishing near natural reefs and 1 percent of days were spent fishing near no reefs. Also, visitor boaters who came to the county to use the reefs spent 22 percent of their visiting days scuba diving or snorkeling. Of these diving/snorkeling days, 51 percent of dives were spent

on artificial reefs, 48 percent of dives were spent on natural reefs, and 1 percent of dives were spent on no reefs.

The number of person-days spent in each saltwater boating activity-boat mode was estimated as the total person days reef-using boaters spent visiting the county in year 2000-2001 (from Table 4.2.1-3) times the proportion visitor days that these visitors spent participating in each activity-boat mode. Then the number of person-days spent in each saltwater boating activity-boat mode was allocated to artificial and natural reefs based on either the proportion of days or the proportion of dives spent in that activity-boat mode on or near artificial versus natural reefs. Proportion of days was used for all activities except scuba diving and snorkeling where the proportion of dives was used to provide a more accurate indicator of reef use.

A summary of the total person-days visitors spent participating in reef-related recreation by type of activity and by type of reef in Broward County is provided in Table 4.2.1-5. The total person-days visitors spent participating in each saltwater activity and boat mode by type of reef is provided in Table 4.2.1-6.

Visitors to Broward County spent about 5.7 million person-days on the reef system from June 2000 to May 2001. About 2.7 million of these days were spent on artificial reefs and about 3.0 million of these days were spent on natural reefs.

Table 4.2.1-5 (Visitors)
Number of Person-Days Spent Using Artificial and Natural Reefs
By Recreation Activity – Broward County

Activity	Number of Person-Days – in millions		
	Artificial Reefs	Natural Reefs	All Reefs
Snorkeling	0.09	0.27	0.35
Scuba Diving	1.59	1.43	3.02
Fishing	1.00	1.29	2.29
Glass Bottom Boat Sightseeing	0.02	0.04	0.05
Total	**2.70**	**3.03**	**5.71**

4.2.2 Economic Contribution – Visitors

The Visitor Boater Survey asked respondents how much money they and members of their party spent on the last day that they participated in fishing, scuba diving and snorkeling in the county. The respondent was also asked how many people spent or benefited from those expenditures. The respondent was asked only to provide the amount of money spent in the county of interview. From this information, a picture of the average itemized expenditures per person per fishing or diving day and by boating mode was estimated.

Table 4.2.1-6 (Visitors)
Number of Person-Days Visitors Spent Participating in
Saltwater Boating Activities and Reef Use - June 2000 to May 2001
Broward County

Activity	Boat Mode	Number of Person Days	Number of Person-Days On:		
			Artificial Reefs	Natural Reefs	No Reefs
Snorkeling	Charter/Party	233,553	52,880	176,267	4,407
	Rental	0	0	0	0
	Private	125,239	34,789	90,450	0
Scuba Diving	Charter/Party	2,613,090	1,370,373	1,233,489	9,228
	Rental	176,011	88,006	88,006	0
	Private	240,323	128,745	111,579	0
Fishing – Offshore / Trolling	Charter	338,483	48,895	52,970	236,619
	Party	2,034,284	293,859	318,347	1,422,078
	Rental	0	0	0	0
	Private	1,133,919	471,151	637,970	24,797
Fishing – Flats or Back Country	Charter/Party	0	0	0	0
	Rental	0	0	0	0
	Private	88,006	29,335	44,298	0
Fishing Bottom	Charter	6,770	978	1,059	4,732
	Party	169,242	24,447	68,826	118,309
	Rental	0	0	0	0
	Private	301,250	134,976	166,274	0
Viewing Nature and Wildlife	Glass Bottom Boat	54,157	16,483	37,675	0
	Back Country Excursion	20,309	0	0	20,309
	Rental	10,154	0	0	10,154
	Private	74,466	0	0	74,466
Personal Watercraft (jet skis, wave runners, etc.)	Rental	13,539	0	0	13,539
	Private	176,011	0	0	176,011
Sailing	Charter/Party	0	0	0	0
	Rental	0	0	0	0
	Private	44,003	0	0	44,003
Other Boating Activities	Charter/Party	60,927	0	0	60,927
	Rental	3,385	0	0	3,385
	Private	10,154	0	0	10,154
Total Person-Days		**7,927,276**	**2,694,915**	**3,027,210**	**2,233,120**

The average itemized per person expenditures by those who participated in each activity and boat mode in Broward County are provided in Table 4.2.2-1. Broward County reef-using visitors who went saltwater fishing on their own boat, a friend's boat or a rental boat spent, on average, $93 per person per day on the day that they went fishing. This amount is comprised of $18 for boat fuel, $12 for lodging, $14 for food and beverages at stores and $17 for food and beverages at restaurants and bars and $13 for shopping, among other items.

The average expenditure of persons who fished on charter boats was $202 per person per day. About $59 was the cost of the charter boat while $19 was spent on lodging, $18 was spent on food and beverages at stores, $46 was spent on food and beverages at restaurants and bars, $14 was spent on auto rental, and $40 was spent on shopping.

Persons who fished on party boats spent, on average, $169 per person on the day they went fishing which included $29 for the party boat fee, $22 for lodging, $12 for food and beverages at stores, $51 for food and beverages at restaurants and bars, $13 for auto rental and $30 for shopping.

Broward County reef-using visitors who went scuba diving or snorkeling on their own boat, a friend's boat or a rental boat spent, on average, $91 per person per day on the day they went diving. This amount is comprised of $18 for boat fuel, $11 for lodging, $15 for food and beverages at stores and $15 for food and beverages at restaurants and bars.

Visitors who went diving on charter or party boats spent, on average, $246 per person per day. This expenditure was comprised of $68 per day for the dive charter or party boat, $34 per day for lodging and $10 per day for food and beverages at stores, $37 per day for food and beverages in restaurants and bars and $73 for shopping, among other items.

The lodging expenditure item includes lodging costs for hotels, motels and campgrounds or if the respondent paid by the day or by the week for the other accommodations. The $33 per person per day for lodging may seem lower than the actual per person rate of a hotel or motel. Bear in mind that only a portion of visitors stay at a hotel or motel. Visitor accommodations also include campgrounds, family or friends, second homes and time shares. Also, as discussed previously, many visitors spend only one day in the county and therefore do not incur the cost of a room. The cost of the second home or time share is not included in the lodging cost because this is a monthly or up front cost that can, at best, only be partially due to the existence of the reefs.

Table 4.2.2-1 (Visitors)
Amount of Money Spent in County Per Person During Most Recent Day Participating in Each Reef-Related Activity and Boating Mode
Broward County
From Visitor Boater Survey Responses – 2000 Dollars

Item	Amount Spent Per Person-Day[a]				
	Fishing On:			Scuba Diving or Snorkeling On:	
	Own, Friend's or Rental Boat[b]	Charter Boat	Party Boat	Own, Friend's or Rental Boat	Charter or Party Boat
Charter / Party Boat Fee		$58.88	$29.29		$68.09
Boat Rental				$0.86	
Boat Fuel	$18.52			$18.13	
Air Refills				$1.00	$1.91
Tackle	$1.29				
Bait	$4.80				
Ice	$1.76			$1.31	$0.10
Ramp Fees	$0.20			$3.44	$0.05
Marina Fees	$0.98			$2.91	$0.00
Lodging	$11.64	$19.29	$22.30	$11.19	$33.97
Camping Fees	$0.16	$0.00	$0.00	$0.00	$0.78
Food and Beverages - Stores	$13.96	$17.57	$11.54	$14.66	$10.40
Food and Beverages - Restaurants/Bars	$17.11	$45.89	$50.65	$14.93	$36.54
Auto Gas	$6.07	$6.09	$10.93	$8.74	$5.56
Auto Rental	$3.16	$13.81	$12.57	$0.00	$12.78
Equipment Rental	$0.00	$0.00	$1.92	$0.00	$2.24
Shopping	$13.47	$40.11	$30.04	$13.53	$73.15
Total	$93.12	$201.65	$169.24	$90.70	$245.56
Number of Respondents	43	53	27	19	127
Number of Respondents and Party Members[c]	136	147	54	58	306

[a] *Expenditures per person per day were estimated from the responses to the Visitor Boater Survey. For each Activity-Mode, the expenditures for each item were summed over all the respondents who participated in the Activity-Mode. This sum was divided by the total number of respondents and party members who spent or benefited from the expenditures.*

[b] *Boat rental is included under Equipment Rental.*

[c] *The number of persons used to calculate the average expenditure per person for a specific item will be up to two percent lower than the number of respondents and party members due to the incidents of "don't knows" for a specific item. "Don't know" answers and the associated number of persons in the party were excluded from the calculation of expenditures per person for a specific expenditure item.*

The expenditures per person per day were multiplied by the number of person-days by boating mode and reef type to obtain an estimate of the total expenditures associated with reef related activities. The itemized total expenditures associated with reef use in Broward County in 2000-2001 are provided in Table 4.2.2-2. The expenditures associated with glass bottom boating days only included the fee per person per ride ($20). The other expenditures associated with the entire day spent in the county were not included for glass bottom boat riders because these visitors are likely in the county for other reasons either not reef-related or included in the other reef-related recreational activities.

Visitors who used the reefs in Broward County spent $1,024,000,000 ($1 billion) on reef-related expenditures. Of this amount $496 million was associated with artificial reef-related expenditures and $529 million was associated with natural reef-related expenditures.

The reef-related visitor expenditures were then used to estimate the economic contribution of artificial and natural reefs to each of the counties. As discussed in the Introduction of the Report, expenditures by visitors generate income and jobs within the industries that supply reef-related goods and services, such as charter / party boat operations, restaurants and hotels. These industries are called direct industries. In addition, these expenditures create multiplier effects wherein additional income and employment is created as the income earned by the reef-related industries is re-spent within the county. These additional effects of reef-related expenditures are called indirect and induced. Indirect effects are generated as the reef-related industries purchase goods and services from other industries in the county. Induced effects are created when the employees of the direct and indirect industries spend their money in the county.

Table 4.2.2-2 (Visitors)
Total Visitor Expenditures In Broward County Associated with Reef Use
All Reef-Related Activities and Boating Modes
June 2000 to May 2001 – In 2000 dollars

Item	Artificial Reef	Natural Reef	Total
Total Number of Person Days	2,694,915	3,027,210	5,722,125
Charter / Party Boat Fee	$109,166,167	$110,508,817	$219,674,984
Boat Rental	216,844	250,030	466,873
Boat Fuel	16,326,072	20,969,451	37,295,524
Air Refills	2,963,161	2,975,942	5,939,103
Tackle	817,690	1,091,875	1,909,565
Bait	3,051,152	4,074,253	7,125,405
Ice	1,593,185	2,017,408	3,610,593
Ramp Fees	1,060,145	1,235,500	2,295,644
Marina Fees	1,352,237	1,672,381	3,024,618
Lodging	66,625,405	70,694,385	137,319,791
Camping Fees	1,219,072	1,242,955	2,462,027
Food and Beverages - Stores	31,911,169	36,176,792	68,087,961
Food and Beverages - Restaurants/Bars	85,044,260	92,450,853	177,495,113
Auto Gas	17,753,895	20,087,351	37,841,245
Auto Rental	24,887,396	26,310,827	51,198,222
Equipment Rental	3,793,516	3,895,783	7,689,299
Shopping	127,637,167	132,276,824	259,913,991
Glass Bottom Boat Ride	329,653	753,493	1,083,146
Total	**$495,748,186**	**$528,684,919**	**$1,024,433,105**

The direct, indirect and induced increase in sales, total income, employment and indirect business taxes generated by the reef-related expenditures were estimated for Broward County using the IMPLAN Regional Input-Output Model. This model uses detailed data on the economies of this county to estimate economic multipliers and to model the impact of reef-related expenditures on the economy.

The economic contribution of the reefs to Broward County is provided in Table 4.2.2-3. The sales contribution is defined as the value of the additional output produced in the county due to the reef-related expenditures. The total income contribution is defined as the sum of employee compensation, proprietor's income, interest, rents, and profits generated as a result of the reef-related expenditures. Income is the money that stays in the county's economy. The employment contribution is the number of full-time and part-time jobs created due to the reef-related expenditures. The indirect business tax contribution is the sum of the additional excise taxes, property taxes, fees, licenses, and sales taxes collected due to the reef-related expenditures.

Table 4.2.2-3
Economic Contribution of Reef-Related Expenditures by Visitors to Broward County
Economic Area is Broward County
June 2000 to May 2001 – In Millions of 2000 dollars

Reef Type/Economic Contribution	Direct	Indirect	Induced	Total
Artificial Reefs				
Sales	$493.3	$136.67	$241.11	$871.08
Total Income	$264.67	$75.01	$149.75	$489.43
Employment (full and part-time jobs)	11,155	1,548	3,306	16,009
Indirect Business Taxes	$46.87	$7.87	$15.11	$69.85
Natural Reefs				
Sales	$526.11	$145.52	$257.48	$929.11
Total Income	$282.27	$79.75	$159.93	$521.95
Employment (full and part-time jobs)	11,814	1,645	3,530	16,989
Indirect Business Taxes	$50.15	$8.37	$16.13	$74.69
Natural and Artificial Reefs				
Sales	$1,019.41	$282.18	$498.59	$1,800.19
Total Income	$546.97	$154.76	$309.67	$1,011.37
Employment (full and part-time jobs)	22,969	3,193	6,837	32,999
Indirect Business Taxes	$97.02	$16.23	$31.24	$144.49

Reef-related expenditures by visitors to Broward County (direct sales in Table 4.2.2-3) during the period June 2000 to May 2001 resulted in $1.8 billion in sales to county businesses. These sales generated $1 billion in income and 33,000 jobs. About $144 million in indirect business taxes were collected as a result. About 48 percent of these values were the result of artificial reef-related expenditures and 52 percent of these values were the result of natural reef-related expenditures.

4.2.3 Use Value

Use value is the maximum amount of money that reef users are willing to pay to maintain the reefs in their existing condition and to add more artificial reefs to the system. Use value was discussed in the introduction to this report. In this study, four types of use values were estimated: (1) the value to natural reef users of maintaining the natural reefs in their existing condition; (2) the value to artificial reef users of maintaining the artificial reefs in their existing condition; (3) the value to all reef users of maintaining the artificial and natural reefs; and (4) the value of adding and maintaining additional artificial reefs. Use value is presented in terms of per person per day of reef use and in aggregate for all users of the reef system.

The visitor reef-user values associated with maintaining the reefs in their existing conditions for Broward County is provided in Table 4.2.3-1. Use value per person day means the value per person day of artificial, natural or all reef use, as specified in the table. The respondent was asked to state *yes, no* or *don't know* to a specified payment to maintain the artificial reefs, the natural reefs and a combined program that would protect both types of reefs. The scenario provided to the respondent was as follows.

> "Local and state government agencies are considering different approaches to maintaining the health and condition of the *natural* and *artificial* reefs in southeast Florida. One plan focuses on providing greater protection for *natural* reefs by maintaining water quality, limiting damage to natural reefs from anchoring, and preventing overuse of the natural reefs. A second plan focuses on protecting the *artificial* reefs by maintaining water quality, limiting damage to artificial reefs from anchoring and preventing overuse of the artificial reefs.
>
> Both of these plans will involve increased costs to local businesses that will ultimately be passed on to both residents and visitors in southeast Florida. We are doing this survey because local government agencies want to know whether you support one, both or none of these plans and if you would be willing to incur higher costs to pay for these plans. Please keep in mind that whether you support these plans or not would not have any effect on your ability to participate in any boating activity or other recreation in southeast Florida."

Then the respondent was asked a yes or no question regarding the natural reef plan, the artificial reef plan and both plans. For example, the question regarding both plans read: "Suppose that both of the above plans to maintain the natural and artificial reefs in southeast Florida were put together in a combined program. Consider once again your total trip cost for your last trip to use the reefs in southeast Florida including travel expenses, lodging, and all boating expenses. If your total costs for this trip would have been $_____ higher, would you be willing to pay this amount to maintain the artificial and natural reefs?"

The amounts (bid values) of $20, $100, $200, $1,000, and $2,000 were rotated from respondent to respondent. For the individual programs (just natural or artificial reef protection), the amounts were one-half of the above amounts: $10, $50, $100, $500 and $1,000.

Values for all reefs were taken from statistical analysis of responses to Question 38 of Visitor Boater Survey[5]: "Suppose that both of the above plans to maintain the natural and artificial reefs in southeast Florida were put together into a combined program...If your total costs for this trip would have been $___ higher, would you have been willing to pay this amount to maintain the artificial and natural reefs." Values for artificial reefs were taken from statistical analysis of responses to Question 36 pertaining only to a program to maintain the existing artificial reefs in their current condition. Values for natural reefs were taken from statistical analysis of responses to Question 34 pertaining only to a program to maintain the natural reefs in their current condition.

Chapter 2.2.2 provides a general description of the procedures used to analyze the data and to estimate the user values presented here. For a more technical discussion, please see the Technical Appendix to this report. The Technical Appendix is a separate document that

[5] *For a complete description of the contingent valuation questions, please refer to the Visitor Boater Survey and the Blue Card (which is a white page in this report but labeled "Blue Card") in Appendix B.*

describes the methods used to derive the values presented here and also provides alternative estimates using different estimation methods. In this final report, the estimates of total annual use value, use value per person-day, and the asset value of the reefs are those that were derived using the logit model.

The estimated use values by type of activity are presented in Table 4.2.3-2 and are consistent with the idea that natural reefs are preferred to artificial reefs although, for Broward County, the difference is not vary large. For Broward County visitors, the average per person-day value of the natural reefs was $21.04 versus $19.39 for artificial reefs. Total use is also higher for natural versus artificial reefs. Broward County visitors' natural reef use was over 3 million person-days versus about 2.7 million person-days for artificial reefs. This translated into an estimate of total annual use value of about $63.7 million for natural reefs and $52.3 million for artificial reefs. Capitalizing the annual use values, using a three percent interest rate, yields asset values of about $2.1 billion for the natural reefs and $1.7 billion for the artificial reefs. When both artificial and natural reef maintenance programs are considered, total use value is $114 million per year for an asset value of $3.8 billion.

Annual use value represents the annual flow of total use value (i.e., the recreational benefits) to the reef-using public. From a public policy point of view, government spends money on the protection and management of the valuable resources of the natural and artificial reefs. Investments include deploying new artificial reefs and enhancing natural reefs. In addition, government entities incur variable costs each year to support marine patrol, biologists, planners and even contracts with economists to help carry out the mission of protecting the existing reef system. These costs can be compared with the annual flow of total use value of the reef to determine if this is indeed a wise investment.

The question combining the natural and artificial reef programs yielded estimates of value lower than that derived by adding-up the values of the natural and artificial reef programs separately. However, for Broward County residents, this difference was not significant. This result is consistent with past research. Some respondents are not willing to pay the sum of the values of the individual programs to finance the combined programs. This is largely due to the income constraints as higher bid values are provided to the respondents under the combined programs. The value of the combined programs would provide a conservative or lower bound estimate of the total natural and artificial reef values.

The capitalized value of the reef user values is the present value of the annual values calculated at three percent discount rate. It represents the "stock" value analogous to land market values. The capitalized visitor reef user value for associated with Broward County reefs, both artificial and natural is $3.8 billion. Bear in mind that this value only includes the value that visitor reef users place on the reefs and does not include the values that resident reef users and non-reef-users place on the reefs or the economic contribution of the reefs. *The estimation of this value was not part of this study.*

Reef users' willingness to pay to invest in and maintain "new" artificial reefs is provided in Table 4.2.3-3. The use value per person-day is the value per day or a portion of a day of artificial reef use. In Broward County, reef users are willing to pay $15 million annually for this program. Scuba divers have the highest value associated with the new artificial reef program.

Table 4.2.3-1 (Visitors)
Annual Value of Reefs To Reef Users and Capitalized Value
Data Represents June 2000 to May 2001
Visitor Reef-Users in Broward County

Item	All Reefs - Artificial and Natural	Artificial Reefs	Natural Reefs
Number of Person-Days of Reef Use	5,722,126	2,694,916	3,027,210
Use Value Per Person-Day ($2000)	$19.92	$19.39	$21.04
Annual Use Value - ($2000)	$113,982,216	$52,259,828	$63,699,452
Capitalized Value @ 3 percent Discount Rate ($2000)	$3,799,407,200	$1,741,994,267	$2,123,315,067

Table 4.2.3-2 (Visitors)
Value of Reefs to Visitors to Broward County, by Reef Type and Activity, 2000-2001

Reef Type/Activity	Person-Days	Annual User Value ($)	User Value Per Person-Day ($)
Natural Reefs	**3,027,210**	**$63,699,452**	**$21.04**
Snorkeling	266,717	$2,475,446	$9.28
Scuba Diving	1,433,074	$31,359,551	$21.88
Fishing	1,289,745	$29,369,538	$22.77
Glass Bottom Boat	37,675	$494,917	$13.14
Artificial Reefs	**2,694,916**	**$52,259,828**	**$19.39**
Snorkeling	87,669	$791,396	$9.03
Scuba Diving	1,587,123	$23,469,635	$14.79
Fishing	1,003,641	$27,777,415	$27.68
Glass Bottom Boat	16,483	$221,382	$13.43
Natural & Artificial Reefs	**5,722,126**	**$113,982,216**	**$19.92**
Snorkeling	354,386	$2,900,266	$8.18
Scuba Diving	3,020,197	$59,584,003	$19.73
Fishing	2,293,386	$50,857,974	$22.18
Glass Bottom Boat	54,157	$639,973	$11.82
New Artificial Reefs	**2,694,916**	**$14,944,495**	**$5.55**
Snorkeling	87,669	$190,895	$2.18
Scuba Diving	1,587,123	$7,934,751	$5.00
Fishing	1,003,641	$6,764,935	$6.74
Glass Bottom Boat	16,483	$53,916	$3.27

Table 4.2.3-3 (Visitors)
Estimated Use Value of Investing in and Maintaining
"New" Artificial Reefs in the County
Visitor Reef-Users in Broward County

Item	Value
Number of Person-Days of Artificial Reef Use	2,694,915
Use Value Per Person-Day for "New" Artificial Reefs ($2000)	$5.55
Annual Use Values for "New" Artificial Reefs	$14,944,495
Capitalized Value @ 3 percent Discount Rate ($2000)	$498,149,833
Note: Use value per person-day is use value per whole day or portion of a day of artificial reef use.	

4.2.4 Demographic Information

The Visitor Boater Survey asked the respondent questions regarding his/her socioeconomic characteristics so that a picture of the typical reef user could be developed. The results for Broward County are summarized in Table 4.2.4-1.

Table 4.2.4-1 (Visitors)
Demographic Characteristics of Visitor Reef-Users in Broward County, 2000

Characteristic	Broward County
Median Age of Respondent – Years	39
Sex of Respondent	
Male	77%
Female	23%
Race of Respondent	
White	89%
Black	7%
Other	4%
Percent Hispanic / Latino	13%
Median Household Income	$87,500
Average Years Boating in Southeast Florida	6.7
Average Length of Own Boat Used in Saltwater Boating in Feet	27
Percent of Respondents Who Belong to Fishing and/or Diving Clubs	12%

4.3 Total – Residents and Visitors

This section summarizes the user activities, economic contribution and use values associated with the artificial and natural reefs for both residents and visitors of Broward County. Demographic information of both resident and visitor reef users is also provided.

4.3.1 User Activity

The numbers of person-days spent using the reefs in Broward County by reef type and population (residents and visitors) are summarized in Table 4.3.1-1. Visitors and residents spent about 9.4 million person-days using artificial and natural reefs in Broward County during the 12 month period from June 2000 to May 2001. Residents spent 3.7 million person-days and visitors spent 5.7 million person-days. Reef users spent 3.9 million person-days using artificial reefs and 5.5 million person-days using natural reefs. A summary of reef use by type of activity is provided in Table 4.3.1-2.

Table 4.3.1-1
Number of Person-Days Spent on Artificial and Natural Reefs in Broward County
Residents and Visitors – in millions

Population	Artificial Reefs	Natural Reefs	All Reefs
Residents	1.28	2.44	3.72
Visitors	2.70	3.02	5.72
Total	3.98	5.46	9.44

Table 4.3.1-2
Number of Person-Days Spent Using Reefs in Broward County by Recreational Activity
Residents and Visitors – in millions

Activity	Residents	Visitors	Total
Snorkeling	0.73	0.35	1.09
Scuba Diving	0.83	3.02	3.85
Fishing	2.15	2.29	4.45
Glass Bottom Boats	-	0.05	0.05
Total	3.71	5.71	9.44
Note: Residents were not asked about their participation in glass bottom boat sightseeing.			

The popularity of reef-related diving is about equal to the popularity of reef-related fishing. Fishing comprised 4.4 million person-days while scuba diving and snorkeling comprised 3.3 million person-days and 1.1 person-days, respectively. Visitor reef-related recreation comprises 65 percent of total reef-related recreation by residents and visitors in Broward County. Visitors spent significantly more days scuba diving than did residents.

4.3.2 Economic Contribution

The total economic contribution of the reefs to Broward County includes the contribution of reef expenditures to sales, income and employment. Expenditures by visitors generate income and jobs within the industries that supply reef-related goods and services, such as charter / party boat operations, restaurants and hotels. These industries are called direct industries. In addition, these visitor expenditures create multiplier effects wherein additional income and employment is created as the income earned by the reef-related industries is re-spent within the county. These additional effects of reef-related expenditures are called indirect and induced. Indirect effects are generated as the reef-related industries purchase goods and services from other industries in the county. Induced effects are created when the employees of the direct and indirect industries spend their money in the county.

For visitors, the direct, indirect and induced economic contribution of the reefs was estimated using the estimated reef-related expenditures and economic input-output models.

For residents, the expenditures were converted to sales, income and employment generated within the directly affected industries. The multiplier effect of reef-related spending by residents in the county was not estimated because this spending is also the result of multiplier effects from other economic activities within the county. The multiplier effect of resident spending on reef-related activities is attributed both to the reef system and to these other economic activities that generated the resident income used to purchase the reef-related goods and services. Thus, the economic importance of the reefs would be overstated if the multiplier effects were considered. To provide a conservative estimate of the economic contribution of resident use of the reef system, the multiplier effects were not included.

The economic contributions of the artificial, natural and all reefs to Broward County are provided in Tables 4.3.2-1 through 4.3.2-3. The sales contribution is defined as the value of the additional output produced in the county due to the reef-related expenditures. The total income contribution is defined as the sum of employee compensation, proprietor's income, interest, rents, and profits generated as a result of the reef-related expenditures. The employment contribution is the number of full-time and part-time jobs created due to the reef-related expenditures.

As presented in Table 4.3.2-3, reef-related expenditures in Broward County generated $2.1 billion in sales during the 12-month period from June 2000 to May 2001. These sales resulted in $1.1 billion in income to Broward County residents and provided 35,500 jobs in Broward County. Artificial reef-related expenditures accounted for 48 percent of the economic contribution of all reefs and natural reef-related expenditures accounted for 52 percent of the economic contribution.

Table 4.3.2-1
Economic Contribution of Artificial Reef-Related Expenditures to Broward County
June 2000 to May 2001 – In Millions of 2000 dollars

Round of Spending	Contribution to:		
	Sales	Income[b]	Employment[c]
Direct[a]			
Resident	$90.90	$12.50	812
Visitor	$493.30	$264.67	11,155
Total	$584.20	$277.17	11,967
Indirect	$136.67	$75.01	1,548
Induced	$241.11	$149.75	3,306
Total	$961.98	$501.93	16,821

[a] *The direct contribution is the actual expenditures made in the county.*
[b] *Total income includes employee compensation, proprietor's income, interest, rents and profits*
[c] *Employment includes the number of full-time and part-time jobs.*

Table 4.3.2-2
Economic Contribution of Natural Reef-Related Expenditures to Broward County
June 2000 to May 2001 – In Millions of 2000 dollars

Round of Spending	Contribution to:		
	Sales	Income[b]	Employment[c]
Direct[a]			
Resident	$178.90	$25.20	1,662
Visitor	$526.11	$282.26	11,814
Total	$705.01	$307.46	13,476
Indirect	$145.51	$79.75	1,645
Induced	$257.48	$159.93	3,530
Total	$1,108.00	$547.11	18,651

[a] *The direct contribution is the actual expenditures made in the county.*
[b] *Total income includes employee compensation, proprietor's income, interest, rents and profits*
[c] *Employment includes the number of full-time and part-time jobs.*

Table 4.3.2-3
Economic Contribution of All Reef-Related Expenditures to Broward County
June 2000 to May 2001 – In Millions of 2000 dollars

Round of Spending	Contribution to:		
	Sales	Income[b]	Employment[c]
Direct[a]			
Resident	$269.80	$37.70	2,474
Visitor	$1,019.41	$546.97	22,969
Total	$1,289.21	$584.67	25,443
Indirect	$282.18	$154.76	3,193
Induced	$498.59	$309.67	6,837
Total	$2,069.98	$1,049.43	35,473

[a] *The direct contribution is the actual expenditures made in the county.*
[b] *Total income includes employee compensation, proprietor's income, interest, rents and profits*
[c] *Employment includes the number of full-time and part-time jobs.*

4.3.3 Use Value

In this study, four types of use values were estimated: (1) the value to natural reef users of maintaining the natural reefs in their existing condition; (2) the value to artificial reef users of maintaining the artificial reefs in their existing condition; (3) the value to all reef users of maintaining both the artificial and natural reefs and (4) the value of adding and maintaining additional artificial reefs. In general, use value is the maximum amount of money that reef users are willing to pay to maintain the reefs in their existing condition and to add more artificial reefs to the system. Use value is presented in terms of per person per day of reef use and in aggregate for all users of the reef system.

The annual value Broward County visitors and residents place on protecting the reefs in their existing condition and the associated capitalized value is presented in Table 4.3.3-1. The annual value visitor and resident reef-users place on investing in and maintaining "new" artificial reefs is presented in Table 4.3.3-2. These values were explained in Sections 4.1.3 and 4.2.3.

Table 4.3.3-1
Annual Use Value Associated with Protecting Reefs in their Existing Condition and Capitalized Value Associated With Reef Use
Data Represents June 2000 to May 2001
Broward County, Florida

Item	Residents	Visitors	Total
All Reefs - Artificial and Natural			
Number of Person-Days of Reef Use (millions)	3.72	5.72	**9.44**
Use Value Per Person-Day	$3.24	$19.92	**$13.35**
Annual Use Value - (million dollars)	$12.04	$113.98	**$126.02**
Capitalized Value @ 3 percent Discount Rate (billion dollars)	$0.40	$3.80	**$4.20**
Artificial Reefs			
Number of Person-Days of Reef Use (millions)	1.28	2.69	**3.97**
Use Value Per Person-Day	$2.81	$19.39	**$14.07**
Annual Use Value - (million dollars)	$3.60	$52.26	**$55.86**
Capitalized Value @ 3 percent Discount Rate (billion dollars)	$0.12	$1.74	**$1.86**
Natural Reefs			
Number of Person-Days of Reef Use (millions)	2.44	3.03	**5.47**
Use Value Per Person-Day	$8.17	$21.04	**$15.16**
Annual Use Value - (million dollars)	$19.91	$63.70	**$82.61**
Capitalized Value @ 3 percent Discount Rate (billion dollars)	$0.66	$2.12	**$2.78**

Table 4.3.3-2
Estimated Value to Reef Users From Investing in and Maintaining "New" Artificial Reefs
Broward County, Florida

Item	Residents	Visitors	Total
Number of Person-Days of Artificial Reef Use (millions)	1.28	2.69	**3.97**
Use Value Per Person-Day for "New" Artificial Reefs	$0.60	$5.55	**$3.95**
Annual Use Values for "New" Artificial Reefs (million dollars)	$0.76	$14.94	**$15.70**
Capitalized Value @ 3 percent Discount Rate ($2000)	$25.40	$498.15	**$523.55**

4.3.4 Demographic Information

This section summarizes and compares the demographic characteristics of visitor and resident reef users. These characteristics were obtained from the resident boater survey and the visitor boater survey. They are summarized in Tables 4.3.4-1. A comparison of the demographics indicate that resident and visitors are very similar in terms of age, race, income, and membership in fishing and/or diving clubs.

Table 4.3.4-1
Demographic Characteristics of Resident and Visitor Reef-Users in Broward County, 2000

	Resident Reef-Users			Visitor Reef-Users		
Median Age of Respondent	48			39		
Sex Of Respondent	**Percent**			**Percent**		
Male	92%			77%		
Female	8%			23%		
	% of Resident Reef-Users			**% of Visitor Reef-Users**		
	White	**Black**	**Other**	**White**	**Black**	**Other**
Race Of Respondent	93%	2%	5%	89%	7%	4%
	% of Resident Reef-Users			**% of Visitor Reef-Users**		
Percent Hispanic/Latino	5%			13%		
	Resident Reef-Users			**Visitor Reef-Users**		
Median Household Income	$72,310			$87,500		
	Residents			**Visitors**		
Average Years Boating in South Florida	22			6.7		
	Residents			**Visitors**		
Average Length of Boat Used for Salt Water Activities in Feet	25			27		
	Residents			**Visitors**		
% of Respondents Who Belong to Fishing and/or Diving Clubs	19%			12%		