

Chapter 6: Socioeconomic Values of Reefs in Monroe County

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

- Volume of user activity on both artificial and natural reefs off Monroe 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 Monroe County; and,
- Demographic and boater profile of reef users in Monroe County.

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

6.1 Residents

The focus of this section is on the socioeconomic values of the reefs off the Coast of Monroe County (The Florida Keys) to resident boaters. Resident boaters are those individuals who live within Monroe County and 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 are registered with the Florida Department of Highway Safety and Motor Vehicles.

6.1.1 User Activity

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

To measure party-days for any recreational resource, it is important to define the universe that 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 or Gulf of Mexico off the coast of Monroe County, Florida. For most residents, their own boats are used to facilitate this recreational process. The use of party boats or charter rentals by residents was not considered during this study.

In 1999-2000, there were 26,564 registered pleasure boats in Monroe County according to the Florida Department of Highway Safety and Motor Vehicles (2001). These pleasure craft were divided into the following size classes:

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Boat Size Category (Length of Boat in Feet)	Number of Boats	Percentage of Total	Cumulative Percentage
Less than 12 feet	3,715	14%	14%
12 feet to 15'11"	3,552	13%	27%
16 feet to 25'11"	15,027	57%	84%
26 feet to 39'11"	3,644	13%	97%
40 feet to 64'11"	598	2%	99%
65 feet to 109'11"	28	1%	100%
Greater than 110 feet	0	0%	100%
Total	26,564	100%	

The largest boat size category of pleasure craft in Monroe County is between 16 and nearly 26 feet in length (57 percent).

Three adjustments were made to reach the target population of boats registered in Monroe County whose owners may visit the reef system. First, sampling was restricted to pleasure craft over 16 feet in length. This was in response to expert opinion that very few pleasure craft less than 16 feet could reach the reef system. Thus, the mail survey was targeted at pleasure craft over 16 feet long so that nonusers 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 Monroe County to 19,296 pleasure craft.

Additionally, 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 only 75.4 percent of these larger vessels used the Monroe County reef system in the last 12 months or 14,550 pleasure craft. Finally, it was determined that about one-half of one percent of the owners of registered boats in the target population had a residence somewhere outside Monroe County. Thus, the target population was again reduced to 14,477 pleasure craft to reflect only resident boat owners.

On average, respondents indicated that over a 12-month period (1999-2000) they used the reef system on 70 separate days while engaging in three main recreational activities: 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, Monroe County residents spent 1,013,355 “party-days” on the reef system (70 party days times 14,477 pleasure craft).

In conducting the mail survey, resident reef-users from Monroe County were asked to distribute their 70 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

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natural reefs. Table 6.1.1-1 presents the distribution of party-days for resident boaters in Monroe County.

Monroe County residents spent an estimated 52 percent of their party-days fishing on the artificial and natural reefs followed by snorkeling (28 percent) and scuba diving (20 percent). For all the recreational activities on reefs, there was an obvious preference for natural reefs with 66 percent of the party-days spent visiting natural reefs. The strongest intensity of natural reef use was for snorkeling where 75 percent of the respondents used the natural reef for this activity.

User activity, measured in "person-days" is presented in the right hand side of Table 6.1.1-1. A "person-day" is equivalent to an individual using the reef system for part or all of one day. The number of person-days was calculated by multiplying by 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. The average party size was reduced by subtracting the individuals who were considered as visitors (i.e., non-residents of Monroe County). About 32 percent of the average party was identified as nonresidents.

Thus, Table 6.1.1-1 utilizes the average resident party size to calculate resident person-days. The average residential party size does not vary appreciably among the various reef-related recreational activities and averages about 3.33 residents per party. Because of this, the distribution of person-days per activity is similar to the distribution of party-days discussed above. For example, saltwater fishing on reefs garnered 1.74 million person-days or 52 percent of all person-days during the 12-month period (December 1999 to November 2000). The total number of person-days residents used the reef system off Monroe County over a 12-month period was estimated at 3.38 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 is discussed below.

Table 6.1.1-1 (Residents)
Estimated Resident User Activity as Measured by Party-Days and Person-Days on
Artificial and Natural Reefs off Monroe 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 ² by Activity by Reef Type	Percentage of Person-Days Per Activity by Reef Type	Percentage of Total Person-Days Per Activity
Fishing			52%	3.31			52%
Artificial	158,083	30%			523,256	30%	
Natural	368,861	70%			1,220,931	70%	
Subtotal	526,944	100%			1,744,187	100%	
Snorkeling			28%	3.89			33%
Artificial	70,935	25%			275,937	25%	
Natural	212,805	75%			827,810	75%	
Subtotal	283,740	100%			1,103,747	100%	
Scuba Diving			20%	2.62			16%
Artificial	115,523	57%			302,669	57%	
Natural	87,149	43%			228,329	43%	
Subtotal	202,672	100%			530,998	100%	
All Activities							
Artificial	344,541	34%			1,101,862	33%	
Natural	668,815	66%			2,277,070	67%	
Total	1,013,356	100%		3.33	3,378,932	100%	

¹ Resident person-days were calculated by multiplying the number of party-days by the average resident party size.

6.1.2 Economic Contribution

To fully understand the economic contribution of reefs to Monroe County it is first important to recognize what factors influence the demand for boating in this area. This will help to understand 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, it is expected that there would be 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 chapter considers the demand for boating in Monroe County, not the infrastructure available. This information will provide the reader with an overview of Monroe County and valuable information necessary to assess the adequacy of the boating infrastructure. The overview includes the size and nature of the county's population, per capita income, industrial structure, and the infrastructure related to saltwater boating. This will provide a background by which to assess the results of this study.

Monroe County is on the southeast coast of Florida bordering both the Atlantic Ocean and the Gulf of Mexico. Key West is the principal city in this county. In 1999, the county ranked 34th in the state in terms of population, with 79,941 residents¹. Over the last ten years, population in this county has grown by 23.5 percent making it the 45th fastest growing county in Florida (out of 67 counties). Monroe County has 87 persons per square mile as compared to 284 for Florida as a whole, making it the 39th most densely populated county in the State. This county's population has a median age of 41 years, which is comparable to the general population of Florida, which has a median age of 39 years.

The University of Florida, Bureau of Economic and Business Research projects the county's population to reach 102,100 by 2015 or a 28 percent increase. In-migration to Monroe County, will account for about 80 percent of this growth. Thus, this county's population growth will depend heavily on individuals moving into the county, and more specifically into the Florida Keys.

In 1998, Monroe County had a per capita income of \$32,501 placing it seventh among the 67 counties in the State of Florida. This per capita income was 21 percent above the state average of \$26,845. Monroe County residents received nearly \$13,000 per capita in dividends, interest and rents. Thus, the holding of capital assets such as stocks, bonds and property largely accounts for the relative affluence of the residents. However, average earnings of those employed in

¹ U.S. Department of Commerce, Bureau of the Census, July 1, 1999.

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Monroe County fall short of the average wage for the State by almost 16 percent. Monroe County appears to have a bimodal population where wealthy individuals live off accumulated capital assets while the other segments of the population are employed in industries paying wages below the state average. The net effect of these factors is a high per capita income above the state average. This could generate a large demand for reef-related recreational boating.

In 1998, there were 41,190 persons employed in Monroe County generating \$1.029 billion in wage and salaries. Over the last ten years, employment grew by 12.2 percent, which corresponds to the growth rate of the population as discussed above. Measured by employee earnings, the largest industries in 1998 were services (34 percent), retail trade (17.8 percent), and state and local government (13.9 percent). Of particular note, this county provides a significant amount of tourist-related services such as lodging, amusement and recreation. About 6,800 workers were involved in these industries in Monroe County in 1998. Tourism provides part of the economic base for this county.

In 2000, there were 26,638 recreational boats (FDHSMV, 2001) registered in Monroe County or 1 boat for every 4 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 Monroe County include the following (FDEP, 2000)(Pybas, 1997):

1. Boat Ramps: 143 with a total of 181 boating lanes;
2. Marinas: 144 with 4,873 wet slips and moorings;
3. Other Facilities: 4,452-boat dry storage;
4. Artificial Reefs: 48 artificial reefs ranging from 2.3 to 19.5 nautical miles from shore.

The relatively high per capita income in Monroe County coupled with the vast water resources makes the demand for recreational boating the highest in the State of Florida as measured by the ratio of registered boats to people. However, the high population density, probably as in many of the southeastern Florida counties, may contribute to crowding and congestion, which impinges on the carrying capacity of both man-made facilities (e.g., artificial reefs; boat ramps) and natural resources. This increases the cost of recreational boating and reduces the demand for pleasure boats. This “working hypothesis” of a supply side problem could be one of several factors that may affect the demand for registered boats in Monroe County.

Using a mail survey, 3,500 registered boaters in Monroe 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 790 registered boaters responded to the mail survey and 75.4 percent (596) indicated that they used their pleasure crafts to visit the reefs offshore of Monroe County during a 12-month period (1999-2000).

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To estimate the economic contribution to Monroe County of resident spending associated with reef use, the respondents were asked to estimate party spending during their last 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 according to the categories of recreational activity as follows.

Average Resident Spending Per Party for Monroe 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	\$249.74	68%	\$169.82
Snorkeling	\$181.86	64%	\$116.39
Scuba Diving	\$171.23	72%	\$123.29

Recreational fishing on reefs was most expensive (\$250 per party per day) and scuba diving was the least expensive (\$171 per party 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 are discussed below.

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 28 to 36 percent of the typical party included individuals who were apparently guests of the Monroe County residents. A simplifying assumption was made that these visitors would pay their fair share of the trip cost. For example, visitors would pay a proportion of the trip costs such as the costs of boat fuel, restaurants and bait. In reality, residents might pay less than their proportionate share. However, it shall be assumed that an equal sharing of cost between residents and their visitors existed to obtain a conservative estimate of resident spending.

To derive the economic impact of a particular reef-related recreational activity, one must briefly return to Table 6.1.1-1. 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 Monroe County. For example, recreational fishing generated 526,945 resident party-days were spent recreational fishing on the reefs of Monroe County. According to resident spending per party discussed above, fishers spent \$169.82 per trip. Thus, annual expenditures for reef-related fishing was estimated to be \$89.5 million dollars (\$169.82 times 526,945).

Based upon the distribution of party-days per reef type, recreational fishers spent about \$26.8 million while using artificial reefs and the balance or \$62.6 million was spent in conjunction with use of natural reefs by. There did not appear to be much difference between per party spending by fishers who used either type of reef. This held for the other two recreational activities as well.

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Table 6.1.2-1 presents the economic contribution of all reef-related recreation off the Monroe County coast. Residents spent an estimated \$147.5 million during a 12-month period (December 1999 through November 2000). About two-thirds of this was spent while using natural reefs (\$98 million) while the balance (\$49 million) was spent in conjunction with use of the artificial reef system. About 61 percent of total spending or \$90 million was due to reef-related recreational fishing while \$33 million (22 percent) was due to reef-related snorkeling and \$25 million (17 percent) was due to reef-related scuba diving.

It is important to clarify the economic contribution of resident boaters in Monroe County. The engine of economic growth for any region is found in its export industries such as tourism in Monroe 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 Monroe 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 groceries to mortgages or rents. Thus, the spending by residents in conjunction with reef use represents the choice of recreating locally as opposed to leaving the area to recreate elsewhere.

**Table 6.1.2-1 (Residents)
Reef-Related Expenditures, Wages and Employment Generated by
Resident Boating Activities in Monroe County, Florida, 2000**

Type of Activity/ Type of Reef	Expenditures (Million \$)	Wages (Million \$)	Employment (Number of Full and Part-Time Jobs)
Artificial Reef			
Fishing	\$26.85	\$3.40	232
Snorkeling	\$8.26	\$1.12	79
Scuba Diving	\$14.24	\$1.90	139
Subtotal	\$49.35	\$6.42	449
Percentage Attributed to Artificial Reefs	33%	34%	34%
Natural Reef			
Fishing	\$62.64	\$7.94	540
Snorkeling	\$24.77	\$3.35	237
Scuba Diving	\$10.74	\$1.44	105
Subtotal	\$98.15	\$12.73	882
Percentage Attributable to Natural Reefs	67%	66%	66%
Total All Reefs			
Fishing	\$89.49	\$11.34	772
Snorkeling	\$33.02	\$4.47	316
Scuba Diving	\$24.99	\$3.34	243
Total All Reefs/All Activities	\$147.50	\$19.15	1,331

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The reef system keeps the “locals” in the county and enlarges the economy by \$147.5 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 will be the regional multiplier because there would be less “leakage” through the purchase of imports or residents leaving the area for recreational pursuits in places such as Fort Lauderdale 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 reef system has the potential to keep more business in Monroe County. For ardent reef-users, the absence of reefs off the Monroe County coast would certainly divert these residents elsewhere for recreation to the economic detriment of Monroe 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 resident reef use, reef-users were asked to break their expenditures into 12 categories such as boat fuel, ice, tackle, and marina fees. For each of the twelve categories, resident expenditures were matched to total sales as published in the 1997 U.S. Census of Business (1997). For example, spending on boat fuel was matched up with sales at gasoline stations in Monroe County. It was found that each gasoline station employee “sells” \$227,300 per year out of which they are paid about \$15,939 or about 7 percent. The annual salary may seem low, but this figure is for full and part time employees with a relatively low skill level. Thus, every \$227,300 in gasoline purchased for reef-related recreation by local users, generates one job paying about \$15,939 per year.

This rather simple procedure was followed for each of the 12 expenditure categories, which 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., need cooks and servers) while gasoline stations are highly automated and need fewer employees per \$100,000 in sales.

Table 6.1.2-1 shows the estimated wages and employment generated by resident spending on reef-related recreational activities in Monroe County. The \$147.5 million in annual spending generated about \$19.2 million dollars in annual wages supporting 1,331 employees or \$14,388 per employee. As discussed above, this annual wage reflects part and full-time employees in low wage service and retail industries where boaters using the reef system would concentrate their spending.

It is also important to identify the industries that benefit from reef-related resident spending. Table 6.1.2-2 shows the 12 spending categories of resident boaters. One would expect that expenditures would be concentrated on running and storing a boat and the results support this expectation. Expenditures for boat oil and gas constituted 28 percent of all spending followed by food and beverages from restaurants (12 percent) and stores (11 percent) and spending on marina slip rentals and dockage fees (8 percent). In terms of dollar figures, resident reef-users spent about \$12 million annually on goods and services provided by the marina industry. According to the U.S. Census of Business (1997), the marina industry in Monroe County grossed about \$35 million in sales. Thus, resident reef-users may account for as much as 50 percent of these sales.

Table 6.1.2-2 (Residents)
Detailed Expenditure Pattern Supporting Employment and Wages by
All Resident Reef-Users in Monroe 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	\$40.4	27%	178	14%	\$2.83	15%
2. Marina slip rentals and dockage fees	\$12.0	8%	98	7%	\$2.03	11%
3. Food and beverages from restaurants/bars	\$19.2	13%	457	35%	\$5.18	27%
4. Food and beverages from stores	\$17.0	12%	108	8%	\$1.60	8%
5. Tackle	\$11.8	8%	99	8%	\$1.80	9%
6. Bait	\$8.9	6%	74	6%	\$1.35	7%
7. Gas for auto	\$5.4	4%	24	2%	\$0.38	2%
8. ICE	\$6.1	4%	27	2%	\$0.43	2%
9. Equipment rentals	\$4.9	3%	90	7%	\$1.13	6%
10. Boat ramp and parking fees	\$2.3	2%	19	1%	\$0.39	2%
11. Sundries (e.g. Sun screen, sea sickness pills, etc.)	\$4.9	3%	39	3%	\$0.50	3%
12. All other	\$14.7	10%	119	8%	\$1.52	8%
Total	\$147.5	100%	1,331	100%	\$19.15	100%

Source: Florida State University

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Resident non-reef users and visitors who keep their boats in local marinas would also generate sales to the marina industry. The role of visitors is discussed in the next section.

In terms of employment, reef-related resident spending created proportionately more employment in marinas and restaurants since, as discussed above, these industries are relatively labor intensive. Although ranked number one as a component of spending, gasoline stations are a capital-intensive industry. That is, spending on boat oil and gas accounted for one-fourth of all spending, but only one in eight 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 6.1.2-2.

6.1.3 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 Monroe 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). The 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 a specific type of 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 respondents were 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, natural or both artificial and natural) in their existing condition.”

² See Clawson and Knetch (1966).

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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 in three forms to each respondent: (1) natural reefs separately; (2) artificial reefs separately and (3) a combination of natural and artificial reefs. For the combined program, the rotated cost increase was doubled. Because the primary spending unit is the “party”, the willingness to pay response was interpreted as an increase in trip cost to the entire party.

To estimate use values per party per trip (a day and a trip are equal for residents), the data for all counties were pooled. A Logit model was used to estimate use values per party per trip. The Logit model tested for differences in willingness-to-pay by county, activity, household income, age of respondent, years of boating experience in South Florida, race/ethnicity, sex, length of boat owned, and whether 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 in willingness-to-pay found were for reef users 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 use values per party per trip among counties. Because party sizes were not significantly different among the counties, the estimated use values per person-trip were also the same across counties for each of the reef valuation programs. The estimated use values per party per trip (day) 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, the number of party-days was multiplied by the estimated values per party per day. The use value per person-day was then estimated 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 Monroe County residents, the average use value per person-day of the natural reef use was \$13.25 versus \$3.18 for artificial reefs. Total use is also higher for natural versus artificial reefs. Monroe County residents’ natural reef use was 2.277 million person-days versus about 1.102 million person-days for artificial reefs. This translated into an estimate of total annual use value of about \$21.77 million for natural reefs and \$3.9 million for artificial reefs. Capitalizing the annual use values, using a three percent discount rate, yields asset values of about \$725.7 million for the natural reefs and about \$129.9 million for the artificial reefs. These results are summarized in Table 6.1.3-1.

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Table 6.1.3-1 (Residents)
Estimated Use Value of Artificial and Natural Reefs off the Coast of
Monroe 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	2.077	\$21.77	\$9.56	\$725.7
Snorkeling	0.828	\$6.93	\$8.37	\$230.9
Scuba Diving	0.228	\$2.84	\$12.42	\$94.6
Fishing	1.221	\$12.00	\$9.83	\$400.2
Artificial Reefs	1.102	\$3.90	\$3.54	\$129.9
Snorkeling	0.276	\$0.80	\$2.91	\$26.7
Scuba Diving	0.303	\$1.31	\$4.32	\$43.6
Fishing	0.523	\$1.79	\$3.42	\$59.6
Natural & Artificial Reefs	3.379	\$13.11	\$3.88	\$437.1
Snorkeling	1.104	\$3.67	\$3.33	\$122.4
Scuba Diving	0.531	\$2.62	\$4.94	\$87.4
Fishing	1.744	\$6.82	\$3.91	\$227.3
New Artificial Reefs	1.102	\$0.47	\$0.42	\$15.6
Snorkeling	0.276	\$0.14	\$0.51	\$4.7
Scuba Diving	0.303	\$0.23	\$0.75	\$7.6
Fishing	0.523	\$0.10	\$0.19	\$3.3

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 to deploy new artificial reefs and enhance 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 would provide a conservative or lower bound estimate of the total natural and artificial reef values.

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One can see the usefulness of measuring the economic benefits of natural reef systems to policy makers 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, the capitalized value of the natural reefs off the Monroe County coast was estimated at \$725.7 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 natural reef system would need to be included. This analysis provides an estimate of the capitalized value of the natural reef system, which is an asset to the residents of Monroe County. 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 such as an oil or hazardous waste spill. If the polluter destroyed for the foreseeable future 20 percent of the natural reef system off the Monroe County coastline, then the government could ask for up to \$145.14 million (i.e., 0.20 times \$725.7 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. The values provided here are quite real and useful especially in the case of environmental damage assessment.

As discussed above, the use value per person-day of artificial reef use is lower than the use value per person-day of natural reef use, as one would expect. However, preservation of the existing artificial reef system off the Monroe County coastline provides an annual use value of about \$3.9 million. Again, this is for the maintenance of these reefs. The capitalized value of the artificial reef system off the Monroe County coastline is estimated as \$129.9 million. If users were obstructed from getting to Monroe 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 some statistically significant differences in willingness-to-pay. Artificial reef users in Palm Beach and Broward counties had higher willingness-to-pay than those from Miami-Dade and Monroe counties. Snorkelers and scuba divers on artificial reefs had higher values than those who participated in fishing activities on artificial reefs. 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 \$1.97 for snorkelers and scuba divers using artificial reefs in Monroe County to a low of \$0.63 for those who participated in fishing activities on artificial reefs in Monroe County.

As with the other three programs, the estimated values per party per day 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

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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 \$0.17 for those fishing to a high of \$0.66 for those who participated in scuba diving off Monroe County. Across all activities, the average was 43 cents per person-day.

In terms of total annual use value, scuba divers have the highest value for new artificial reefs. Even though there were more fishing person-days than scuba diving person-days, the value per person-day was much higher for scuba diving than for fishing. Across all activities, the total annual user value of new artificial reefs is about \$467 thousand with an asset value of \$15.6 million.

The relatively low marginal willingness to pay of \$0.42 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 the Monroe County coastline. 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.

6.1.4 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 study of artificial reefs in northwest Florida (Bell, et al., 1999) 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, “no take” zones in the Florida Keys and other counties in southeast Florida are examined. “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.

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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 created a decline of 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 for their opinion of using “no-take” zones as a management tool for artificial and natural reefs in southeast Florida.

In each of our four counties, reef-users were asked questions regarding “no-take” zones. The results for Monroe County are summarized in Table 6.1.4-1. In 1997, the Florida Keys National Marine Sanctuary created 23 areas or zones (13.37 square miles) in which the taking of anything including fish and shellfish is prohibited. It is reasonable to believe that residents of Monroe County may have formed an opinion about this management effort and indeed, about 78 percent of the Monroe County respondents supported this experimental management effort. Because Monroe County (Florida Keys) already has a system of “no take” zones in effect, respondents were asked if they would support additional “no take” zones in their county. About 57 percent of the respondents were willing to support additional “no take” zones in Monroe County. Only 44 percent of respondents were willing to extend this concept northward through Miami-Dade, Broward and Palm Beach counties – 17 percent of the respondents did not know.

Finally, respondents were asked for their opinion regarding the percent of the reef system that should be included in “no take” zones. Targeting only natural reefs, respondents indicated, on average, they would be willing to extend this management tool to almost 32 percent of the natural reefs off the Monroe County coast. Since the average may be skewed by exceptionally large answers, the median percent of natural reefs respondents felt might be managed by the use of “no-take” zones was also reviewed. The median, or the midpoint between the highest and lowest answer, was 20 percent.

Given the short experience of the Keys “no-take” zones, it was remarkable that present reef-users would be willing to reduce their present natural reef recreational areas from 20 to 32 percent in an effort to improve the net recreational benefits. These statistics indicate a willingness to support management efforts in the direction of “no-take” zones. Such results are important to public officials responsible for managing the natural reef system off the Monroe County coast.

³ See Green (1984) and Bell (1992).

Table 6.1.4-1 (Residents)
Opinion of Monroe 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 "NO TAKE" Zones in for some reefs in the Florida Keys	78%	18%	4%	609
Support "NO TAKE" Zones on some reefs off shore of Monroe County	57%	21%	22%	609
Support "NO TAKE" Zones on some reefs off shore of Palm Beach, Broward and Miami-Dade Counties	44%	39%	17%	609
	Average for All Response	Median of All Responses		
What Percent of Natural Reefs in Monroe County Should be Protected with "NO TAKE" Zones	32%	20%		609

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6.1.5 Demographic Information

The mail survey administered to Monroe County residents included questions regarding demographic characteristics. The reason for collecting such information was to determine what segment of the population would gain from protecting and maintaining artificial and natural reefs and/or designating “no-take” zones as discussed in the previous section. Respondents were asked to provide some background on both themselves and their boating experiences. Thus, the survey was used to collect demographic information and to develop a boater profile to better understand these people called “reef-users” in Monroe County. Table 6.1.5-1 presents the results from the mail survey combined with comparable information on the entire Monroe County population.

**Table 6.1.5-1
Demographic Characteristics and Boater Profile of Reef-Users in
Monroe County Florida, 2000**

Demographic Characteristics of Respondents to Mail Survey	Reef Users	Monroe County Population
Median Age	54	41
Sex		
Male	86%	51%
Female	14%	49%
Race		
White	94%	91%
Black/African American	1%	5%
Hispanic/Latino	7%	16%
Other	6%	5%
Education ¹		
Percentage that completed College Degree or More	57%	16%
Median Household Income	\$56,393	\$31,922
Boater Profile		
Average Years of Residence in Broward County	16	N/A
Average Years of Boating in South Florida	22	N/A
Average Length of Boat Used for Saltwater Activities (ft)	24	N/A
Percentage of Respondents that belong to fishing and/or diving clubs	15%	N/A
Sample Size		604
<i>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).</i>		

The owners of reef-using registered boats were significantly older than the general population of Monroe County. The median age of reef-users is 54 years compared to 41 years for the general population. Statistically speaking, there is real age difference between these two groups. Further, boating appears to be a male-dominated activity as over 86 percent of the respondents

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indicated they were male compared to about 51 percent in the general population. Of course, there is no foolproof way to control who completes the survey instrument once it reaches a boat owner's residence. However, the survey is directed at the person to whom the boat was registered.

With respect to race, about 94 percent of the respondents characterized themselves as white compared to 91 percent in the general population of Monroe County.

Further, a lesser percentage characterized themselves as Hispanic/Latino (7 percent) as compared to the general population (16 percent).

Nearly 57 percent of the respondents indicated that they had at least a college degree compared to about 16 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 6.1.5-1 where respondents reported a median household income of nearly \$56,393 compared to \$31,922 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 was discussed earlier in this chapter. So, this finding is not unusual.

Using the information gathered from the first section on user activity, it is estimated that a minimum of 42,497 residents engaged in reef-using recreational activities during the 12-month period from December 1999 to November 2000 in Monroe County. This number was obtained by multiplying the number of registered boats that were estimated to be involved in reef use (12,996) by the average number of residents per party (3.27 individuals). Because the turnover rate of the party is unknown, the term "minimum" is used because the same residents may not go on every boat outing. There are about 73,367 residents in Monroe County who 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 17.7 percent of the county's population (12,996/73,367). 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 Monroe County population that 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.

Finally, a boater profile for Monroe County was developed from the survey results as follows. The typical reef-using boater has lived in Monroe County for 16 years and boated for 22 years. The reef-using boaters in the sample own a pleasure craft of 24 feet in length, on average. The

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

weighted average of registered boats 16 feet and over in Monroe County is about 25 feet so it appears that the sample is particularly reflective of the population based on average boat length. About 15 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 the coast of Monroe County, Florida.

6.2 Visitors

The focus of this section is the socioeconomic value of the reefs associated with visitors to Monroe County. Tourism and reef use in Monroe County takes place in the Florida Keys. As defined in Chapter 1, Introduction, visitors to a county are defined as nonresidents of the county that they are visiting. For example, a person from Broward County visiting the Florida Keys is considered to be a visitor to Monroe County. Likewise, a person from New York visiting the Florida Keys is considered to be a visitor to Monroe County.

This section provides the following values regarding visitors to Monroe 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 Monroe County are provided in Chapter 1: Introduction and Chapter 2: Socioeconomic Values of Reefs in Southeast Florida.

6.2.1 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 Monroe County must be estimated. Total visitation includes visits to Monroe County by non-residents of Monroe 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. 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 Monroe County using information from the General Visitor Survey.

The number of person-trips taken by all visitors to Monroe County and the number of person-days these visitors spent in the county during the year 2000-2001, developed in Chapter 2, is summarized in Table 6.2.1-1.

Table 6.2.1-1 (Visitors)
Number of Person-Trips and Person-Days
All Visitors to Monroe County^a June 2000 to May 2001 – in millions

Measure of Visitation	Summer – 00	Winter – 01	Total
Number of Person-Trips	1.51	1.60	3.11
Number of Person-Days	5.54	6.59	12.13

^a Includes cruise ship passengers who disembark at Key West for day trip.

Note: Summer 2000 is from June 2000 to November 2000. Winter 2001 is from December 2000 to May 2001.

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Visitors took 3.1 million person-trips to Monroe County from June 2000 to May 2001 and spent 12.1 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 Tables 6.2.1-2.

**Table 6.2.1-2 (Visitors)
Person-Trips of Visitors Who Boated
And Visitors Who Used the Reefs in Monroe 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	1,513,099	0.33	502,031	0.90	450,077
Winter – December 2000 to May 2001	1,596,298	0.26	413,226	0.90	370,462
Year Round - June 2000 to May 2001	3,109,397		915,257		820,539

^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 the total number of respondents to the General Visitor Survey.

^b From the Visitor Boater Tally Sheets: $= 1 - (Q6/(Q6+Q7+Q8+Q10))$

Of the 3.1 million person-trips visitors took to Monroe County from June 2000 to May 2001, 33 percent of the trips involved saltwater boating activities in the summer and 26 percent involved saltwater boating activities in the winter. Of the resulting 915,000 boating person-trips by visitors to Monroe County, 90 percent of those trips involved recreational reef use. Thus,

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visitors who used the reefs for recreation in Monroe County made about 821,000 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 used 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 a 1 was added to each of the responses to convert number of nights to number of days. The average number of days and the total person-days reef users spent in Monroe County in 2000-2001 are provided in Table 6.2.1-3.

**Table 6.2.1-3 (Visitors)
Average Number of Days Visiting Monroe County
And Total Person Days in Monroe 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
Monroe	8.39	6,887,497

Reef-using boaters who visited Monroe County spent an average of 8.39 days in the county during their trip. As a result, these visitors spent 6.9 million person-days in Monroe 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

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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 the artificial and natural reefs and the proportions of dives spent on the artificial and natural reefs were obtained.

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 Monroe County are presented in Table 6.2.1-4.

Table 6.2.1-4 (Visitors)
Saltwater Recreational Activities from All Boating Modes
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
Monroe 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	1,392	26%	20%	40%	40%	100%
Scuba Diving/Snorkeling ^b	1,392	17%	16%	80%	4%	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 Monroe County to use the reefs spent 26 percent of their visiting days participating in saltwater fishing from a charter, party, rental or private boat. Of these fishing days, 20 percent of days were spent fishing near artificial reefs, 40 percent of days were spent fishing near natural reefs and 40 percent of days were spent fishing near no reefs. Also, visitor boaters who came to the county to use the reefs spent 17 percent of their visiting days scuba diving or snorkeling. Of these diving/snorkeling days, 16 percent of dives were spent on artificial reefs, 80 percent of dives were spent on natural reefs, and 4 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 6.2.1-3) times the proportion visitor days that these visitors spent participating in each activity-

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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 Monroe County is provided in Table 6.2.1-5. The total person-days visitors spent participating in each saltwater activity and boat mode by type of reef is provided in Table 6.2.1-6.

Visitors to Monroe County spent about 2.1 million person-days on the reef system from June 2000 to May 2001. About 478 thousand of these days were spent on artificial reefs and about 1.6 million of these days were spent on natural reefs.

**Table 6.2.1-5 (Visitors)
Number of Person-Days Spent Using Artificial and Natural Reefs
By Recreation Activity – Monroe County**

Activity	Number of Person-Days		
	Artificial Reefs	Natural Reefs	All Reefs
Snorkeling	121,778	641,218	762,996
Scuba Diving	75,632	282,336	357,967
Fishing	277,349	603,549	880,899
Glass Bottom Boat Sightseeing	3,636	71,363	75,000
Total	478,395	1,598,467	2,076,862

6.2.2 Economic Contribution – Visitors

The Visitor Boater Survey asked respondents how much money they and members of their party spent on their 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.

The average itemized per person expenditures by those who participated in each activity and boat mode in Monroe County are provided in Table 6.2.2-1. Monroe County reef-using visitors who went saltwater fishing on their own boat, a friend's boat or a rental boat spent, on average, \$157 per person per day on the day that they went fishing. This amount is comprised of \$28 for boat fuel, \$21 for lodging, \$11 in camping fees, \$21 for food and beverages at stores and \$22 for food and beverages at restaurants and bars and \$17 for shopping, among other items.

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Table 6.2.1-6 (Visitors)
Number of Person-Days Visitors Spent Participating in
Saltwater Boating Activities and Reef Use - June 2000 to May 2001
Monroe County (Florida Keys)

Activity	Boat Mode	Number of Person Days	Number of Person-Days On:		
			Artificial Reefs	Natural Reefs	No Reefs
Snorkeling	Charter/Party	269,479	13,413	250,701	5,365
	Rental	65,315	8,476	56,590	249
	Private	465,424	99,889	333,928	31,607
Scuba Diving	Charter/Party	119,816	17,678	99,738	2,401
	Rental	18,600	1,898	16,702	0
	Private	222,331	56,056	165,896	379
Fishing – Offshore / Trolling	Charter	93,863	4,779	41,190	47,894
	Party	110,300	5,616	48,403	56,281
	Rental	35,902	10,097	21,317	4,488
	Private	618,547	119,763	215,028	283,756
Fishing – Flats or Back Country	Charter/Party	18,167	0	0	18,167
	Rental	9,084	0	0	9,084
	Private	305,380	62,694	95,052	147,634
Fishing Bottom	Charter	21,195	1,079	9,301	10,815
	Party	24,223	1,233	10,630	12,360
	Rental	15,572	4,152	7,786	3,633
	Private	467,587	67,935	154,842	244,810
Viewing Nature and Wildlife	Glass Bottom Boat	80,454	3,636	71,363	5,455
	Back Country Excursion	15,572	0	0	15,572
	Rental	50,608	0	0	50,608
	Private	309,273	0	0	309,273
Personal Watercraft (jet skis, wave runners, etc.)	Rental	31,576	0	0	31,576
	Private	154,420	0	0	154,420
Sailing	Charter/Party	12,111	0	0	12,111
	Rental	3,028	0	0	3,028
	Private	18,167	0	0	18,167
Other Boating Activities	Charter/Party	17,735	0	0	17,735
	Rental	2,595	0	0	2,595
	Private	134,091	0	0	134,091
Total Person-Days		3,710,416	478,394	1,598,467	1,633,554

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Table 6.2.2-1 (Visitors)
Amount of Money Spent in County Per Person During Most Recent Day
Participating in Each Reef-Related Activity and Boating Mode
Monroe 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		\$95.17	\$40.88		\$44.33
Boat Rental				\$8.03	
Boat Fuel	\$27.51			\$12.70	
Air Refills				\$1.46	\$1.66
Tackle	\$6.85				
Bait	\$5.71				
Ice	\$3.86			\$2.74	\$0.17
Ramp Fees	\$1.09			\$1.26	\$0.00
Marina Fees	\$6.34			\$3.48	\$2.06
Lodging	\$21.12	\$49.59	\$38.67	\$36.67	\$42.46
Camping Fees	\$10.76	\$11.57	\$2.96	\$11.43	\$4.92
Food and Beverages - Stores	\$21.31	\$17.51	\$13.08	\$18.82	\$11.75
Food and Beverages - Restaurants/Bars	\$22.21	\$58.88	\$32.56	\$22.50	\$30.68
Auto Gas	\$8.21	\$6.63	\$3.56	\$7.21	\$4.55
Auto Rental	\$2.83	\$14.80	\$4.49	\$4.47	\$8.52
Equipment Rental	\$2.08	\$1.18	\$0.63	\$0.44	\$2.69
Shopping	\$16.68	\$29.68	\$30.73	\$11.03	\$19.11
Total	\$156.57	\$284.99	\$167.57	\$142.23	\$172.89
Number of Respondents	368	126	171	342	544
Number of Respondents and Party Members ^c	1,468	394	484	1,463	1,888

^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.

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The average expenditure of persons who fished on charter boats was \$285 per person per day. About \$95 was the cost of the charter boat while \$50 was spent on lodging, \$12 was spent in camping fees, \$18 was spent on food and beverages at stores, \$59 was spent on food and beverages at restaurants and bars, \$15 was spent on auto rental, and \$30 was spent on shopping.

Persons who fished on party boats spent, on average, \$168 per person on the day they went fishing which included \$41 for the party boat fee, \$39 for lodging, \$13 for food and beverages at stores, \$33 for food and beverages at restaurants and bars, and \$31 for shopping.

Monroe 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, \$142 per person per day on the day they went diving. This amount is comprised of \$13 for boat fuel, \$37 for lodging, \$11 for camping fees, \$19 for food and beverages at stores and \$23 for food and beverages at restaurants and bars.

Visitors who went diving on charter or party boats spent, on average, \$173 per person per day. This expenditure was comprised of \$44 per day for the dive charter or party boat, \$42 per day for lodging, \$5 per day for camping fees, \$12 per day for food and beverages at stores, \$31 per day for food and beverages in restaurants and bars and \$19 for shopping, among other items.

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 Monroe County in 2000-2001 are provided in Table 6.2.2-2. 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 Monroe County spent \$319 million on reef-related expenditures. Of this amount \$73 million was associated with artificial reef-related expenditures and \$245 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.

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Table 6.2.2-2 (Visitors)
Total Visitor Expenditures In Monroe 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	478,395	1,598,467	2,076,862
Charter / Party Boat Fee	\$2,215,748	\$22,752,503	\$24,968,251
Boat Rental	1,335,356	4,601,477	5,936,833
Boat Fuel	9,391,142	20,866,226	30,257,368
Air Refills	294,492	1,417,735	1,712,226
Tackle	1,812,737	3,383,970	5,196,707
Bait	1,510,516	2,819,792	4,330,308
Ice	1,483,748	3,539,523	5,023,271
Ramp Fees	498,254	1,261,038	1,759,293
Marina Fees	2,321,536	5,850,565	8,172,101
Lodging	13,562,993	51,114,784	64,677,777
Camping Fees	4,989,991	14,348,964	19,338,955
Food and Beverages - Stores	9,326,234	27,085,778	36,412,012
Food and Beverages - Restaurants/Bars	11,142,883	39,515,821	50,658,705
Auto Gas	3,575,394	10,323,454	13,898,848
Auto Rental	1,875,831	7,959,339	9,835,170
Equipment Rental	718,651	2,319,993	3,038,643
Shopping	7,228,354	24,573,805	31,802,159
Glass Bottom Boat Ride	72,727	1,427,269	1,499,996
Total	\$73,356,586	\$245,162,036	\$318,518,623

While the IMPLAN Regional Input-Output Model was used to estimate economic contribution associated with the reef-related expenditures, for Monroe County, a different approach was used. This was due to concern that the IMPLAN model does not adequately capture the unique economy of this county. Relative to other counties in the nation, this economy is very dependent on imports and heavily dependent on one industry, tourism. Therefore, the approach used in Leeworthy (1996) was used. This approach utilized several ratios on economic measures for Monroe County derived from data published by the U.S. Census (1997 Economic Census) and the Bureau of Economic Analysis. The analysis then utilized sales, income, and employment multipliers taken from a recent Monroe County economic study (Leeworthy, 1996) to estimate total (direct, indirect and induced) contributions to sales, income and employment from visitor expenditures associated with reef related activities. This method provides estimates of total direct, indirect and induced economic contributions for Monroe County and cannot provide a breakdown of direct versus indirect versus induced effects.

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The economic contribution of the reefs to Monroe County is provided in Table 6.2.2-3. 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.

Table 6.2.2-3 (Visitors)
Economic Contribution of Reef-Related Expenditures by Visitors to Monroe County
Economic Area is Monroe County
June 2000 to May 2001 – In 2000 dollars

	Artificial Reefs	Natural Reefs	Total
Total Sales	\$82,159,376	\$274,581,481	\$356,740,857
Total Income	\$26,695,085	\$94,168,665	\$120,863,750
Total Employment	1,916	6,737	8,653

Reef-related expenditures by visitors to Monroe County during the period June 2000 to May 2001 resulted in \$357 million in sales to county businesses. These sales generated \$121 million in income and 8,700 jobs. About 22 percent of these values were the result of artificial reef-related expenditures and 78 percent of these values were the result of natural reef-related expenditures.

6.2.3 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. 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 artificial and natural reefs in their existing condition; and (4) the value to artificial reef users 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 is provided in Table 6.2.3-1. 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

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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 you 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.

**Table 6.2.3-1 (Visitors)
Annual Value of Reefs To Reef Users and Capitalized Value
Data Represents June 2000 to May 2001
Visitor Reef-Users in Monroe County**

Item	All Reefs – Artificial and Natural	Artificial Reefs	Natural Reefs
Number of Person-Days of Reef Use	2,076,862	478,395	1,598,467
Use Value Per Person-Day (\$2000)	\$17.19	\$12.23	\$22.35
Annual Use Value - (\$2000)	\$38,673,282	\$5,851,199	\$35,719,677
Capitalized Value @ 3 percent Discount Rate (\$2000)	\$1,289,109,400	\$195,039,967	\$1,190,655,900

Values for all reefs were taken from statistical analysis of responses to Question 38 of Visitor Boater Survey⁵: “Suppose that both of the above plans to maintain the natural and artificial reefs

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

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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 the procedures used to estimate the user values presented here. For a more technical discussion, please see the Technical Appendix to this document, which is a separate report. The Technical Appendix describes the methods used to derive the values presented here and provides alternative estimates using different methods. Here we present only the estimates of total annual use value, use value per person-day, and the asset value of the reefs derived using the Logit model.

The estimated use values are consistent with the idea that natural reefs are preferred to artificial reefs. For Monroe County visitors, the average use value per person-day of natural reef use was \$22.35 versus \$12.23 for artificial reef use. Total use is also higher for natural versus artificial reefs. Monroe County visitors’ natural reef use was almost 1.6 million person-days versus 478 thousand person-days for artificial reefs. This translated into an estimate of total annual use value of \$35.7 million for natural reefs and \$5.9 million for artificial reefs. Capitalizing the annual use values, using a three percent interest rate, yields asset values of about \$1.2 billion for the natural reefs and \$195 million for the artificial reefs.

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 to deploy new artificial reefs and enhance 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 provides a conservative or lower bound estimate of the total natural and artificial reef values.

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The capitalized value of reef use value 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 associated with Monroe County reefs, both artificial and natural, is \$1.3 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 the value of reefs to non-reef users was not part of this study.

Reef users’ willingness to pay to invest in and maintain “new” artificial reefs is provided in Table 6.2.3-2. The use value per person-day is the value per day or a portion of a day of artificial reef use. In Monroe County, reef users are willing to pay \$1.7 million annually for this program in Monroe County.

**Table 6.2.3-2 (Visitors)
Estimated Use Value of Investing in and Maintaining
"New" Artificial Reefs in the County
Visitor Reef-Users in Monroe County**

Item	Value
Number of Person-Days of Artificial Reef Use	478,395
Use Value Per Person-Day for "New" Artificial Reefs (\$2000)	\$3.60
Annual Use Values for "New" Artificial Reefs	\$1,724,324
Capitalized Value @ 3 percent Discount Rate (\$2000)	\$57,477,467
<i>Note: Use value per person-day is the use value per whole day or portion of a day of artificial reef use.</i>	

The value of reefs by reef type and activity type for Monroe County is provided in Table 6.2.3-3.

Table 6.2.3-3 (Visitors)
Value of Reefs to Visitors to Monroe County, by Reef Type and Activity, 2000-2001

Reef Type/Activity	Person-Days	Annual User Value (\$)	User Value Per Person-Day (\$)
Natural Reefs	1,598,467	\$35,719,677	\$22.35
Snorkeling	641,218	\$17,428,710	\$27.18
Scuba Diving	282,336	\$5,854,637	\$20.74
Fishing	603,549	\$10,479,512	\$17.36
Glass Bottom Boats	71,363	\$1,956,818	\$27.42
Artificial Reefs	478,395	\$5,851,199	\$12.23
Snorkeling	121,778	\$1,755,307	\$14.41
Scuba Diving	75,632	\$751,366	\$9.93
Fishing	277,349	\$3,290,720	\$11.86
Glass Bottom Boats	3,636	\$53,807	\$14.80
Natural & Artificial Reefs	2,076,862	\$38,673,282	\$18.62
Snorkeling	762,996	\$15,397,007	\$20.18
Scuba Diving	357,967	\$6,445,422	\$18.01
Fishing	880,899	\$15,141,356	\$17.19
Glass Bottom Boats	75,000	\$1,689,496	\$22.53
New Artificial Reefs	478,395	\$1,724,324	\$3.60
Snorkeling	121,778	\$356,746	\$2.93
Scuba Diving	75,632	\$425,167	\$5.62
Fishing	277,349	\$923,763	\$3.33
Glass Bottom Boats	3,636	\$18,648	\$5.13

6.2.4 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 Monroe County are summarized in Table 6.2.4-1.

**Table 6.2.4-1 (Visitors)
Demographic Characteristics of Visitor Reef-Users in Monroe County, 2000**

Characteristic	Value
Median Age of Respondent – Years	44
Sex of Respondent	
Male	70%
Female	30%
Race of Respondent	
White	95%
Black	2%
Other	3%
Percent Hispanic / Latino	8%
Median Household Income	\$87,500
Average Years Boating in Southeast Florida	7.4
Average Length of Own Boat Used in Saltwater Boating in Feet	22
Percent of Respondents Who Belong to Fishing and/or Diving Clubs	11%

6.3 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 Monroe County. Demographic information of both resident and visitor reef users is also provided.

6.3.1 User Activity

The numbers of person-days spent using the reefs in Monroe County by reef type and population (residents and visitors) are summarized in Table 6.3.1-1. Visitors and residents spent 5.45 million person-days using artificial and natural reefs in Monroe County during the 12-month period from June 2000 to May 2001. Residents spent 3.37 million person-days and visitors spent 2.1 million person-days. Reef users spent 1.6 million person-days using artificial reefs and 3.9 million person-days using natural reefs. A summary of reef use by type of activity is provided in Table 6.3.1-2.

**Table 6.3.1-1
Number of Person-Days Spent on Artificial and
Natural Reefs in Monroe County
Residents and Visitors – in millions**

Population	Artificial Reefs	Natural Reefs	All Reefs
Residents	1.10	2.28	3.38
Visitors	0.48	1.60	2.08
Total	1.58	3.88	5.46

**Table 6.3.1-2
Number of Person-Days Spent Using Reefs in Monroe County
By Recreational Activity
Residents and Visitors – in millions**

Activity	Residents	Visitors	Total
Snorkeling	1.10	0.76	1.86
Scuba Diving	0.53	0.36	0.89
Fishing	1.74	0.88	2.62
Glass Bottom Boat	-	0.075	0.075
Total	3.37	2.08	5.46

Note: Residents were not asked about their use of glass-bottom boats.

Reef diving and reef fishing are equally common in Monroe County. Snorkeling is more common than scuba diving. Fishing comprises 2.62 million person-days while scuba diving and snorkeling comprise 0.89 million person-days and 1.86 million person-days, respectively. Resident reef-related recreation comprises 61.8 percent of total reef-related recreation by residents and visitors in Monroe County. Residents spend significantly more days in snorkeling, scuba diving and fishing than do visitors.

6.3.2 Economic Contribution

The total economic contribution of the reefs to Monroe 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.

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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 Monroe County are provided in Tables 6.3.2-1 through 6.3.2-3. 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.

Reef-related expenditures in Monroe County generated \$504 million in sales during the 12-month period from June 2000 to May 2001. These sales resulted in \$140 million in income to Monroe County residents and provided 9,984 jobs in Monroe County. Artificial reef-related expenditures accounted for 26 percent of the economic contribution of all reefs and natural reef-related expenditures accounted for 74 percent of the economic contribution.

**Table 6.3.2-1
Economic Contribution of Artificial Reef-Related Expenditures
to Monroe County
June 2000 to May 2001 – In Millions of 2000 Dollars**

Round of Spending	Contribution to:		
	Sales	Income ^b	Employment ^c
Direct ^a			
Resident	\$49.35	\$6.42	449
Visitor ^d	\$51.35	\$26.70	1,916
Total	\$100.70	\$33.12	2,365
Indirect ^d	\$30.81		
Induced			
Total	\$131.51	\$33.12	2,365

^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.

^d For sales, both the indirect and induced contribution are included under indirect. For income and employment, the direct, indirect and induced contributions are included under direct.

**Table 6.3.2-2
Economic Contribution of Natural Reef-Related Expenditures
to Monroe County
June 2000 to May 2001 – In Millions of 2000 Dollars**

Round of Spending	Contribution to:		
	Sales	Income ^b	Employment ^c
Direct ^a			
Resident	\$98.16	\$12.73	882
Visitor ^d	\$171.61	\$94.20	6,737
Total	\$269.77	\$106.93	7,619
Indirect ^d	\$102.97		
Induced			
Total	\$372.74	\$106.93	7,619

^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.
For sales, both the indirect and induced contribution are included under indirect. For income and employment, the direct, indirect and induced contributions are included under direct.

**Table 6.3.2-3
Economic Contribution of All Reef-Related Expenditures
to Monroe County
June 2000 to May 2001 – In Millions of 2000 Dollars**

Round of Spending	Contribution to:		
	Sales	Income ^b	Employment ^c
Direct ^a			
Resident	\$147.51	\$19.15	1,331
Visitor ^d	\$222.96	\$120.90	8,653
Total	\$370.47	\$140.05	9,984
Indirect ^d	\$133.78	\$0	0
Induced		\$0	0
Total	\$504.25	\$140.05	9,984

^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
^d For sales, both the indirect and induced contribution are included under indirect. For income and employment, the direct, indirect and induced contributions are included under direct.

6.3.3 Use Value

In this study, three types of use values were estimated: (1) the value of maintaining the natural reefs in their existing condition; (2) the value of maintaining the artificial reefs in their existing condition and (3) 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 measured in terms of per person per day of reef use and in aggregate for all users of the reef system.

The annual value Monroe County visitors and residents place on protecting the reefs in their existing condition and the associated capitalized value is presented in Table 6.3.3-1. The annual value visitor and resident reef-users place on investing in and maintaining “new” artificial reefs is presented in Table 6.3.3-2. These values were explained in Sections 6.1.3 and 6.2.3.

**Table 6.3.3-1
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
Monroe County, Florida**

Item	Residents	Visitors	Total
All Reefs - Artificial and Natural			
Number of Person-Days of Reef Use (millions)	3.38	2.08	5.46
Use Value Per Person-Day	\$3.64	\$17.19	\$9.48
Annual Use Value - (million dollars)	\$13.11	\$38.67	\$51.78
Capitalized Value @ 3 percent Discount Rate (million dollars)	\$364	\$1,289	\$1,653
Artificial Reefs			
Number of Person-Days of Reef Use (millions)	1.10	0.48	1.58
Use Value Per Person-Day	\$3.54	\$12.23	\$6.18
Annual Use Value - (million dollars)	\$3.89	\$5.85	\$9.75
Capitalized Value @ 3 percent Discount Rate (million dollars)	\$129.8	\$195.0	\$324.8
Natural Reefs			
Number of Person-Days of Reef Use (millions)	2.28	1.60	3.88
Use Value Per Person-Day	\$9.48	\$22.35	\$14.83
Annual Use Value - (million dollars)	\$21.77	\$35.72	\$57.49
Capitalized Value @ 3 percent Discount Rate (million dollars)	\$726	\$1,191	\$1,916

**Table 6.3.3-2
Estimated Value to Reef Users From Investing in and
Maintaining "New" Artificial Reefs
Monroe County, Florida**

Item	Residents	Visitors	Total
Number of Person-Days of Artificial Reef Use (millions)	1.10	0.48	1.58
Use Value Per Person-Day for "New" Artificial Reefs	\$0.42	\$3.60	\$1.39
Annual Use Values for "New" Artificial Reefs (million dollars)	\$0.47	\$1.72	\$2.19
Capitalized Value @ 3 percent Discount Rate (million dollars)	\$15.6	\$57.5	\$73.1

6.3.4 Demographic Information⁴⁴⁴

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 6.3.4-1. A comparison of the demographics indicates that resident and visitors are very similar in terms of age, race, income, and membership in fishing and/or diving clubs.

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**Table 6.3.4-1
Demographic Characteristics of Resident and Visitor Reef-Users in
Monroe County, 2000**

	Resident Reef-Users			Visitor Reef-Users		
Median Age of Respondent	54			44		
Sex Of Respondent	Percent			Percent		
Male	86%			14%		
Female	70%			30%		
	% of Resident Reef-Users			% of Visitor Reef-Users		
	White	Black	Other	White	Black	Other
Race Of Respondent	94%	.02%	5.8%	95%	2%	3%
	% of Resident Reef-Users			% of Visitor Reef-Users		
Percent Hispanic/Latino	7%			8%		
	Resident Reef-Users			Visitor Reef-Users		
Median Household Income	\$56,393			\$87,500		
	Residents			Visitors		
Average Years Boating in South Florida	22			7.4		
	Residents			Visitors		
Average Length of Boat Used for Salt Water Activities in Feet	24			22		
	Residents			Visitors		
% of Respondents Who Belong to Fishing and/or Diving Clubs	15%			11%		