

Chapter 2: Socioeconomic Values of Reefs in Southeast Florida

The artificial and natural reefs of southeast Florida provide benefits to those who use the reefs and to those who depend on the local economies. Investment in and maintenance of public resources, such as the reef system, is a prime function of government. Policy makers need to know the extent of reef use by the public and the importance of reefs to the public in order to prioritize investments that protect the reefs and provide for new artificial reefs.

The reef users evaluated in this study are the visitors and residents who fish off the reefs using a boat; who scuba dive and/or snorkel on the reefs using a boat; and/or who view the reefs from glass-bottom boats. The southeastern part of Florida is the focus of this study and includes Palm Beach, Broward and Miami-Dade counties that border the Atlantic Ocean and Monroe County which borders both the Atlantic Ocean and the Gulf of Mexico. Monroe County includes the Florida Keys.

This chapter summarizes the results of a detailed analysis of the socioeconomic value of reefs in southeast Florida to residents and visitors. Chapters 3 through 6 discuss the results for each of the four counties mentioned above. Each chapter includes the following information.

- 1) Boater activity on the reef system by residents and visitors;
- 2) Economic contribution of artificial and natural reefs to the county's economy;
- 3) Resident and visitor use value from recreating on artificial and natural reefs;
- 4) Demographic and boater profile of reef users; and
- 5) For residents, their opinions regarding “no-take” zones as a tool to maximize the public value of the reef system.

The goal of this research is to aid public policy makers in their efforts to deploy additional artificial reefs, to care for the existing natural and artificial reef systems and to formulate management strategies, which will be in the best interest of the residents and visitors to each county.

Economic contribution of the reefs refers to the sales, income, and employment generated in each county as a result of visitors and residents spending money in the county to use the reefs. The income and employment represents money and employment that stays within the county as a result of reef use.

Although the economic contribution of the reef system is important, it does not measure the recreational value derived by reef users. The reef is called a “common property” resource because it is not owned by one individual, but by society in general. There is no one selling tickets to admit fishers to a reef. However, a recreational experience on a reef yields “value”

expressed in dollar terms to fishers and divers. Ordinary market forces, however, do not measure this value. In this case, economists are able to simulate the market value of these resources using various methodologies. There is a “use value” associated with reef systems that should be measured, if possible. The reason for such a measurement is to provide information to the government on the benefits of the reefs to reef users. This value can be compared to the investments that are made to create artificial reefs and/or to maintain artificial and natural reefs. An earlier study by Bell, et al (2000) focused on the benefits and costs of artificial reef systems in Northwest Florida.

There is also a value of reefs to non-reef users that is in addition to the values enjoyed by reef users. *Therefore, the total value of natural reefs is the sum of the values to reef users and non-reef users. The estimation of the value of the reefs to non-reef users was not part of this study.*

2.1 Residents

The focus of this section is the socioeconomic values of the reefs in Southeast Florida to resident boaters. Resident boaters are those individuals who live within one of the four counties in the study area, who used a boat that is owned by a resident of that county, and who used the boat for saltwater recreational activities offshore of that county during the study period. For this study, the population of resident boaters was treated separately from visitors. For example, resident boaters of Palm Beach County are those individuals who used a boat owned by a resident of Palm Beach County to participate in saltwater recreational activities off shore of Palm Beach County during the study period. A resident of Palm Beach County who uses a Palm Beach County registered boat to visit the reefs off Broward County is considered a visitor to Broward County for the purposes of this study. Resident boats are defined as those greater than or equal to 16 feet in length and registered with the Florida Department of Highway Safety and Motor Vehicles.

2.1.1 User Activity - Residents

There are two fundamental measures of natural resource user activity such as scuba diving the reef systems off southeast Florida. First, user activity can be measured by the number of boating days. This is usually called “party-days” since each boat carries one or more individuals depending, for the most part, on the size of the boat. Party-days gives us a “boating measure” of activity. This measure is important for several purposes. For instance, this measure can be used to estimate boat ramp use for planning purposes. In addition, this measure can be used to estimate the number of boats that are expected to arrive at artificial and/or natural reefs in a given day.

Finally, the term “party-days” is used in economic analysis because the party is the principal spending unit. When we multiply the number of party-days by the number in the party, we obtain “person-days”. This second measure of boating activity is important since it tells us how many people will be fishing and/or diving on a particular reef during a day. In the case of fishing, a person-day is the principal measure of fishing effort or pressure on a renewable resource (e.g., fishery biomass).

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"Person-days" is of particular significance when estimating the "user value" of recreating while using a reef. The principal unit of both consumption and production of an activity involving the reefs is a "person-day". If it were determined that recreational fishers valued a day of fishing at a reef at \$10 per person per day, then a party of four (i.e., the party-day) would receive \$40 in "use value" (four person days multiplied by the value per person per day from recreational fishing). Thus, while the party-day is boat oriented in terms of accommodating a boatload of fishers, a person-day measures both fishing effort on a resource and the unit of output of the resource available to the user. Thus, the first order of business in this project was to estimate the number of party-days and person-days by residents involved in reef-related activities off the southeastern coast of Florida.

Table 2.1.1-1 presents resident boater user activity on artificial and natural reefs for Palm Beach, Broward, Miami-Dade and Monroe counties as measured in party-days and person-days. These activity measures were estimated in a two-step procedure. First, a mail survey was sent to a sample of registered boat owners in the four counties in the study area during the Fall of 2000. A total of 12,500 surveys were mailed out to registered boat owners in the study area who owned boats at least 16 feet long. The boat size distinction was made because reef visitations are heavily concentrated among larger boats and we wished to target the segment of the boater population that are heavy reef users. This allowed us to obtain a larger sample of our targeted group with greater statistical reliability. Florida State University received 2,543 completed surveys from resident boaters. Of the surveys received, 65.2 percent of respondents reported using artificial and/or natural reefs in the last 12 months. Eliminating those not using reefs, we obtained 1,658 surveys from resident boaters who indicated they do use the reefs.

The distribution of resident reef users who responded to the survey is provided in the table below.

**Boat Length Distributions of Resident Reef Users Who Responded to the 2000 Survey
(Percent)**

Boat Length Category	Palm Beach	Broward	Miami-Dade	Monroe	Total
16' to 25' 11"	66	65	79	73	71
26' to 39' 11"	29	30	18	23	25
40' to 64' 11"	5	5	3	4	4
65' to 109' 11"	0	0	0	0	0
110' and Greater	0	0	0	0	0
	100	100	100	100	100

The number of registered boats in the county at least 16 feet long, that are owned by a county resident, and that carried parties to the reef in the last 12 months was estimated using the inventory of boat registrations furnished by the Florida Department of Highway Safety and Motor Vehicles (2000). From this inventory, boats less than 16 feet and owners who live outside

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of the county were excluded. The remaining number of boats in each county was multiplied by the proportion of survey respondents who said they used their boats on the county's reefs in the last 12 months. The resulting target population of boats carrying parties that used the reefs at least once in the past 12 months is provided below.

Target Population of Resident Boats by County in Southeast Florida

County	Total Registered Boats in County	Target Population - Number of Boats Carrying Parties that Used the Reefs
Palm Beach	56,924	19,463
Broward	61,124	23,854
Miami-Dade	67,936	30,695
Monroe	26,564	14,477

The sample data obtained from the survey was then used in combination with the target population of boats to estimate the total number of party-days spent using artificial and natural reefs off the coast of each county. The results are provided in Table 2.1.1-1. Reef-using respondents were asked to estimate their total days spent on or about the reefs over the last 12 months. For example, we estimated that resident boaters of Palm Beach County spent a total of 779,000 party-days on reefs over the last 12 months. Total party-days was estimated as follows. Palm Beach County survey respondents stated that they spent, on average, 40 days over the 12-month period using their boat to visit the reef system. The "40-days" was multiplied by the target population of boaters for Palm Beach County (i.e., 19,463 times 40 days). All other estimates of party-days for each county in Table 2.1.1-1 were derived in the same manner.

Miami-Dade County had the most party-days while Palm Beach County had the least party-days among the four counties evaluated. This was primarily due to the fact that Miami-Dade County has the largest number of boats in the target population. Among all counties, resident boaters spent over 3.8 million party-days using the reef system.

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**Table 2.1.1-1 (Residents)
A Summary of Resident Boater User Activity on
Artificial and Natural Reefs in Southeast Florida, 2000**

Total "Party-Days" on All Reefs		
County	Total Party-Days (Thousands)	Percentage for Each County
Palm Beach	779	20%
Broward	930	24%
Miami-Dade	1,105	29%
Monroe	1,013	26%
Total All Counties	3,827	100%
Total "Party-Days" on Artificial Reefs		
County	Total Party-Days	Percent Spent on Artificial Reefs in County
Palm Beach	281	36%
Broward	319	34%
Miami-Dade	376	34%
Monroe	345	34%
Total All Counties	1,321	35%
Total "Party-Days" on Natural Reefs		
County	Total Party-Days	Percent Spent on Natural Reefs in County
Palm Beach	497	64%
Broward	612	66%
Miami-Dade	729	66%
Monroe	669	66%
Total All Counties	2,507	65%
Total Person-Days on All Reefs (Thosands)		
County	Total Person-Days	Percentage for Each County
Palm Beach	2,978	20%
Broward	3,718	25%
Miami-Dade	4,506	31%
Monroe	3,379	23%
Total All Counties	14,581	100%
Total "Person-Days" on Artificial Reefs		
County	Total Person-Days	Percent Spent on Artificial Reefs in County
Palm Beach	1,075	36%
Broward	1,281	34%
Miami-Dade	1,540	34%
Monroe	1,102	33%
Total All Counties	4,998	34%
Total Person-Days on Natural Reefs		
County	Total Person-Days	Percent Spent on Natural Reefs in County
Palm Beach	1,903	64%
Broward	2,437	66%
Miami-Dade	2,965	66%
Monroe	2,277	67%
Total All Counties	9,582	66%

Note: A party-day is a one-day visit by a party of people. A person-day is a one-day visit by one individual.

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Respondents were asked to distribute their reef activities by the type of reef used. Without much variation among counties, resident reef-users spent two-thirds of their party-days on natural as opposed to artificial reefs. Boater preference for natural reefs is hardly surprising, but it does show that artificial reefs are apparently substitutes for natural reefs. This is of interest to the artificial reef program managed by state and local officials.

The second half of Table 2.1.1-1 summarizes the estimated number of person-days for residents by county and reef type. For this estimate, we purposely netted out any nonresidents since they are, in fact, tourists. This is a significant factor in the Florida Keys, which attracts more friends and relatives from outside Monroe County than any other county in the study area. Using the results of the survey, the average resident party size was estimated to be 3.8 individuals. The total number of person-days per county is equal to the resident party size times the number of party-days per county. For all four counties, the number of person-days was estimated at 14.6 million. As expected, about two-thirds of these person-days were spent on natural as opposed to artificial reefs.

Respondents were then asked to breakdown their time on reefs by recreational activity. These activities were (1) fishing, (2) snorkeling and (3) scuba diving. Table 2.1.1-2 summarizes the breakdown of party-days by activity for all the counties. Alternatively, Table 2.1.1-3 shows the number of party-days and person-days broken down by this classification for each county separately.

**Table 2.1.1-2 (Residents)
Party-Days by Activity for All Counties**

Activity	Number of Party-Days Spent on Reef System by Activity	Percentage of Total Party-Days by Activity
Fishing	2,040,159	53%
Snorkeling	911,293	24%
Scuba Diving	875,758	23%
Total	3,827,209	100%

Resident fishing constitutes about 53 percent of all resident party-days in the four county study area. Snorkeling and Scuba diving are almost evenly split in terms of the number of party-days, with snorkeling at 911 thousand and scuba diving at 876 thousand party days. Thus, reefs accommodate three rather important recreational activities as indicated in these two tables. These percentages remain similar for both artificial and natural reefs. That is, about two-thirds of fishing, snorkeling and scuba diving are spent on natural as opposed to artificial reefs using party-days as a measure of user activity. Person-days follow the same pattern as discussed for party-days. The activity tables will come into greater play as in other sections of this summary chapter. For now, the party-day is being used as a spending unit in conjunction with the information on party spending per day obtained from our sample survey of reef users.

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Table 2.1.1-3 (Residents)
Summary of the Kinds of Recreational Activities on Reefs in Southeastern Florida, 2000

(A) Party-Days (Thousands)						
Kind of Activity	All Reefs		Artificial Reefs		Natural Reefs	
	Total Party-Days	Each County's Percentage of Total Party-Days	Total Party-Days	Each County's Percentage of Total Party-Days	Total Party-Days	Each County's Percentage of Total Party-Days
Fishing						
Palm Beach	405	20%	146	20%	259	20%
Broward	512	25%	205	28%	307	24%
Miami-Dade	597	29%	227	31%	370	28%
Monroe	527	26%	158	21%	369	28%
Total	2,040	100%	735	100%	1,305	100%
Snorkeling						
Palm Beach	163	18%	77	29%	87	14%
Broward	177	19%	39	15%	138	21%
Miami-Dade	287	32%	80	30%	207	32%
Monroe	284	31%	71	27%	213	33%
Total	911	100%	267	100%	644	100%
Scuba Diving						
Palm Beach	210	24%	59	19%	151	28%
Broward	242	28%	75	24%	167	30%
Miami-Dade	221	25%	69	22%	152	27%
Monroe	203	23%	116	36%	87	16%
Total	876	100%	318	100%	558	100%
(B) Person-Days (Thousands)						
Kind of Activity	Total Person-Days	Each County's Percentage of Total Person-Days	Total Person-Days	Each County's Percentage of Total Person-Days	Total Person-Days	Each County's Percentage of Total Person-Days
Fishing						
Palm Beach	1,551	19%	558	19%	992	19%
Broward	2,154	27%	862	29%	1,292	25%
Miami-Dade	2,578	32%	980	34%	1,598	31%
Monroe	1,744	22%	523	18%	1,221	24%
Total	8,027	100%	2,923	100%	5,103	100%
Snorkeling						
Palm Beach	616	17%	290	27%	327	13%
Broward	732	20%	161	15%	571	22%
Miami-Dade	1,230	33%	344	32%	885	34%
Monroe	1,104	30%	276	26%	828	32%
Total	3,682	100%	1,071	100%	2,611	100%
Scuba Diving						
Palm Beach	811	28%	227	23%	584	31%
Broward	832	29%	258	26%	574	31%
Miami-Dade	698	24%	216	22%	482	26%
Monroe	531	18%	303	30%	228	12%
Total	2,872	100%	1,004	100%	1,868	100%

2.1.2 Economic Contribution

This section presents the economic contribution of resident reef-users to the economies of the counties in the study area. Economic contribution is measured in terms of the impact of expenditures by reef-users on county wages and employment. Regional economies grow by an expansion in their export industries. Export industries either sell goods and services to individuals outside the local economy or experience an injection of cash by visitors from outside the area. For example, boating visitors to Palm Beach County inject cash into this economy and stimulate economic growth. Such injections have a multiplier effect as discussed in the next section of the report under “Visitors”.

However, local spending is somewhat different in that it is a result of the expansion in many local export industries, not just the reef industry. As money circulates through the local economy, local residents receive income from this flow and use it to purchase goods and services such as boats, supplies, food, and fuel. Although resident spending on reef-related boating does not create multiplier effects that can be directly tied to the reefs, the existence of the reefs does keep money in the local economy. If the reef system did not exist off the coast of a particular county, residents may go elsewhere and spend their income. Generally, the more money kept in the local economy, the greater will be the multiplier effect of many local exports. In effect, reef-related spending by residents keeps the wages and employment in the home economy rather than exiting the economy as residents go elsewhere to recreate. It is this economic contribution that we seek to measure in this section.

The estimated economic contribution of reef-related expenditures by local residents is summarized in Table 2.1.2-1. For example, for the four counties in the study area, resident reef-users spent about \$888 million during the 12-month period. This spending created about \$118 million in wages and supported 7,416 employees. Without the artificial and natural reefs existing off the coasts of these counties, much of this spending might take place in other coastal counties. It is difficult to predict how many jobs might be lost without the existing reef system. However, given the intense demand for this kind of recreation, it is possible that losses would be considerable. Such potential losses were not estimated.

Estimated spending by resident reef-users was derived as follows using Palm Beach County as an example. In 2000, there were an estimated 779 party-days spent visiting the reefs off the coast of Palm Beach County as shown in Table 2.1.1-1. The mail survey respondents were asked to estimate their local spending per party-day.¹ Spending per party-day was asked separately for fishing, snorkeling and scuba diving. The weighted average expenditures by residents for all these activities was then calculated as \$251 per party-day and the average party size was 3.8 residents. Respondents were also asked to breakdown their reef-related expenditures into 12 categories that are discussed in detail below. These categories range from marina fees to eating in restaurants during a reef trip. Multiplying the number of party-days by resident spending per party-day, we arrive at \$195.5 million (i.e. 779 times \$251). This is the reef-related spending

¹ This is why “party-day” is referred to as the spending unit.

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estimate for Palm Beach County as summarized in Table 2.1.2-1.² All other estimates of county aggregate expenditures in Table 2.1.2-1 were derived in the same manner.

Table 2.1.2-1 (Residents)
A Summary of the Economic Contribution of Reef-Related Recreational Activities by
County in Southeast Florida, 2000

Economic Contribution: All Reefs				
County	Expenditures (Million 2000\$)	County Expenditures as Percentage of Total Reef- Related Expenditures	Employment (Full and Part-Time Jobs)	Wages (Million 2000\$)
Palm Beach	195.5	22%	1,503	22.5
Broward	269.8	30%	2,473	37.6
Miami-Dade	275.5	31%	2,109	38.9
Monroe	147.5	17%	1,331	19.1
Total	888.3	100%	7,416	118.1
Economic Contribution: Artificial Reefs				
County	Expenditures (Million 2000\$)	County Expenditures as Percentage of Total Reef- Related Expenditures	Employment (Full and Part-Time Jobs)	Wages (Million 2000\$)
Palm Beach	69.3	23%	536	8.0
Broward	90.9	30%	811	12.4
Miami-Dade	95.2	31%	724	13.4
Monroe	49.3	16%	449	6.4
Total	304.7	100%	2,520	40.2
Economic Contribution: Natural Reefs				
County	Expenditures (Million 2000\$)	County Expenditures as Percentage of Total Reef- Related Expenditures	Employment (Full and Part-Time Jobs)	Wages (Million 2000\$)
Palm Beach	126.2	22%	968	14.0
Broward	178.9	31%	1,662	25.2
Miami-Dade	180.3	31%	1,385	25.6
Monroe	98.2	17%	882	12.7
Total	583.6	100%	4,896	77.5

² *The party size of 3.8 persons includes residents only. Actual party size is somewhat larger than 3.8 individuals because it includes nonresidents. In areas such as the Florida Keys (i.e., Monroe County), nonresidents may be up to a third of the actual party. Respondents were asked about the composition of their party in terms of residents and non-residents because the nonresident component is really part of the visitor sector. The goal of the resident section was to cover only residents of the county under study. The above procedure was used for all spending entries in Table 2.1.2-1.*

Table 2.1.2-2 (Residents)
A Summary of Estimated Expenditures by Reef-Related Recreational Activity
By Residents Off the Southeast Coast of Florida, 2000

Recreational Activity	Estimated Expenditures Per County (Million 2000\$)				Total Expenditures	Percentage of Total Expenditures
	Palm Beach	Broward	Miami-Dade	Monroe		
Fishing	\$121	\$134	\$165	\$89	\$509	57%
Snorkeling	\$26	\$52	\$59	\$33	\$170	19%
Scuba Diving	\$49	\$84	\$52	\$25	\$210	24%
Total	\$196	\$270	\$276	\$147	\$889	100%

Estimated spending had to be translated into its generated wages and employment. The percent of wages generated by spending in certain industrial categories was obtained from the U.S. Census of Business (1997). For example, in Palm Beach County, spending on marinas generated \$130 per employee annually expressed in 2000 dollars. Out of this spending, 11 percent goes to payments for wages or \$15 per employee annually. Thus, if reef-related boating generated \$130 (i.e., derived as outlined above) in spending, this would create one part or fulltime job paying \$15 per year based on the labor market data from Palm Beach County. Using this method, Table 2.1.2-1 shows that the \$195.5 million of spending in Palm Beach County generated a payroll for all reef-related spending of \$22.0 million supporting 1,503 full and part-time employees.

It is of interest to breakdown spending between artificial and natural reefs. About two-thirds of all resident spending was related to natural reefs while the balance was attributed to artificial reefs. The distribution of spending is closely linked to the distribution of party-days and person-days discussed above. In addition, there was not much difference between party spending per day on artificial as opposed to natural reefs. Expenses such as marina fees, eating at restaurants and boat oil and gas will not vary depending upon the type of the reef. Any differences we found were assumed to be due to sampling error associated with smaller sample sizes (i.e., a further breakdown of categories reduces the sample size per category).

In terms of spending, there is a difference in spending per party-day depending on the kind of recreational activity on the reef system. In general, fishing is more expensive per day than various kinds of diving. Table 2.1.2-2 presents a breakdown of expenditures by county in terms of the kind of resident-related recreational pursuit involving the coastal reef system. Over all counties, expenditures on reef-related fishing were 57 percent of total spending on all activities. Scuba diving comprised 24 percent of total spending and snorkeling comprised 19 percent of total spending. Nearly \$510 million was spent on reef-related fishing during the 12-month period (1999-2000). This was followed by spending on scuba diving of \$210 million and \$170 million on snorkeling.

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The industries that benefit from resident expenditures for reef-related recreation are provided in Table 2.1.2-3. As discussed above, reef-users were asked to breakdown their total expenditures per party-day into 12 categories. These individual categories are shown in Table 2.1.2-3. Aggregate spending in each category was derived by multiplying average spending per party-day for that category by the number of party-days per year (i.e., Table 2.1.1-3). As might be expected, the greatest spending by reef users is for travel to and from the reef system and for boat storage. Thus, boat oil and gas; and marina fees are the two largest expenditures as shown in Table 2.2.2-3. In the four counties, reef users spent \$224 million on boat oil and gas (i.e., travel to a reef) and \$147 million on marina fees (i.e., large boat storage). These two items were nearly 42 percent of all reef-user spending. This was followed by expenditures on food and drink. Expenditures for food in restaurants and from stores constituted \$88 million (10%) and \$80 million (9%), respectively, of total spending.

The retention of resident spending by the existence of artificial and natural reefs in the four county area helps keep jobs in the local economy as discussed above. Table 2.2.2-3 illustrates which industries benefited from having reefs off the coast of these four counties. The Technical Appendix to this report contains a more detailed discussion of the data and methodology used to estimate the economic contribution of resident's use of the reef system.

**Table 2.1.2-3 (Residents)
A Summary of the Economic Contribution by Expenditure Category for Reef Related
Recreational Activities for Southeast Florida, 2000**

Expenditure Category	Total Itemized Expenditures by County (Million 2000\$)				Total Expenditures
	Palm Beach	Broward	Miami- Dade	Monroe	
1. Boat Oil and Gas	\$50	\$67	\$67	\$40	\$224
2. Marina Slip Rentals and Dockage	\$35	\$47	\$53	\$12	\$147
3. Food and Beverages from Restaurants	\$16	\$36	\$17	\$19	\$88
4. Food and Beverages from Stores	\$15	\$22	\$26	\$17	\$80
5. Tackle	\$11	\$25	\$16	\$12	\$64
6. Bait	\$9	\$12	\$19	\$9	\$49
7. Gas for Auto	\$9	\$10	\$16	\$5	\$40
8. Ice	\$5	\$6	\$7	\$6	\$24
9. Equipment Rentals	\$5	\$7	\$7	\$5	\$24
10. Boat Ramp and Parking Fees	\$4	\$5	\$20	\$2	\$31
11. Sundries Such as Sun Screen, Sickness Pills, etc.	\$5	\$7	\$7	\$5	\$24
12. All Other	\$32	\$25	\$20	\$15	\$92
Total Expenditures	\$196	\$269	\$275	\$147	\$887

2.1.3 Use Value

This section provides a summary of the value that southeast Florida resident reef users place on being able to use the reefs in their existing condition. For technical details and alternative use value estimates, please see the technical appendix to this report

In general, use value is measured as the willingness of reef users to pay for a recreational day on the reef. Because reef-users are not charged a price to use the reefs, they receive all of the utility or satisfaction possible from a recreational reef day. Such satisfaction is by its very nature incremental. In other words, reef-users have higher use values for experiences associated with the reef than those who participate in the same activity without the reef. For example, fishers can fish in reef areas or non-reef areas of the Atlantic Ocean or Gulf of Mexico. However, most reef users feel that reefs are responsible for increasing catch rates. This is one factor that increases the satisfaction of the fishing day near the reefs. This phenomenon has been documented by Green (1984), Glassure (1987) and Bell (1992) to mention just a few studies using fishing as an example.

We asked the reef-using respondents a series of questions dealing with their willingness to pay for the reef program. The respondents were asked to consider the total cost of their last boating trip to Southeast Florida including travel expenses, lodging, and all boating expenses. Then, the respondent was asked the following:

“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) in their existing condition.”

Payment amounts (or cost increases) were put in the survey instrument on a random basis (\$10, \$50, \$100, \$200 and \$500). 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. Each respondent was asked for their willingness to pay to maintain the natural reefs and their willingness to pay to maintain the artificial reefs in their existing conditions. For the combined artificial and natural reef program, the payment amounts were doubled.

The purposes of these survey questions were to establish the use value per day from artificial and natural reefs. The expectation is that as the payment is increased, the percent of reef-users willing to pay the added cost would decline. If the percentage of respondents accepting the additional cost starts high and declines very gradually then the willingness to pay (WTP) or use value per trip is high for a particular kind of reef. Respondents were also given the option to say “NO” to all trip cost increases. It would be expected that the percentage of respondents answering “NO” to each cost increase (i.e., payment amount) would increase with the amount of payment since it would become too costly to maintain the reef system for recreational enjoyment at the higher payment values.

Two statistical procedures were used to analyze this question. One is called the Turnbull Distribution and the other is called Dichotomous Choice. An explanation of these procedures is

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provided in the Technical Appendix to this report. The results using the Dichotomous Choice approach are presented in this Final Report.

The above willingness to pay question was asked in three forms: (1) natural reefs separately; (2) artificial reefs separately and (3) a combination of natural and artificial reefs. Since the primary spending unit is the “party”, we interpreted the willingness to pay response to an increase in trip cost to the entire party.

To estimate values per party per trip, the data were pooled for all counties. A logit model was used to estimate the values per-party-per-trip. The logit model tested for differences by county, activity, household income, age of respondent, years of boating experience in South Florida, race/ethnicity, sex, length of boat owned, and whether the respondent is a member of a fishing or diving club.

Separate models were estimated for each of the four reef programs (e.g., natural reefs, existing artificial reefs, natural & artificial reefs combined and new artificial reefs). For the natural reef, existing artificial reefs and the combined programs, the only significant differences found were for those with income greater than \$100. 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 values per party per trip among counties. Also, because party sizes were not significantly different among the counties, the estimated values per person-trip were also the same across counties for each of the reef valuation programs. For residents, a person-trip is equal to one day. Therefore, a person-trip equals a person-day and a party-trip equals a party-day.

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

The results are consistent with the idea that natural reefs are preferred to artificial reefs. Across all counties, the average per person-day value of the natural reefs was \$8.52 versus \$2.99 for artificial reefs. Total use is also higher for natural versus artificial reefs. Across all counties, natural reef use by residents was over 9.6 million person-days versus about 5.0 million person-days for artificial reefs. This translated into an estimate of total annual use value by residents of about \$82 million for natural reefs and \$15 million for artificial reefs. Capitalizing the annual use values, using a three percent interest rate, yields asset values of about \$2.7 billion for the natural reefs and about \$500 million for the artificial reefs. These results are summarized in Table 2.1.3-1.

Annual use value represents the annual flow of total use value (i.e., the recreational benefits) to the reef-using public. From a public policy point of view, government spends money on the protection and management of the valuable resources of the natural and artificial reefs. This includes investments such as deployment of new artificial reefs and enhancements of natural reefs. In addition, government entities incur variable costs each year to support marine patrol, biologists, planners and even contracts with economists to help carry out the mission of

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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.

For the four counties combined, the best estimate is that the total resident use value per year for artificial and natural reefs expressed in 2000 dollars is \$49.5 million. Thus, reef-users receive about \$50 million dollars in recreational use value from participating in fishing, snorkeling and scuba diving near the reef systems compared to not having any reef system at all. Governmental authorities can consider this outcome as the economic benefits that could be sustained with proper maintenance of the existing reef system. On a county level, Miami-Dade has the largest flow of recreational value for the simple reason that they have more person-days, which results from a larger number of registered boats participating in the use of the reef system.

The estimates of use value for the reef system by county become important for public policy programs such as those that protect the existing reef resources. One kind of program involving “No-Take” zones will be discussed below. But, first, we consider the asset value of reefs.

All private land that is owned is rigorously assessed for real estate transactions and taxation. It is often suggested that public lands be sold or rented to private interests. However, little attention is given to what is called the “asset” value of natural resources and man-made resources. In this case, natural reefs are an illustration of the former while artificial reefs are an illustration of the latter.

The capitalized value of reef resources can be calculated by dividing the annual flow of user value by the real discount rate, which is approximately 3 percent. Private land owners and businesses do the same thing only they use the future flow of profits as their annual flow of economic benefits. The last column in Table 2.1.3-1 shows the capitalized value of artificial and natural reefs as calculated using this method. For example, the capitalized value of the artificial reef system deployed by government agencies and other interested groups is estimated to be about \$500 million. Miami-Dade County once again has the largest capitalized value since this county also has the largest flow of use value benefits as discussed above. The natural reef system has a capitalized value of \$2.7 billion or 5.4 times that of the artificial system. This is the case because the use value for natural reefs is much higher than artificial reefs. In addition, more than two-thirds of the total person-days spent on the total reef system are spent on natural reefs.

Table 2.1.3-1 (Residents)
Annual Use Value and Capitalized Value Associated with
Resident Reef Use in Southeast Florida, 2000

County	Total Person-Days	Use Value Per Person-Day of Reef Use	Total Estimated Annual Use Value (Million Dollars)	Capitalized Value at 3% Discount Rate (Million Dollars)
Artificial And Natural Reefs				
Palm Beach	2,978,274	\$3.38	\$10.1	\$335.8
Broward	3,718,019	\$3.24	\$12.0	\$401.3
Miami-Dade	4,505,773	\$3.17	\$14.3	\$476.6
Monroe	3,378,932	\$3.88	\$13.1	\$437.1
Total	14,580,998	\$3.40	\$49.5	\$1,650.8
Artificial Reefs				
Palm Beach	1,075,067	\$2.96	\$3.2	\$106.1
Broward	1,280,601	\$2.81	\$3.6	\$120.1
Miami-Dade	1,540,343	\$2.76	\$4.3	\$141.6
Monroe	1,101,862	\$3.54	\$3.9	\$129.9
Total	4,997,873	\$2.99	\$15.0	\$497.7
Natural Reefs				
Palm Beach	1,903,207	\$8.50	\$16.2	\$539.3
Broward	2,437,418	\$8.17	\$19.9	\$663.8
Miami-Dade	2,965,430	\$8.01	\$23.7	\$791.3
Monroe	2,277,070	\$9.56	\$21.8	\$725.7
Total	9,583,125	\$8.52	\$81.6	\$2,720.1

Finally, some reef-users refuse to pay anything for their use of the reef in terms of increased trip costs. We sometimes call these “protestors” since they really would pay something, but just like to protest government in general. Policy makers will have to deal with this group when it comes to reef management budgets so it is wise to analyze the reasons given for saying “NO” to our hypothetical question. For respondents who answered no to the willingness-to-pay questions, their reasons for saying no are summarized in Table 2.1.3-2.

Table 2.1.3-2 (Residents)
Reason Given by Respondents for "No" Answers to WTP Question

Reason for "No" Answer to WTP Question	Percentage of "NO" Responses for Artificial Reefs	Percentage of "NO" Responses for Natural Reefs
1. Government waste should be reduced to pay for water quality protection and management of the natural reefs.	17.10%	17.00%
2. Not Enough Information	11.10%	10.60%
3. Pay Too Much to Government Already	9.10%	9.80%
4. Reef Not Worth That Contribution	8.90%	2.60%
5. Cannot Calculate Reef Worth	4.70%	2.10%
6. Cannot Understand Question	1.90%	2.80%
7. No Water Quality Problems	1.60%	1.30%
8. Numerous Miscellaneous Concerns	45.60%	53.80%

For artificial reefs, negative reaction was concentrated on the feeling that there is too much government waste already to impose additional cost on users. This was the feeling of natural reef users as well. In addition, some reef users who responded no to the willingness-to-pay questions felt that there was not enough information provided with the question and that they already pay too much to government. Other artificial reef users felt that reef preservation is not worth the incremental trip cost presented to them while natural reef users were less concerned with this cost.

Government programs dealing with reef recreation may be divided into two areas. The first area is the maintenance of the existing artificial and natural reef system. This was the object of the first three willingness-to-pay questions aimed at determining use value of the existing reef system. The second area is that government may add artificial reefs to the existing system.

The resident survey included a question to solicit resident reef users' willingness-to-pay for new artificial reefs. The question is as follows.

Local and state government agencies are being asked to evaluate how users of artificial reefs value new artificial reefs. Artificial reef programs cost money. Suppose that the government proposed that all users of the artificial reefs would pay for all newly constructed reefs. Fishermen and divers with their own boats would pay for a decal as part of their boat registration and/or, if they used a charter/party boat or a rental boat (pay operation), they would pay for the costs through higher fees charged by the pay operation. The money would go into a

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trust fund that could only be used for the construction and maintenance of artificial reefs in southeast Florida.

14. Would you be willing to pay \$ _____ per year when you renew your boat registration and/or the amount in higher fees to a charter/party boat or rental boat operation to fund this program?

Payment amounts of \$5, \$10, \$20, \$30, \$50 and \$100 were assigned randomly. The survey results were statistically analyzed using the logit model.

The logit model estimated for the new artificial reef program found some statistically significant differences. Residents in Palm Beach and Broward counties had higher willingness-to-pay than those from Miami-Dade and Monroe counties. Snorkelers and scuba divers had higher values than those who participated in fishing activities. The only other statistically significant variable was household income. As household income levels increased so did willingness-to-pay for new artificial reefs. On a per party per day basis, the estimated values ranged from a high of \$3.60 for snorkelers and scuba divers from Palm Beach and Broward counties to a low of \$0.63 for those who participated in fishing activities off Miami-Dade and Monroe counties.

As with the other three programs, the estimated per party per day values were multiplied by the total party-days spent on artificial reefs by artificial reefs users in each county to get total annual use value for each county. The total annual use values were then divided by the total annual person-days of artificial reef use in each 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 28 cents in Miami-Dade County to a high of 72 cents in Palm Beach County. Across all four counties, the average was 49 cents per person-day of reef use.

**Table 2.1.3-3 (Residents)
Estimated Resident Use Value of Investing in and Maintaining “New” Artificial Reefs**

County	Total Person-Days for Artificial Reefs	Use Value Per Person-Day of Artificial Reef Use	Total Estimated Annual Use Value (Million Dollars)	Capitalized Value at 3% Discount Rate (Million Dollars)
Palm Beach	1,075,067	\$0.72	\$0.777	\$25.9
Broward	1,280,601	\$0.60	\$0.762	\$25.4
Miami-Dade	1,540,343	\$0.28	\$0.436	\$14.5
Monroe	1,101,862	\$0.42	\$0.467	\$15.6
Total	4,997,873	\$0.49	\$2.442	\$81.4

The addition of “new” artificial reefs is estimated to add \$2.4 million to the use value for resident artificial reef-users in the four-county area. This program will add a capitalized value of \$81.4

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million dollars to an artificial reef system worth nearly \$500 million according to our estimates in Table 2.1.3-1. Even though Miami-Dade County had the highest amount of artificial reef use, it did not have the highest total annual use value because of the relatively low value per person-day. For government benefit/cost analysis, the annual use value would be compared to the annual cost of artificial reef deployment and associated maintenance and administration costs.

It is of interest that slightly over 75 percent of the respondents refused to pay the amount given to them in the question for additional artificial reefs. Of course, these amounts varied from \$10 to \$100 per year. Those answering “NO” to the increased annual cost felt that government should fund this program out of general revenue (15.5 percent) rather than levy a specific tax on reef-users. Other “protestors” felt that there was presently too much government waste (13.3 percent) and that the increased cost was more than the new reef would be worth (10.6 percent). Finally, the theme that government already receives too much in taxes was repeated by 8.3 percent of the respondents.

2.1.4 Role of “No-Take” Zones

Reefs play a vital role in the entire oceanic ecosystem by providing habitat and protection for young fish and other creatures. A no-take zone is a designated area of the reef systems in which nothing is to be taken from this area, including fish and shellfish. To provide a net benefit, it is argued that “no-take” zones would actually increase the total pie available to users. Supporters of “no-take” zones point to the overuse of common property resources such as ocean fisheries by both recreational and commercial interests. In effect, “no-take” zones would vest the property right with the government. In theory, “no-take” zones would increase fish and coral populations to the carrying capacity of the specified area with benefits spilling over into areas used by recreational and even commercial users. Some question these alleged benefits and opposed the imposition of such zones. Therefore, as part of this study, we were asked to obtain the opinion of resident artificial and natural reef-users regarding “no-take” zones as management tools. The results are shown in Table 2.1.4-1.

Under the National Marine Sanctuary Act, 23 areas or zones were created where the taking of anything including fish and shellfish has been prohibited since 1997 in the Florida Keys. It is reasonable to assume that residents of neighboring counties may have formed an opinion about this management effort. Apparently, it is a favorable opinion because of the respondents surveyed from the four counties, about three quarters support “no-take” zones in the Florida Keys. However, do respondents want this management tool used in “their own backyard”? Although somewhat less supportive, between 57 percent and 65 percent of all respondents support the use of “no-take” zones off their county shores. Since the Florida Keys are in Monroe County, we asked the residents of that county whether they would be willing to support additional “no-take” zones off their county. Nearly 60 percent were still in favor of extending this management tool to additional areas.

Table 2.1.4-1 (Residents)
A Summary of the Opinion of Resident Reef-Users on "No Take" Zones in Southeast Florida, 2000

Question: "Support "No Take" Zones in the Florida Keys"			
County	Percentage of Respondents Answering "Yes"	Percentage of Respondents Answering "No"	Percentage of Respondents Answering "Don't Know"
Palm Beach	75.7%	14.5%	9.8%
Broward	74.9%	17.9%	7.2%
Miami-Dade	73.6%	18.8%	7.6%
Monroe	78.1%	17.9%	3.8%
Question: "Support "No Take" Zones on Some Reefs in Your County"			
County	Percentage of Respondents Answering "Yes"	Percentage of Respondents Answering "No"	Percentage of Respondents Answering "Don't Know"
Palm Beach	65.1%	22.9%	11.9%
Broward	63.4%	26.6%	9.7%
Miami-Dade	60.6%	27.7%	10.6%
Monroe ¹	56.9%	20.5%	21.9%
Question: "Support "No Take" Zones on Some Reefs Off Palm Beach, Miami-Dade and Broward Counties"			
County	Percentage of Respondents Answering "Yes"	Percentage of Respondents Answering "No"	Percentage of Respondents Answering "Don't Know"
Palm Beach	64.7%	21.2%	13.9%
Broward	63.9%	23.9%	12.1%
Miami-Dade	61.4%	27.6%	9.7%
Monroe	44.3%	38.5%	16.9%
Question: "What Percentage of Coral or Natural Reefs in Your County Would Be Reasonable to Protect Using "No Take" Zones?"			
County	Average Percentage		Median Percentage
Palm Beach	29.9%		20.0%
Broward	35.0%		25.0%
Miami-Dade	30.0%		20.0%
Monroe	32.0%		20.0%

¹ Since Monroe County already has "no take" zones, the word "additional" was inserted into this question for Monroe County surveys.

Since resident reef-users in the Florida Keys have been the subject of this experiment, it is indeed impressive that they are convinced enough of the "net benefits theory" to extend this management tool to other areas off the shores of their counties. A clear majority of the respondents in three of the four counties were in favor of having "no-take" zones (e.g. Palm Beach, Broward and Miami-Dade Counties). Only 44.3 percent of the respondents in Monroe

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County were in favor of extending such zones northward. It is not clear why the “no-take” zones in northern areas lost majority support by the resident respondents in Monroe County.

Finally, we asked what percentage of natural reefs should be protected using this management tool. Respondents from all counties indicated on average that 30 percent to 35 percent of natural reefs should be protected using this method. This gives the regulatory authority some idea of what reef-users feel is reasonable regarding this protection strategy.

However, the imposition of “no-take” zones is not necessarily consistent with maximizing net benefits to all users. This is still under study in the Florida Keys and elsewhere in the world. Since averages may be skewed by exceptionally larger answers, we also looked at the median answer (i.e., half the distance between the highest and lowest answer). The median was much lower than the average reported above and ranged from 20 percent to 25 percent. This may be a better estimate to use since it is both conservative and minimizes the influence of high and low responses including protest responses (e.g. respondents that answer no or zero to every proposal). Apparently, reef-users endorse the idea of the “no-take” zones and desire over 20 percent of the existing natural reefs to be designated off limits to recreational activity to benefit the entire group of reef-users. Such a result provides public officials with information important to the management of the reef system from Palm Beach to Monroe County.

2.1.5 Demographic Information

The mail survey included questions regarding demographic characteristics of respondents. The reason for collecting this type of information is to determine just what segment of the population will benefit from deploying artificial reefs, continued preservation of natural reefs and/or designating “no-take” zones as discussed in the last section. Respondents were asked to provide some background on both themselves and their boating experience. Table 2.1.5-1 provides the results from the mail survey combined with comparable information for the counties in the study area.

In general, owners of registered boats who use the reef system are older than the general population as measured by the median age. In Monroe County, the age difference is quite substantial. Among the four counties, the average respondent is predominately male. For example, 93 percent of respondents in Miami-Dade County were male compared to 48.4 percent in the general population of that county.

With respect to race, boat owners responding to the survey were predominately white in all counties. Palm Beach County had the highest percentage of boat owners who indicated they were white at 97 percent while none of the respondents indicated they were black. This is consistent with county data showing Palm Beach with the lowest percentage of blacks in the population among the four counties surveyed. As a percent of the population, those respondents identifying themselves as Hispanic/Latino were less than 7 percent except in Miami-Dade County where nearly 33 percent of the respondents were in this category. This distribution follows the Hispanic/Latino concentration in each county except that as a percentage of registered boat owners it is lower than countywide percentages.

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For all the counties, about one-half of the respondents had completed college or a more advanced degree. This is higher than the percentage of individuals that have completed these education levels in the general population for 1990.³ Although these percentages have certainly risen for the general public since 1990, there is no question that boat owners responding to the survey are more highly educated than the general population. The reason for this statement is the very high correlation between education and income. The median income level reported by boat owners in the survey is much higher than the general population in all counties in the study area. The median household income reported by respondents is nearly double that of the general population. Of course, the purchase of a relatively large pleasure craft is associated with higher income as found by Bell and Leeworthy (1986). Thus, boat owners tend to be older, affluent white males with a higher degree of education.

The results of the survey were also used to estimate the lower bound on how many residents in the four county area participated in reef-using recreational activities. This was done by multiplying the number of estimated reef-using boats by the average size of the party. In the four-county area, it was estimated that there are 88,489 registered boats that use the reef system with an average party size of 3.83 individuals per trip. Therefore, there are 338,913 residents, at a minimum, that participated in reef-based outdoor recreation. The term “minimum” is used because the turnover rate of the parties is unknown. That is, the same residents may not go boating on every trip. Therefore, 3,801,268 residents 15 years and older in the four county area can be characterized as the population from which the boating party is drawn. At a minimum, an estimated 8.8 percent of this population might be engaged in recreation, based upon the use of the artificial and natural reef system. This may be useful in answering questions of public policy dealing with just how many and what percent of the population may gain from programs directed at the reef system.

Finally, we obtained information on what is called the “boater profile”. This is included in Table 2.1.5-2. The average reef-using boater has lived in his or her present county from 16 (Monroe) to 33 (Miami-Dade) years. In addition, the average resident boater has been boating from his or her county of residence for almost as long. The average boat owned by the reef-users ranges from 23 feet in length in Miami-Dade County to 25 feet in length in both Palm Beach and Broward Counties. These sample values are comparable to the average size of boats over 16 feet in length in the boat registration database, which average 25 feet long. Finally, from 15.4 percent (Monroe) to 19.9 percent (Palm Beach) of the reef using population are members of fishing and/or diving clubs.

³ 1990 was the last time the U.S. Census Bureau obtained educational levels at the county level.

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Table 2.1.5-1 (Residents)
A Summary of the Demographic Characteristics of Reef-Users in Southeast Florida, 2000

Median Age of Respondent	Reef-Users			County Population		
Palm Beach	48			45.5		
Broward	48			39.8		
Miami-Dade	46			35.9		
Monroe	54			41.0		
Sex Of Respondent	Reef-Users			County Population		
	Male	Female		Male	Female	
Palm Beach	91.10%	8.90%		48.00%	52.00%	
Broward	92.10%	7.90%		48.10%	51.90%	
Miami-Dade	93.50%	6.50%		48.40%	51.60%	
Monroe	85.60%	14.40%		50.60%	49.40%	
Race Of Respondent	Reef-Users			County Population		
	White	Black	Other	White	Black	Other
Palm Beach	97.30%	0%	2.70%	79.10%	13.80%	7.10%
Broward	93.10%	2.20%	4.80%	70.60%	20.50%	8.90%
Miami-Dade	87.90%	1.30%	10.80%	69.70%	20.30%	10.00%
Monroe	93.60%	0.20%	6.20%	90.70%	2.30%	7.00%
Percent Hispanic/Latino	Reef-Users			County Population		
Palm Beach	4.30%			12.40%		
Broward	4.70%			15.50%		
Miami-Dade	32.70%			57.30%		
Monroe	6.80%			15.80%		
Education Level: Percentage Completed College Or More	Reef-Users			County Population¹		
Palm Beach	52.50%			16.20%		
Broward	49.60%			13.40%		
Miami-Dade	56.70%			12.40%		
Monroe	56.60%			16.70%		
Median Household Income	Reef-Users			County Population		
Palm Beach	\$71,695			\$39,560		
Broward	\$72,310			\$37,431		
Miami-Dade	\$69,722			\$36,846		
Monroe	\$56,393			\$31,922		

1 Latest available data on educational level by county is for 1990.

**Table 2.1.5-2 (Residents)
Boater Profile of Reef-Users in Southeast Florida, 2000**

Average Years Living in County	
County	Average Years
Palm Beach	23
Broward	26
Miami-Dade	33
Monroe	16

Average Years Boating in South Florida	
County	Average Years
Palm Beach	21
Broward	22
Miami-Dade	25
Monroe	22

Average Length of Boat Used for Salt Water Activities	
County	Average Length
Palm Beach	25
Broward	25
Miami-Dade	23
Monroe	24

Percentage of Respondents That Belong to Fishing and/or Diving Clubs	
County	Percent
Palm Beach	19.9%
Broward	18.9%
Miami-Dade	17.7%
Monroe	15.4%

2.2 Visitors

The focus of this section is the socioeconomic value of the reefs associated with visitors to each of the four southeast Florida counties. 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 in Monroe County 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 information regarding visitors to each of the four counties: reef user activity, economic contribution of the reefs, use value of the reefs and demographic information.

2.2.1 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 each county must be estimated. Total visitation includes visits to a county by non-residents of that 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 model uses the following information for each county. The number of hotel/motel rooms in each county during the study period (June 2000 to May 2001) and the average hotel/motel occupancy rate during the summer and winter of the same study period was obtained from the counties. Summer is defined from June 2000 to November 2000 and winter is defined from December 2000 to May 2001. The model also requires estimates of average party size for those using hotel and motel accommodations, the average trip length in nights for those staying in hotels/motels, and the proportion of visitors who stay in hotels/motels. This information was obtained from the general visitor survey responses.

The equation for the Capacity Utilization Model is as follows.

$$\begin{aligned} &\text{Total Number of Person-Trips by All Visitors to the County During a Season} = \\ &\quad (\text{Hotel/Motel Occupancy Rate} \times \text{Number of Hotel/Motel Rooms} \times \\ &\quad 183 \text{ Days in the Season} \times \text{Average Party Size for those Using Hotels/Motels}) \\ &\quad \text{divided by} \\ &\quad \text{Average Trip Length in Nights for those staying in Hotels/Motels} \\ &\quad \text{divided by} \\ &\quad \text{Proportion of Visitors who stay at Hotels/Motels} \end{aligned}$$

The results for each of the four counties are provided in Table 2.2.1-1 and Table 2.2.1-2, for the summer and winter seasons, respectively.

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**Table 2.2.1-1 (Visitors)
Results of Capacity Utilization Model
Calculation of Number of Person-Trips to County
Summer Season (June 2000 to November 2000)**

Variable	Summer			
	Palm Beach	Broward	Miami-Dade	Monroe
Hotel/Motel Occupancy Rate (k) ^a	0.629	0.662	0.660	0.673
Average Number of Hotel/Motel Rooms During the Year (R) ^b	16,076	28,600	48,000	8,916
Number of Days in Season (p)	183	183	183	183
Average Size of Party for those using hotels/motels (SP) ^c	1.80	2.55	2.86	2.65
Average Trip Length in Nights for those staying in hotels/motels (LS) ^d	3.99	6.26	5.94	4.03
Proportion of Visitors who stay at hotels/motels (g) ^e	0.43	0.42	0.42	0.56
Estimated Number of Person Trips by Visitors who used hotels/motels = $k \times R \times p \times SP / LS$	832,110	1,404,824	2,782,827	720,322
Estimated Total Number of Person Trips by All Visitors to County = $k \times R \times p \times SP / LS / g$	1,938,327	3,314,292	6,574,428	1,288,464

^a Palm Beach County - For year ending September 30, 2000; Broward, Miami-Dade and Monroe Counties - For calendar year 2000. Sources: Palm Beach County Tourist Development Council, Greater Fort Lauderdale Convention and Visitors Bureau, Greater Miami Convention and Visitors Bureau; Monroe County Tourist Development Council. All rates are from Smith Travel Research.

^b Data represent 1999. Source: Florida Department of Professional Regulation, Division of Hotels and Restaurants.

^c From General Visitor Survey responses to Question 25 for parties who stayed in hotels/motels and party size was five or fewer people.

^d From General Visitor Survey responses to Questions 8 (On this trip, how many nights will you have spent in county?) for those respondents who stayed at hotels/motels on this trip.

^e From General Visitor Survey responses to Question 10 (Where are you staying on this trip?). Proportion equal to number of respondents staying at hotel or motel divided by all respondents. All respondents include all accommodation modes and day-trippers (no accommodation) and exclude cruise ship passengers who disembark at Key West for a day trip.

**Table 2.2.1-2 (Visitors)
Results of Capacity Utilization Model
Calculation of Number of Person-Trips to County
Winter Season (December 2000 to May 2001)**

Variable	Winter			
	Palm Beach	Broward	Miami-Dade	Monroe
Hotel/Motel Occupancy Rate (k) ^a	0.744	0.763	0.738	0.730
Average Number of Hotel/Motel Rooms During the Year (R) ^b	16,076	28,600	48,000	8,916
Number of Days in Season (p)	183	183	183	183
Average Size of Party for those using hotels/motels (SP) ^c	1.92	2.35	2.24	2.46
Average Trip Length in Nights for those staying in hotels/motels (LS) ^d	8.28	5.00	6.27	5.08
Proportion of Visitors who stay at hotels/motels (g) ^e	0.22	0.31	0.38	0.46
Estimated Number of Person Trips by Visitors who used hotels/motels = $k \times R \times p \times SP / LS$	506,882	1,873,450	2,306,184	575,605
Estimated Total Number of Person Trips by All Visitors to County = $k \times R \times p \times SP / LS / g$	2,313,013	6,088,714	6,039,217	1,263,466

Note: See Table 2.2.1-1 for footnotes.

The number of person-trips for the year 2000-2001 is summarized in Table 2.2.1-3 for each county. The number of cruise ship passengers who disembarked at Key West during the study period was added to the number of person-trips for Monroe County. The number of cruise ship passengers docking at Key West by month was obtained from the Monroe County Tourist Development Council. These numbers were multiplied by an estimate of the proportion of passengers who actually disembark to visit Key West for a half-day (0.9883 for summer and 0.9547 for winter). This proportion was obtained from Leeworthy, 1996 and is based on a NOAA study of cruise ship passengers in Key West.

Table 2.2.1-3 (Visitors)
Number of Person-Trips to Each County
All Visitors
June 2000 to May 2001

County	Number of Person-Trips (millions)		
	Summer - 00	Winter - 01	Total
Palm Beach	1.94	2.31	4.25
Broward	3.31	6.09	9.40
Miami-Dade	6.57	6.04	12.61
Monroe ^a	1.51	1.60	3.11
Total	13.33	16.04	29.37

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

Next, the number of person-trips was converted to number of person-days. For each county, the number of person-trips, as presented on the last rows of Tables 2.2.1-1 and 2.2.1-2 (net of cruise ship passengers), was distributed to the different types of accommodation modes and day-trippers. This distribution was based on the general survey responses to Question 10 (Where are you staying on this trip?) and Question 8 (On this trip, how many nights will you have spent?). The proportions of respondents by accommodation are provided in Table 2.2.1-4.

Table 2.2.1-4 (Visitors)
Proportion of General Visitor Respondents Surveyed by Accommodation

Accommodation	County							
	Palm Beach		Broward		Miami-Dade		Monroe	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Day Trippers	0.12	0.20	0.13	0.21	0.25	0.34	0.15	0.09
Hotel/Motel/Guest House/Bed & Breakfast	0.43	0.22	0.42	0.31	0.42	0.38	0.56	0.46
Home of Family and Friends	0.36	0.40	0.32	0.24	0.27	0.18	0.07	0.07
Campground	0.00	0.07	0.03	0.11	0.01	0.04	0.16	0.32
Condominium or Second Home (own)	0.08	0.09	0.04	0.04	0.03	0.03	0.04	0.03
Vacation Rental	0.00	0.02	0.02	0.04	0.01	0.01	0.02	0.03
Time Share	0.01	0.01	0.03	0.05	0.01	0.01	0.00	0.01
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
No. of Respondents	396	397	486	260	378	364	635	529

Then, for each accommodation mode and the day-trippers, the number of person-trips was multiplied by average number of days per trip from Question 8. The average number of days per

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trip is provided in Table 2.2.1-5. Then the number of person-trips by accommodation mode and day-trippers was summed over all accommodation modes and day-trippers. The numbers of cruise ship passengers who disembark at Key West for the day were added to the Monroe County results. The numbers of person-days all visitors spent in each county are presented in Table 2.2.1-6.

Table 2.2.1-5 (Visitors)
Average Number of Days Per Trip by Accommodation
General Visitor Survey

Accommodation	County – Summer				County – Winter			
	Palm Beach	Broward	Miami-Dade	Monroe	Palm Beach	Broward	Miami-Dade	Monroe
Day Trippers	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hotel/Motel/Guest House/Bed & Breakfast	4.99	7.26	6.94	5.03	9.28	6.00	7.27	6.08
Home of Family and Friends	8.46	10.79	10.31	5.36	11.66	10.24	12.44	6.26
All Other Accommodations ^a	17.83	9.02	12.39	5.03	40.85	21.06	16.03	11.54

^a All Other Accommodations include campground, condo or second home, vacation rental and time-share.

Source: General Visitor Survey responses to Question 8 (on this trip, how many nights have you spent in this county) plus 1.

Table 2.2.1-6 (Visitors)
Number of Person-Days Spent in Each County
All Visitors
June 2000 to May 2001

County	Number of Person-Days (Millions)		
	Summer - 00	Winter - 01	Total
Palm Beach	13.41	33.44	46.85
Broward	25.94	58.69	84.63
Miami-Dade	44.19	56.43	100.62
Monroe ^a	5.54	6.60	12.13
Total	89.08	155.16	244.23

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

The number of person-trips by all visitors is 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

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12 months in this county?) for one boating activity per respondent divided by the total number of respondents.

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 2.2.1-7 to 2.2-9.

**Table 2.2.1-7 (Visitors)
Person-Trips of Visitors Who Boated
And Visitors Who Used the Reefs Over the Past 12 Months
Summer 2000**

County	Summer – June 2000 to November 2000				
	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
Palm Beach	1,938,327	0.16	306,304	0.98	299,522
Broward	3,314,292	0.20	668,204	0.99	663,312
Miami- Dade	6,574,428	0.28	1,843,418	0.91	1,682,421
Monroe	1,513,099	0.33	502,031	0.90	450,077
Total	13,340,147		3,319,957		3,095,332

^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) for one boating activity divided by total number of respondents.

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

**Table 2.2.1-8 (Visitors)
Person-Trips of Visitors Who Boated
And Visitors Who Used the Reefs Over the Past 12 Months
Winter 2001**

County	Winter - December 2000 to May 2001				
	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
Palm Beach	2,313,013	0.14	330,430	0.98	323,115
Broward	6,088,714	0.19	1,145,612	0.99	1,137,225
Miami- Dade	6,039,217	0.13	768,919	0.91	701,764
Monroe	1,596,298	0.26	413,226	0.90	370,462
Total	16,037,242		2,658,187		2,532,566

Note: See Table 2.2.1-7 for an explanation of the footnotes.

**Table 2.2.1-9 (Visitors)
Person-Trips of Visitors Who Boated
And Visitors Who Used the Reefs Over the Past 12 Months
June 2000 to May 2001**

County	Year Round - June 2000 to May 2001		
	Total Person Trips – All Visitors	Boating Person Trips	Boating Person Trips When the Reefs Were Used for Recreation
Palm Beach	4,251,341	636,734	622,637
Broward	9,403,006	1,813,816	1,800,537
Miami-Dade	12,613,645	2,612,337	2,384,185
Monroe	3,109,397	915,257	820,539
Total	29,377,389	5,978,144	5,627,898

Next, the total number of person-days that visitor boaters who used the reefs spent visiting the county was estimated. This estimate is the total boating person-trips when reefs were used times the average days per visit by boaters who use the reefs. The average days per visit by boaters who used the reefs was obtained from the answers to Question 10 of the Visitor Boater Survey (How many nights are you spending on this trip?) where a 1 was added to each answer to represent number of days. The average number of days and the total person days reef users spent in the county in 2000-2001 are provided in Table 2.2.1-10 for each county.

**Table 2.2.1-10 (Visitors)
Average Number of Days Visiting County
And Total Person-Days in County
By Visitor Boaters Who Used the Reefs**

County	Average Days Visiting the County Per Trip	Total Person-Days Spent Visiting the County
Palm Beach	5.36	3,336,923
Broward	8.47	15,252,053
Miami-Dade	7.58	18,068,870
Monroe	8.39	6,887,497
Total		43,545,343

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.

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

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

The proportions of visitor days that visitor boaters who use the reefs participated in fishing and diving/snorkeling are presented in Tables 2.2.1-11 and 2.2.1-12. These tables also provide the proportion of fishing days and scuba/snorkeling dives that visitor boaters spent on the artificial, natural and no reefs. For example, visitor boaters who came to Broward County to use the reefs spent 27 percent of their visiting days participating in saltwater fishing from a charter, party, rental or private boat. Of these fishing days, 47 percent of days were spent fishing near artificial reefs, 52 percent of days were spent fishing near natural reefs and 1 percent of days were spent fishing near no reefs. In Palm Beach County, visitor boaters who came to the county to use the reefs spent 32 percent of their visiting days scuba diving or snorkeling. Of these diving/snorkeling days, 25 percent of days were spent on artificial reefs, 74 percent of days were spent on natural reefs, and 1 percent of days were spent on no reefs.

Table 2.2.1-11 (Visitors)
Percent of Visitor Person-Days That Reef-Using Boaters Went Saltwater Fishing
And Percent of Fishing Days Spent on Artificial, Natural and No Reefs
From Visitor Boater Survey

County	Total Respondents	Percent of Visitor Days	Percent of Fishing Days on:			Sum of Proportions
			Artificial Reefs	Natural Reefs	No Reefs	
Palm Beach	490	10%	21%	45%	34%	100%
Broward	252	27%	47%	52%	1%	100%
Miami-Dade	339	22%	24%	61%	15%	100%
Monroe	1,392	26%	20%	40%	40%	100%

Note: Boating Modes are Charter, Party, Rental, and Private (Own or Friend's) Boat.

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Table 2.2.1-12 (Visitors)
Percent of Visitor Person-Days That Reef-Using Boaters Went Scuba Diving or Snorkeling
And Percent of Diving/Snorkeling Dives Spent on Artificial, Natural and No Reefs
From Visitor Boater Survey

County	Total Respondents	Percent of Visitor Days	Percent of Dives on:			
			Artificial Reefs	Natural Reefs	No Reefs	Sum of Proportions
Palm Beach	490	32%	25%	74%	1%	100%
Broward	252	22%	51%	48%	1%	100%
Miami-Dade	339	8%	32%	65%	3%	100%
Monroe	1,392	17%	16%	80%	4%	100%

Note: Boating Modes are Charter, Party, Rental, and Private (Own or Friend's) Boat.

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 2.2.1-10) times the proportion of visitor days that these visitors spent participating in each activity-boat mode. Then the number of person-days spent in each saltwater boating activity-boat mode was allocated to artificial and natural reefs based on either the proportion of days or the proportion of dives spent in that activity-boat mode on or near artificial versus natural reefs. Proportion of days was used for all activities except scuba diving and snorkeling where the proportion of dives was used to provide a more accurate indicator of reef use.

A summary of the total person-days that visitors spent participating in all activity-boat modes by type of reef is provided in Table 2.2.1-13. A summary of total person days visitors spent participating in each activity for each county is provided in Tables 2.2.1-14 through Tables 2.2.1-17. The total person-days visitors spent participating in all saltwater activities and boat modes by type of reef is provided in Tables 2.2.1-18 to 2.2.1-21 for each county.

Table 2.2.1-13 (Visitors)
Total Person-Days Visitors Spent on Artificial and Natural Reefs by County
June 2000 to May 2001 (Millions)

County	Number of Visitor Person Days on:		
	Artificial Reefs	Natural Reefs	All Reefs
Palm Beach	0.33	0.93	1.26
Broward	2.69	3.03	5.72
Miami-Dade	1.41	3.25	4.66
Monroe	0.48	1.60	2.08
All Counties	4.91	8.81	13.72

Visitors to the four counties spent about 14 million person-days on the reef systems of southeast Florida from June 2000 to May 2001. About 5 million of these days were spent on artificial reefs and about 9 million of these days were spent on natural reefs.

Table 2.2.1-14 (Visitors)
Number of Person-Days Spent Using Artificial and Natural Reefs
By Recreation Activity – Palm Beach County

Activity	Number of Person-Days		
	Artificial Reefs	Natural Reefs	All Reefs
Snorkeling	36,940	90,544	127,484
Scuba Diving	237,921	681,802	919,723
Fishing	55,252	158,329	213,580
Glass Bottom Boat Sightseeing	0	0	0
Total	330,112	930,675	1,260,787

Table 2.2.1-15 (Visitors)
Number of Person-Days Spent Using Artificial and Natural Reefs
By Recreation Activity – Broward County

Activity	Number of Person-Days		
	Artificial Reefs	Natural Reefs	All Reefs
Snorkeling	87,669	266,717	354,386
Scuba Diving	1,587,123	1,433,074	3,020,197
Fishing	1,003,641	1,289,745	2,293,386
Glass Bottom Boat Sightseeing	16,483	37,675	54,157
Total	2,694,915	3,027,210	5,722,125

Table 2.2.1-16 (Visitors)
Number of Person-Days Spent Using Artificial and Natural Reefs
By Recreation Activity – Miami-Dade County

Activity	Number of Person-Days		
	Artificial Reefs	Natural Reefs	All Reefs
Snorkeling	281,347	599,359	880,706
Scuba Diving	168,664	270,813	439,477
Fishing	959,302	2,363,723	3,323,024
Glass Bottom Boat Sightseeing	3,124	14,060	17,184
Total	1,412,438	3,247,954	4,660,392

Table 2.2.1-17 (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	74,999
Total	478,395	1,598,467	2,076,862

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Table 2.2.1-18 (Visitors)
Number of Person-Days Visitors Spent Participating in Saltwater Boating Activities and Reef Use - June 2000 to May 2001
Palm Beach County

Activity	Boat Mode	Number of Person Days	Number of Person-Days on:		
			Artificial Reefs	Natural Reefs	No Reefs
Snorkeling	Charter/Party	34,171	6,276	27,895	0
	Rental	9,528	5,558	3,970	0
	Private	83,785	25,105	58,679	0
Scuba Diving	Charter/Party	795,460	179,124	607,859	8,477
	Rental	5,257	1,643	3,614	0
	Private	127,484	57,155	70,329	0
Fishing – Offshore / Trolling	Charter	39,428	5,399	18,221	15,808
	Party	73,270	10,032	33,861	29,377
	Rental	16,428	0	986	15,443
	Private	115,655	32,937	64,004	18,714
Fishing – Flats or Back Country	Charter/Party	329	0	0	329
	Rental	329	0	0	329
	Private	657	0	657	0
Fishing Bottom	Charter	18,071	2,474	8,351	7,245
	Party	32,200	4,409	14,881	12,910
	Rental	0	0	0	0
	Private	39,428	0	17,367	22,061
Viewing Nature and Wildlife	Glass Bottom Boat	0	0	0	0
	Back Country Excursion	986	0	0	986
	Rental	5,914	0	0	5,914
	Private	23	0	0	23
Personal Watercraft (jet skis, wave runners, etc.)	Rental	2,629	0	0	2,629
	Private	42,714	0	0	42,714
Sailing	Charter/Party	657	0	0	657
	Rental	1,314	0	0	1,314
	Private	34,171	0	0	34,171
Other Boating Activities	Charter/Party	4,929	0	0	4,929
	Rental	0	0	0	0
	Private	33,185	0	0	33,185
Total Person-Days		1,540,978	330,112	930,675	280,190

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Table 2.2.1-19 (Visitors)
Number of Person-Days Visitors Spent Participating in Saltwater Boating Activities and Reef Use - June 2000 to May 2001
Broward County

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

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Table 2.2.1-20 (Visitors)
Number of Person-Days Visitors Spent Participating in Saltwater Boating Activities and Reef Use - June 2000 to May 2001
Miami-Dade County

Activity	Boat Mode	Number of Person Days	Number of Person-Days on:		
			Artificial Reefs	Natural Reefs	No Reefs
Snorkeling	Charter/Party	144,205	51,231	79,692	13,282
	Rental	0	0	0	0
	Private	751,307	230,116	519,667	1,524
Scuba Diving	Charter/Party	142,763	25,318	102,677	14,769
	Rental	0	0	0	0
	Private	311,483	143,347	168,136	0
Fishing – Offshore / Trolling	Charter	288,410	93,657	114,974	79,778
	Party	501,833	162,964	200,056	138,814
	Rental	347,534	139,013	208,520	0
	Private	1,455,027	318,640	817,748	318,640
Fishing – Flats or Back Country	Charter/Party	1,442	0	0	1,442
	Rental	0	0	0	0
	Private	637,386	59,393	538,880	39,112
Fishing Bottom	Charter	18,747	6,088	7,473	5,186
	Party	233,612	75,862	93,129	64,620
	Rental	0	0	0	0
	Private	501,833	103,684	382,941	15,207
Viewing Nature and Wildlife	Glass Bottom Boat	18,747	3,124	14,060	1,562
	Back Country Excursion	0	0	0	0
	Rental	2,884	0	0	2,884
	Private	341,766	0	0	341,766
Personal Watercraft (jet skis, wave runners, etc.)	Rental	30,283	0	0	30,283
	Private	73,544	0	0	73,544
Sailing	Charter/Party	23,073	0	0	23,073
	Rental	7,210	0	0	7,210
	Private	235,054	0	0	235,054
Other Boating Activities	Charter/Party	46,146	0	0	46,146
	Rental	2,884	0	0	2,884
	Private	194,677	0	0	194,677
Total Person-Days		6,311,847	1,412,438	3,247,954	1,651,455

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Table 2.2.1-21 (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	478,395	1,598,467	1,633,554

2.2.2 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 the activity-boat mode are provided for each county in Tables 2.2.2-1 through 2.2.2-4. For example, Palm Beach County visitors who went scuba diving or snorkeling on charter or party boats spent, on average, \$138 per person per day. This expenditure was comprised of \$56 per day for the dive charter or party boat, \$21 per day for lodging and \$21 per day for food and beverages in restaurants and bars, among other items. As can be seen from Palm Beach County's daily expenditure table, visitors who fish via charter boats spent significantly more per person per day than visitors who dive or who fish via other boating modes. This also is the case for Miami-Dade and Monroe counties primarily due to the greater expense associated with renting a charter boat.

The lodging expenditure item includes lodging costs for hotels, motels and campgrounds or if the respondent paid by the day or by the week for the other accommodations. The \$21 per person per day for lodging may seem lower than the actual per person rate of a hotel or motel. Bear in mind that only a portion of visitors stay at a hotel or motel. Visitor accommodations also include campgrounds, family or friends, second homes and time-shares. Also, as discussed previously, many visitors spend only one day in the county and therefore do not incur the cost of a room. The cost of the second home or time share is not included in the lodging cost because this is a monthly or up front cost that can, at best, only be partially due to the existence of the reefs.

The number of person-days multiplied the expenditures per person per day 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 2000-2001 are provided in Tables 2.2.2-5 through 2.2.2-8 for each county. 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.

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

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goods and services from other industries in the county. Induced effects are created when the employees of the direct and indirect industries spend their money in the county.

Table 2.2.2-1 (Visitors)
Amount of Money Spent in County Per Person During Most Recent Day
Participating in Each Reef-Related Activity and Boating Mode
Palm Beach 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		\$96.00	\$24.41		\$56.26
Boat Rental				\$0.94	
Boat Fuel	\$58.84			\$38.40	
Air Refills				\$1.86	\$1.67
Tackle	\$28.21				
Bait	\$6.22				
Ice	\$1.96			\$1.56	\$0.06
Ramp Fees	\$4.80			\$15.12	\$0.01
Marina Fees	\$30.63			\$21.23	\$0.17
Lodging	\$7.36	\$28.68	\$17.84	\$1.72	\$20.60
Camping Fees	\$0.00	\$0.00	\$0.00	\$0.45	\$0.67
Food and Beverages - Stores	\$11.71	\$16.03	\$13.77	\$17.66	\$8.34
Food and Beverages - Restaurants/Bars	\$23.12	\$33.54	\$29.74	\$19.39	\$21.54
Auto Gas	\$3.85	\$30.70	\$2.89	\$3.36	\$8.24
Auto Rental	\$8.99	\$29.29	\$10.69	\$5.80	\$9.12
Equipment Rental	\$1.73	\$0.00	\$4.97	\$0.50	\$2.09
Shopping	\$7.99	\$28.88	\$11.20	\$9.39	\$9.68
Total	\$195.42	\$263.13	\$115.50	\$137.37	\$138.48
Number of Respondents	47	19	78	42	314
Number of Respondents and Party Members ^c	152	51	176	137	718

^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. The total number of respondents and party members who spent or benefited from the expenditures divided this sum.

^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.

Table 2.2.2-2 (Visitors)
Amount of Money Spent in County Per Person During Most Recent Day
Participating in Each Reef-Related Activity and Boating Mode
Broward County
From Visitor Boater Survey Responses – 2000 Dollars

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

^a Expenditures per person per day were estimated from the responses to the Visitor Boater Survey. For each Activity_Mode, the expenditures for each item were summed over all the respondents who participated in the Activity_Mode. The total number of respondents and party members who spent or benefited from the expenditures divided this sum.

^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.

Table 2.2.2-3 (Visitors)
Amount of Money Spent in County Per Person During Most Recent Day
Participating in Each Reef-Related Activity and Boating Mode
Miami-Dade 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		\$75.26	\$30.47		\$30.50
Boat Rental				\$6.80	
Boat Fuel	\$38.28			\$17.12	
Air Refills				\$6.38	\$2.04
Tackle	\$4.72				
Bait	\$2.53				
Ice	\$2.02			\$2.06	\$0.15
Ramp Fees	\$1.93			\$1.57	\$0.00
Marina Fees	\$1.25			\$6.71	\$2.84
Lodging	\$0.00	\$46.36	\$40.15	\$3.59	\$20.15
Camping Fees	\$0.52	\$0.11	\$0.11	\$0.75	\$0.19
Food and Beverages - Stores	\$21.22	\$16.41	\$13.98	\$16.83	\$6.87
Food and Beverages - Restaurants/Bars	\$14.54	\$33.96	\$40.34	\$10.79	\$22.23
Auto Gas	\$6.17	\$6.98	\$8.01	\$7.45	\$4.54
Auto Rental	\$8.25	\$15.72	\$22.16	\$1.47	\$14.79
Equipment Rental	\$1.13	\$0.00	\$2.18	\$1.65	\$1.56
Shopping	\$11.61	\$30.10	\$36.86	\$4.26	\$19.45
Total	\$114.17	\$224.90	\$194.24	\$87.42	\$125.30
Number of Respondents	89	71	69	47	76
Number of Respondents and Party Members ^c	289	228	186	147	291

^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 know" 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.

Table 2.2.2-4 (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

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. The total number of respondents and party members who spent or benefited from the expenditures divided this sum.

^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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Table 2.2.2-5 (Visitors)
Total Visitor Expenditures In Palm Beach 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	330,112	930,675	1,260,787
Charter / Party Boat Fee	\$11,539,154	\$39,509,116	\$51,048,270
Boat Rental	84,080	128,377	212,457
Boat Fuel	5,373,044	10,129,360	15,502,404
Air Refills	476,896	1,318,351	1,795,247
Tackle	929,222	2,341,949	3,271,170
Bait	204,837	516,259	721,096
Ice	215,386	414,936	630,322
Ramp Fees	1,512,441	2,470,091	3,982,532
Marina Fees	2,939,896	5,550,829	8,490,725
Lodging	4,699,409	15,575,573	20,274,983
Camping Fees	165,415	490,450	655,865
Food and Beverages - Stores	3,836,933	9,783,741	13,620,674
Food and Beverages - Restaurants/Bars	7,183,784	20,604,786	27,788,570
Auto Gas	2,238,482	6,974,355	9,212,837
Auto Rental	2,891,652	8,638,760	11,530,413
Equipment Rental	561,319	1,784,856	2,346,175
Shopping	3,287,962	9,415,881	12,703,843
Glass Bottom Boat Ride	0	0	0
Total	\$48,139,911	\$135,647,670	\$183,787,582

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Table 2.2.2-6 (Visitors)
Total Visitor Expenditures In Broward County Associated with Reef Use
All Reef-Related Activities and Boating Modes
June 2000 to May 2001 – In 2000 dollars

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

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Table 2.2.2-7 (Visitors)
Total Visitor Expenditures In Miami-Dade 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	1,412,438	3,247,954	4,660,392
Charter / Party Boat Fee	\$17,118,148	\$23,710,254	\$40,828,402
Boat Rental	2,540,565	4,678,931	7,219,496
Boat Fuel	30,156,338	86,350,800	116,507,138
Air Refills	2,538,890	4,760,334	7,299,223
Tackle	2,932,339	9,202,805	12,135,144
Bait	1,570,737	4,929,575	6,500,312
Ice	2,035,146	5,381,221	7,416,367
Ramp Fees	1,782,445	4,834,576	6,617,021
Marina Fees	3,496,104	7,559,320	11,055,423
Lodging	17,096,751	23,592,903	40,689,654
Camping Fees	651,817	1,602,569	2,254,386
Food and Beverages - Stores	24,957,770	60,274,523	85,232,293
Food and Beverages - Restaurants/Bars	27,777,276	55,785,655	83,562,932
Auto Gas	9,568,144	21,174,183	30,742,328
Auto Rental	13,659,366	28,193,581	41,852,947
Equipment Rental	1,958,101	4,261,687	6,219,788
Shopping	22,089,926	43,581,942	65,671,868
Glass Bottom Boat Ride	62,489	281,199	343,688
Total	\$181,992,354	\$390,156,057	\$572,148,411

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Table 2.2.2-8 (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

2.0 Socioeconomic Value of Reefs in Southeast Florida

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

For Monroe County, a different approach was used because of 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. These ratios included (1) wage-to-sales ratio, (2) wages-to-employment ratio, (3) total income-to-wage and salaries ratio, and (4) proprietor's income-to-proprietor's employment ratio. These ratios were multiplied by the total visitor expenditures associated with reef-related activities to estimate total direct sales, direct income and direct employment due to these activities. The analysis then utilized sales (1.6), income (1.6) and employment (1.6) 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.

The economic contribution of the reefs to each of the counties is provided in Tables 2.2.2-9 through 2.2.2-12. The sales contribution is defined as the value of the additional output produced in the county due to the reef-related expenditures. The total income contribution is defined as the sum of employee compensation, proprietor's income, interest, rents, and profits generated as a result of the reef-related expenditures. Income is the money that stays in the county's economy. The employment contribution is the number of full-time and part-time jobs created due to the reef-related expenditures. The indirect business tax contribution is the sum of the additional excise taxes, property taxes, fees, licenses, and sales taxes collected due to the reef-related expenditures.

Each table represents the economic contribution to the county as visitors to that county spend money in the county to use the reefs. The economic contributions cannot be summed over the four counties to get the total contribution of the reefs to southeast Florida. Instead, the expenditures of visitor reef users to southeast Florida would have to be estimated wherein a visitor comes from outside the four county area. In this study, each county's visitors were evaluated on a county-by-county basis, so that a visitor in Palm Beach County could be a resident of Broward County. If the expenditures of all four counties reported in this study were added together and then input into the IMPLAN model to estimate the economic contribution to southeast Florida, the reported economic contribution of the reefs would be overestimated. This is because southeast Florida resident expenditures would be included in the multiplier effects.

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Table 2.2.2-9 (Visitors)
Economic Contribution of Reef-Related Expenditures by Visitors to Palm Beach County
Economic Area is Palm Beach County
June 2000 to May 2001 – In 2000 dollars

Reef Type/Economic Contribution	Direct	Indirect	Induced	Total
Artificial Reefs				
Sales	\$48,139,911	\$13,615,865	\$19,410,419	\$81,166,195
Total Income	\$25,033,935	\$7,408,596	\$12,211,129	\$44,653,660
Employment	849	142	253	1,244
Indirect Business Taxes	\$4,087,804	\$754,643	\$1,210,601	\$6,053,048
Natural Reefs				
Sales	\$135,647,661	\$37,909,019	\$54,627,400	\$228,184,080
Total Income	\$72,055,317	\$20,844,992	\$34,328,471	\$127,228,780
Employment	2,439	401	712	3,552
Indirect Business Taxes	\$11,220,086	\$2,152,321	\$3,417,124	\$16,789,531
Natural and Artificial Reefs				
Sales	\$183,787,572	\$51,524,884	\$74,037,819	\$309,350,275
Total Income	\$97,089,252	\$28,253,588	\$46,539,600	\$171,882,440
Employment	3,288	543	965	4,796
Indirect Business Taxes	\$15,307,890	\$2,906,964	\$4,627,725	\$22,842,579

Table 2.2.2-10 (Visitors)
Economic Contribution of Reef-Related Expenditures by Visitors to Broward County
Economic Area is Broward County
June 2000 to May 2001 – In 2000 dollars

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

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Table 2.2.2-11 (Visitors)
Economic Contribution of Reef-Related Expenditures by Visitors to Miami-Dade County
Economic Area is Miami-Dade County
June 2000 to May 2001 – In 2000 dollars

Reef Type/Economic Contribution	Direct	Indirect	Induced	Total
Artificial Reefs				
Sales	\$181,992,354	\$50,373,237	\$91,522,054	\$323,887,645
Total Income	\$98,068,036	\$26,955,522	\$56,811,301	\$181,834,859
Employment	3,532	520	1,214	5,266
Indirect Business Taxes	\$18,462,677	\$2,954,424	\$5,467,652	\$26,884,753
Natural Reefs				
Sales	\$390,156,057	\$106,631,671	\$200,284,701	\$697,072,429
Total Income	\$211,942,283	\$56,642,529	\$124,502,414	\$393,087,226
Employment	7,462	1,087	2,662	11,211
Indirect Business Taxes	\$41,647,111	\$6,178,534	\$11,923,603	\$59,749,248
Natural and Artificial Reefs				
Sales	\$572,148,411	\$157,004,908	\$291,806,755	\$1,020,960,074
Total Income	\$310,010,319	\$83,598,051	\$181,313,715	\$574,922,085
Employment	10,994	1,607	3,876	16,477
Indirect Business Taxes	\$60,109,788	\$9,132,958	\$17,391,255	\$86,634,001

Table 2.2.2-12 (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

2.2.3 Use Value

Use value was defined in the introduction to this report. In this study, four 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; (3) the value of maintaining both artificial and natural reefs in their existing condition; and (4) the value of adding and maintaining additional artificial reefs. In general, use value is the maximum amount of money that reef users are willing to pay to maintain the reefs in their existing condition and to add more artificial reefs to the system. Use value is measured in terms of per party per trip for existing natural and artificial reefs, and per party per year for new artificial reefs. For presentation, values were normalized to values per person-day of reef use so they can be compared with the results of other studies. Use value is also presented in aggregate for all users of the reef system.

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The visitor reef-user values associated with maintaining the reefs in their existing conditions for each county is provided in Table 2.2.3-1. Use value per person day means the value per person day of artificial, natural or all reef use, as specified in the table. Values for all reefs were taken from statistical analysis of responses to Question 38 of Visitor Boater Survey: “Suppose that both of the above plans to maintain the natural and artificial reefs in southeast Florida were put together into a combined program...If your total costs for this trip would have been \$___ higher, would you have been willing to pay this amount to maintain the artificial and natural reefs.” Values for artificial reefs were taken from statistical analysis of responses to Question 36 pertaining only to a program to maintain the existing artificial reefs in their current condition. Values for natural reefs were taken from statistical analysis of responses to Question 34 pertaining only to a program to maintain the natural reefs in their current condition.

A logit model was used on the entire visitor data pooled across all four counties and the two seasons (e.g., summer and winter). The logit model was used to test for differences by county, season, activity-boat mode, type of reef used (e.g., natural or artificial), and various user characteristics such as, household income, age of respondent, race/ethnicity, sex, boat ownership, years of boating experience in South Florida and whether the respondent was 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 and artificial reefs combined, and new artificial reefs and maintenance). For all four reef programs, significant differences were found by county. On both a per-party per trip and per person-trip basis, Miami-Dade County had the lowest values for all four reef programs. In order from lowest to highest values were Miami-Dade, Palm Beach, Broward and Monroe.

Significant differences were also found by activity-boat modes, but these differences were dependent on reef type and county. For natural reefs, there were no differences that could be identified for Miami-Dade County. For Palm Beach and Broward counties, scuba divers from charter/party boats had significantly higher values than users from all other activity-boat modes. For Monroe County, snorkelers from private/rental boats and scuba divers from charter/party boats had higher values than users of all other activity-boat modes.

For existing artificial reefs, there were no differences found by activity-boat modes for Miami-Dade, Palm Beach and Broward counties. For Monroe County, differences were found for snorkelers from private/rental boats and for those who bottom fished from private/rental boats. These latter user groups were, holding all other factors constant, willing to pay more than those who participated in other activity-boat modes.

For the combined natural and artificial reef program, there were no differences found among activity-boat modes in Miami-Dade County. For Palm Beach and Broward counties, scuba divers from charter/party boats were willing to pay more than those who participated in other activity-boat modes. For Monroe County, snorkelers from private/rental boats, scuba divers

2.0 Socioeconomic Value of Reefs in Southeast Florida

from charter/party boats, and those who participated in bottom fishing from private/rental boats had higher willingness to pay than those who participated in other activity-boat modes.

For the new artificial reefs, there were no differences found among the different activity-boat modes in Miami-Dade County. For Palm Beach, Broward and Monroe counties, scuba divers from charter/party boats had a higher willingness to pay than those who participated in all other activity-boat modes.

Season was a significant factor in all estimated models. Summer season visitors had significantly lower willingness to pay than winter season visitors. This influenced our decision on how to calculate total annual value. We calculated separate total values for the summer and winter seasons and then added them together to get annual values.

Household income was a significant factor in all of the estimated logit models. The higher the household income levels, the higher the willingness to pay. Race/ethnicity was mixed. There were no significant differences for Hispanic visitors. Whites (95 percent of the visitors) had higher willingness to pay for natural reefs, existing artificial reefs and the combination of natural and artificial reefs, but being white was not significant for new artificial reefs.

Sex was only significant for existing artificial reefs. Males (74 percent of the sample reef users) had higher willingness to pay than female reef users. Boat ownership was significant for existing artificial reefs and for the combined natural and artificial reef programs. Boat owners had higher willingness to pay than non-boat owners, holding all other factors constant, for these two programs.

For all other factors tested, there were no significant differences in willingness-to-pay for any of the four programs. These factors included age, years of experience in South Florida boating and membership in a fishing or diving club.

The logit model was used to estimate the values per party per trip for each of the sampled users for each reef type program. For new artificial reefs, this required an additional calculation because the question asked for a yearly amount instead of an amount per trip. For new artificial reefs, we divided the per party per year estimate by the number of trips that the person made to South Florida on which they used artificial reefs over the past 12 months. We then estimated separate sample averages for each county, Season and Activity-boat mode for which there were significant differences. These values per party per trip were then divided by the average party size (number of people who benefited from or incurred the trip expenses) by county and activity-boat mode to get estimates of willingness to pay per person-trip.

To estimate annual user values, the values per person-trip were multiplied by the estimates of the number of person-trips by county, Season and Activity-boat mode. Although we present the more aggregated results here, the details are provided in the Technical Appendix to this report.

2.0 Socioeconomic Value of Reefs in Southeast Florida

Dividing the total annual user value by the relevant number of total annual person-days derived user value per person-day. Again, the value per person-day is a standardized measure that can be compared with results from other studies.

The results are consistent with the idea that natural reefs are more valuable than artificial reefs. Across all four counties, natural reefs were valued by visitors at \$16.85 per person-day versus \$14.26 per person-day for artificial reefs. Numbers of person-days of reef use were also higher for natural versus artificial reefs. This translates into an estimated \$148 million in annual use value for the natural reefs versus \$70 million for the artificial reefs.

Visitor reef users in Palm Beach County are willing to pay \$21 million per year to maintain both the artificial reefs and the natural reefs in their current condition by maintaining water quality, limiting damage to reefs from anchoring, and preventing overuse of the reefs. When the projects to protect the artificial and natural reefs are considered separately, visitor reef users are willing to pay \$6 million to protect the artificial reefs and \$26 million to protect the natural reefs.

Visitor reef users in Broward County are willing to pay \$113 million per year to maintain both the artificial reefs and the natural reefs in their current condition by maintaining water quality, limiting damage to reefs from anchoring, and preventing overuse of the reefs. When the projects to protect the artificial and natural reefs are considered separately, visitor reef users are willing to pay \$52 million to protect the artificial reefs and \$64 million to protect the natural reefs.

Visitor reef users in Miami-Dade County are willing to pay \$33 million per year to maintain both the artificial reefs and the natural reefs in their current condition by maintaining water quality, limiting damage to reefs from anchoring, and preventing overuse of the reefs. When the projects to protect the artificial and natural reefs are considered separately, visitor reef users are willing to pay \$6 million to protect the artificial reefs and \$23 million to protect the natural reefs.

Visitor reef users in Monroe County are willing to pay \$39 million per year to maintain both the artificial reefs and the natural reefs in their current condition by maintaining water quality, limiting damage to reefs from anchoring, and preventing overuse of the reefs. When the projects to protect the artificial and natural reefs are considered separately, visitor reef users are willing to pay \$6 million to protect the artificial reefs and \$36 million to protect the natural reefs.

The sum of the values for the individual reef programs can be different from the value for the combined programs. This is because some respondents are not willing to pay the sum of the individual program values to finance the combined programs. This is probably due to income constraints as higher bid values are provided to the respondents. So bear in mind that willingness to pay for the combined programs is a completely different scenario from willingness to pay for the individual programs.

The capitalized value of the reef user values is the present value of the annual values calculated at three percent discount rate. It represents the “stock” value analogous to land market values. The capitalized visitor reef user value for all southeast Florida reefs is \$6.9 billion. Bear in mind

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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 2.2.3-2. The use value per person-day is the value per day or a portion of a day of artificial reef use. In Palm Beach County, reef users are willing to pay \$4 million annually for this program in Palm Beach County. Broward County reef users are willing to pay \$15 million per year while Miami-Dade County reef users are willing to pay \$3.6 million per year. Monroe County reef users are willing to pay \$1.7 million annually per year to fund this program in Monroe County.

Table 2.2.3-1 (Visitors)
Annual Use Value From June 2000 to May 2001 and Capitalized Value associated With Reef Use
Visitor Reef-Users by County

Item	Palm Beach County	Broward County	Miami-Dade County	Monroe County	Total
All Reefs - Artificial and Natural					
Number of Person-Days of Reef Use	1,260,787	5,722,125	4,660,392	2,076,862	13,720,166
Use Value Per Person-Day of Reef Use	\$16.68	\$19.92	\$7.01	\$17.19	\$15.04
Annual Use Value in Million Dollars	\$21.03	\$113.98	\$32.65	\$38.67	\$206.34
Capitalized Value @ 3 percent Discount Rate in Billion Dollars	\$0.7	\$3.8	\$1.1	\$1.3	\$6.9
Artificial Reefs					
Number of Person-Days of Artificial Reef Use	330,112	2,694,915	1,412,438	478,395	4,915,860
Use Value Per Person-Day	\$17.89	\$19.39	\$4.31	\$12.23	\$14.26
Annual Use Value in Million Dollars	\$5.91	\$52.26	\$6.08	\$5.85	\$70.10
Capitalized Value @ 3 percent Discount Rate in Billion Dollars	\$0.2	\$1.7	\$0.2	\$0.2	\$2.3
Natural Reefs					
Number of Person-Days of Natural Reef Use	930,675	3,027,210	3,247,954	1,598,467	8,804,306
Use Value Per Person-Day	\$27.85	\$21.04	\$7.09	\$22.35	\$16.85
Annual Use Value in Million Dollars	\$25.92	\$63.70	\$23.01	\$35.72	\$148.35
Capitalized Value @ 3 percent Discount Rate in Billion Dollars	\$0.8	\$2.1	\$0.8	\$1.2	\$4.9

Table 2.2.3-2 (Visitors)
Estimated Use Value of Investing in and Maintaining "New" Artificial Reefs
Visitor Reef-Users by County

Item	Palm Beach County	Broward County	Miami-Dade County	Monroe County	Total
Number of Person-Days of Artificial Reef Use	330,112	2,694,915	1,412,438	478,395	4,915,860
Use Value Per Person-Day for "New" Artificial Reefs	\$12.01	\$5.55	\$2.57	\$3.60	\$4.94
Annual Use Values for "New" Artificial Reefs in Million Dollars	\$4.00	\$14.94	\$3.63	\$1.72	\$24.26
Capitalized Value @ 3 percent Discount Rate in Million Dollars	\$132.15	\$498.15	\$120.89	\$57.48	\$808.67

Note: Use value per person-day is use value per day or portion of a day of artificial reef use.

2.0 Socioeconomic Value of Reefs in Southeast Florida

2.2.4 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 each county are summarized in Table 2.2.4-1.

**Table 2.2.4-1 (Visitors)
Demographic Characteristics of Visitor Reef-Users in Southeast Florida, 2000**

Characteristic	Palm Beach County	Broward County	Miami-Dade County	Monroe County
Median Age of Respondent – Years	41	39	41	44
Sex of Respondent				
Male	79%	77%	75%	70%
Female	21%	23%	25%	30%
Race of Respondent				
White	94%	89%	83%	95%
Black	2%	7%	7%	2%
Other	4%	4%	10%	3%
Percent Hispanic / Latino	5%	13%	29%	8%
Median Household Income	\$87,500	\$87,500	\$55	\$87,500
Average Years Boating in Southeast Florida	9.2	6.7	6.7	7.4
Average Length of Own Boat Used in Saltwater Boating in Feet	25	27	26	22
Percent of Respondents Who Belong to Fishing and/or Diving Clubs	24%	12%	6%	11%

2.3 Total – Residents and Visitors

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

2.3.1 User Activity

The number of person-days spent using the reefs in southeast Florida by county, reef type and population (residents and visitors) are summarized in Table 2.3.1-1. Visitors and residents spent 28 million person-days using artificial and natural reefs in southeast Florida during the 12-month period from June 2000 to May 2001. Residents spent 14.6 million person-days and visitors spent 13.7 million person-days. Reef users spent 10 million person-days using artificial reefs

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and 18 million person-days using natural reefs. A summary of reef use by type of activity is provided in Table 2.3.1-2.

**Table 2.3.1-1
Number of Person-Days Spent on Artificial and Natural Reefs in Southeast Florida
Residents and Visitors By County (in millions)**

Population	Palm Beach County			Broward County		
	Artificial Reefs	Natural Reefs	All Reefs	Artificial Reefs	Natural Reefs	All Reefs
Residents	1.08	1.90	2.98	1.28	2.44	3.72
Visitors	0.33	0.93	1.26	2.70	3.02	5.72
Total	1.41	2.83	4.24	3.98	5.46	9.44

Population	Miami-Dade County			Monroe County		
	Artificial Reefs	Natural Reefs	All Reefs	Artificial Reefs	Natural Reefs	All Reefs
Residents	1.54	2.97	4.51	1.10	2.28	3.38
Visitors	1.41	3.25	4.66	0.48	1.60	2.08
Total	2.95	6.22	9.17	1.58	3.88	5.46

Population	Southeast Florida		
	Artificial Reefs	Natural Reefs	All Reefs
Residents	5.00	9.58	14.58
Visitors	4.92	8.80	13.72
Total	9.92	18.38	28.30

Table 2.3.1-2
Number of Person-Days Spent Using Reefs in Southeast Florida By Recreational Activity
Residents and Visitors By County (in millions)

Population	Palm Beach County			Broward County		
	Residents	Visitors	Total	Residents	Visitors	Total
Snorkeling	0.62	0.13	0.74	0.73	0.35	1.09
Scuba Diving	0.81	0.92	1.73	0.83	3.02	3.85
Fishing	1.55	0.21	1.76	2.15	2.29	4.45
Glass Bottom Boats	-	0	0	-	0.05	0.05
Total	2.98	1.26	4.23	3.71	5.71	9.44

Population	Miami-Dade County			Monroe County		
	Residents	Visitors	Total	Residents	Visitors	Total
Snorkeling	1.23	0.88	2.11	1.10	0.76	1.86
Scuba Diving	0.70	0.44	1.14	0.53	0.36	0.89
Fishing	2.58	3.32	5.90	1.74	0.88	2.62
Glass Bottom Boats	-	0.02	0.02	-	0.08	0.08
Total	4.51	4.66	9.17	3.37	2.08	5.45

Population	Southeast Florida		
	Residents	Visitors	Total
Snorkeling	3.68	2.13	5.81
Scuba Diving	2.87	4.73	7.60
Fishing	8.03	6.71	14.74
Glass Bottom Boats	-	0.15	0.15
Total	14.58	13.72	28.30
<i>Note: Residents were not asked about their participation in glass bottom boat sightseeing.</i>			

Overall, fishing activity on the reefs appears to dominate when snorkeling and scuba diving are compared separately. When snorkeling and scuba diving are considered together as diving activities, diving and fishing contribute about equally to total reef use in southeast Florida.

2.3.2 Economic Contribution

The total economic contribution of the reefs to each 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

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county. Induced effects are created when the employees of the direct and indirect industries spend their money in the county.

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

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

The economic contributions of the reefs to each of the counties are provided in Tables 2.3.2-1 through 2.3.2-9. 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.

The economic contributions cannot be summed over the four counties to get the total contribution of the reefs to southeast Florida. Instead, the expenditures of visitor reef users to southeast Florida would have to be estimated wherein a visitor comes from outside the four county area. In this study, each county's visitors were evaluated on a county-by-county basis, so that a visitor in Palm Beach County could be a resident of Broward County. If the expenditures of all four counties reported in this study were added together and then input into the economic input-output models to estimate the economic contribution to southeast Florida, the reported economic contribution of the reefs would be overestimated. This is because southeast Florida resident expenditures imbedded in the expenditures by visitors would be included in the multiplier effects.

Reef-related expenditures generated about \$505 million in sales in Palm Beach County, \$2.1 billion in sales in Broward County, \$1.3 billion in sales in Miami-Dade County and \$504 million in sales in Monroe County during the 12-month period from June 2000 to May 2001 as summarized in Table 2.3.2-3. These sales resulted in \$194 million in income to Palm Beach County residents, \$1.05 billion in income to Broward County residents, \$614 million in income to Miami-Dade County residents and \$140 million in income to Monroe County residents during the same time period as summarized in Table 2.3.2-6. Reef-related expenditures provided 6,300 jobs in Palm Beach County, 35,500 jobs in Broward County, 18,600 jobs in Miami-Dade County and 10,000 jobs in Monroe County as summarized in Table 2.3.2-9. Artificial reef-related

2.0 Socioeconomic Value of Reefs in Southeast Florida

expenditures comprised about a third of the economic contribution and natural reef-related expenditures comprised about two-thirds of the economic contribution among the four counties.

Reef-related expenditures within each county are responsible for almost ten percent of personal income by place of work, and 18.5 percent of employment, depending on the county. The percent of reef-related income that is total personal income for each county is provided in Table 2.3.2-10. The percent of reef-related employment that is total county employment is also presented in this table. The income and employment data used to calculate the percentages are provided in Table 2.3.2-11. Personal income is income from all sources, including employee compensation, proprietor's income, other property income and government transfer payments.

Table 2.3.2-1
Economic Contribution of Artificial Reef-Related Expenditures to Each County
Contribution to Sales
June 2000 to May 2001 – In Millions of 2000 dollars

Round of Spending	County			
	Palm Beach	Broward	Miami-Dade	Monroe
Direct ^a				
Resident	\$69.30	\$90.90	\$95.20	\$49.35
Visitor	\$48.14	\$493.30	\$181.99	\$51.35
Total	\$117.44	\$584.20	\$277.19	\$100.70
Indirect ^b	\$13.62	\$136.67	\$50.37	\$30.81
Induced	\$19.41	\$241.11	\$91.52	
Total	\$150.47	\$961.98	\$419.09	\$131.51

^a The direct contribution is the actual expenditures made in the county.

^b For Monroe County, both the indirect and induced contribution are included under indirect.

Table 2.3.2-2
Economic Contribution of Natural Reef-Related Expenditures to Each County
Contribution to Sales
June 2000 to May 2001 – In Millions of 2000 dollars

Round of Spending	County			
	Palm Beach	Broward	Miami-Dade	Monroe
Direct ^a				
Resident	\$126.20	\$178.90	\$180.40	\$98.15
Visitor	\$135.65	\$526.11	\$390.16	\$171.61
Total	\$261.85	\$705.01	\$570.56	\$269.76
Indirect ^b	\$37.91	\$145.51	\$106.63	\$102.97
Induced	\$54.63	\$257.48	\$200.28	
Total	\$354.39	\$1,108.01	\$877.47	\$372.73

^a The direct contribution is the actual expenditures made in the county.

^b For Monroe County, both the indirect and induced contribution are included under indirect.

Table 2.3.2-3
Economic Contribution of All Reef-Related Expenditures to Each County
Contribution to Sales
June 2000 to May 2001 – In millions of 2000 dollars

Round of Spending	County			
	Palm Beach	Broward	Miami-Dade	Monroe
Direct ^a				
Resident	\$195.40	\$269.80	\$275.60	\$147.50
Visitor	\$183.79	\$1,019.41	\$572.15	\$222.96
Total	\$379.19	\$1,289.21	\$847.75	\$370.46
Indirect ^b	\$51.53	\$282.18	\$157.00	\$133.78
Induced	\$74.04	\$498.59	\$291.80	\$0
Total	\$504.75	\$2,069.98	\$1,296.55	\$504.24

^a The direct contribution is the actual expenditures made in the county.

^b For Monroe County, both the indirect and induced contribution are included under indirect.

Table 2.3.2-4
Economic Contribution of Artificial Reef-Related Expenditures to Each County
Contribution to Total Income^a
June 2000 to May 2001 – In millions of 2000 dollars

Round of Spending	County			
	Palm Beach	Broward	Miami-Dade	Monroe
Direct				
Resident	\$8.0	\$12.50	\$13.40	\$6.42
Visitor ^b	\$25.0	\$264.67	\$98.00	\$26.70
Total	\$33.0	\$277.17	\$111.40	\$33.12
Indirect	\$7.4	\$75.01	\$27.00	
Induced	\$12.2	\$149.75	\$56.80	
Total	\$52.6	\$501.93	\$195.20	\$33.12

^a Total income includes employee compensation, proprietor's income, interest, rents and profits

^b For Monroe County, the direct, indirect and induced contributions are included under direct.

Table 2.3.2-5
Economic Contribution of Natural Reef-Related Expenditures to Each County
Contribution to Total Income^a
June 2000 to May 2001 – In millions of 2000 dollars

Round of Spending	County			
	Palm Beach	Broward	Miami-Dade	Monroe
Direct				
Resident	\$14.4	\$25.20	\$25.50	\$12.73
Visitor ^b	\$72.0	\$282.26	\$211.90	\$94.20
Total	\$86.4	\$307.46	\$237.40	\$106.93
Indirect	\$21.0	\$79.75	\$56.60	
Induced	\$34.0	\$159.93	\$124.50	
Total	\$141.4	\$547.14	\$418.50	\$106.93

^a Total income includes employee compensation, proprietor's income, interest, rents and profits

^b For Monroe County, the direct, indirect and induced contributions are included under direct.

Table 2.3.2-6
Economic Contribution of All Reef-Related Expenditures to Each County
Contribution to Total Income^a
June 2000 to May 2001 – In millions of 2000 dollars

Round of Spending	County			
	Palm Beach	Broward	Miami-Dade	Monroe
Direct				
Resident	\$22.40	\$37.70	\$38.90	\$19.15
Visitor ^b	\$97.00	\$546.93	\$309.90	\$120.90
Total	\$119.40	\$584.63	\$348.80	\$140.05
Indirect	\$28.40	\$154.76	\$83.60	\$0
Induced	\$46.20	\$309.68	\$181.30	\$0
Total	\$194.00	\$1,049.07	\$613.70	\$140.05

^a Total income includes employee compensation, proprietor's income, interest, rents and profits

^b For Monroe County, the direct, indirect and induced contributions are included under direct.

Table 2.3.2-7
Economic Contribution of Artificial Reef-Related Expenditures to Each County
Contribution to Employment^a
June 2000 to May 2001 – Number of Full-Time and Part-Time Jobs

Round of Spending	County			
	Palm Beach	Broward	Miami-Dade	Monroe
Direct				
Resident	536	812	724	449
Visitor ^b	849	11,155	3,532	1,916
Total	1,385	11,967	4,256	2,365
Indirect	142	1,548	520	
Induced	253	3,306	1,214	
Total	1,780	16,821	5,990	2,365

^a Total income includes employee compensation, proprietor's income, interest, rents and profits

^b For Monroe County, the direct, indirect and induced contributions are included under direct.

Table 2.3.2-8
Economic Contribution of Natural Reef-Related Expenditures to Each County
Contribution to Employment^a
June 2000 to May 2001 – Number of Full-Time and Part-Time Jobs

Round of Spending	County			
	Palm Beach	Broward	Miami-Dade	Monroe
Direct				
Resident	968	1,662	1,385	882
Visitor ^b	2,439	11,814	7,462	6,737
Total	3,407	13,476	8,847	7,619
Indirect	401	1,645	1,087	
Induced	712	3,530	2,662	
Total	4,520	18,651	12,596	7,619

^a Total income includes employee compensation, proprietor's income, interest, rents and profits

^b For Monroe County, the direct, indirect and induced contributions are included under direct.

Table 2.3.2-9
Economic Contribution of All Reef-Related Expenditures to Each County
Contribution to Employment^a
June 2000 to May 2001 – Number of Full-Time and Part-Time Jobs

Round of Spending	County			
	Palm Beach	Broward	Miami-Dade	Monroe
Direct				
Resident	1,504	2,474	2,109	1,331
Visitor ^b	3,288	22,969	10,994	8,653
Total	4,792	25,443	13,103	9,984
Indirect	543	3,193	1,607	0
Induced	965	6,836	3,876	0
Total	6,300	35,472	18,586	9,984

^a Total income includes employee compensation, proprietor's income, interest, rents and profits

^b For Monroe County, the direct, indirect and induced contributions are included under direct.

Table 2.3.2-10
Percent of County Income and Employment Tied to Reef Use

County	Personal Income Place of Residence (Percent)	Personal Income Place of Work (Percent)	Employment (Percent)
Palm Beach	0.42	0.81	0.98
Broward	2.19	3.74	4.19
Miami-Dade	1.07	1.38	1.46
Monroe	4.98	10.0	19.0

Source: Study results and U.S. Department of Commerce, Bureau of Economic Analysis

Table 2.3.2-11
Personal Income and Employment by County, 1999

County	Personal Income Place of Residence (Billions \$)	Personal Income Place of Work (Billions \$)	Employment (Number) ^a
Palm Beach	46.589	23.804	645,965
Broward	47.997	28.097	847,398
Miami-Dade	57.356	44.356	1,271,031
Monroe	2.813	1.452	54,200

^a Number of full and part-time jobs

Source: U.S. Department of Commerce, Bureau of Economic Analysis

2.3.3 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 presented in terms of per person per day of reef use and in aggregate for all users of the reef system.

The reef-user values associated with maintaining the reefs in their existing conditions for each county is provided in Table 2.3.3-1. Use value per person day means the value per person day of artificial, natural or all reef use, as specified in the table. Values for all reefs were taken from statistical analysis of responses to Question 38 of Visitor Boater Survey: “Suppose that both of the above plans to maintain the natural and artificial reefs in southeast Florida were put together into a combined program...If your total costs for this trip would have been \$___ higher, would you have been willing to pay this amount to maintain the artificial and natural reefs.” Values for artificial reefs were taken from statistical analysis of responses to Question 36 pertaining only to a program to maintain the existing artificial reefs in their current condition. Values for natural reefs were taken from statistical analysis of responses to Question 34 pertaining only to a program to maintain the natural reefs in their current condition.

Visitor and resident reef users in Palm Beach County are willing to pay \$31 million per year to maintain both the artificial reefs and the natural reefs in their current condition by maintaining water quality, limiting damage to reefs from anchoring, and preventing overuse of the reefs. When the projects to protect the artificial and natural reefs are considered separately, visitor and resident reef users are willing to pay \$9 million to protect the artificial reefs and \$42 million to protect the natural reefs.

Visitor and resident reef users in Broward County are willing to pay \$126 million per year to maintain both the artificial reefs and the natural reefs in their current condition by maintaining water quality, limiting damage to reefs from anchoring, and preventing overuse of the reefs. When the projects to protect the artificial and natural reefs are considered separately, visitor and resident reef users are willing to pay \$56 million to protect the artificial reefs and \$83 million to protect the natural reefs.

Visitor and resident reef users in Miami-Dade County are willing to pay \$47 million per year to maintain both the artificial reefs and the natural reefs in their current condition by maintaining water quality, limiting damage to reefs from anchoring, and preventing overuse of the reefs. When the projects to protect the artificial and natural reefs are considered separately, visitor and resident reef users are willing to pay \$10 million to protect the artificial reefs and \$47 million to protect the natural reefs.

Visitor and resident reef users in Monroe County are willing to pay \$52 million per year to maintain both the artificial reefs and the natural reefs in their current condition by maintaining water quality, limiting damage to reefs from anchoring, and preventing overuse of the reefs.

2.0 Socioeconomic Value of Reefs in Southeast Florida

When the projects to protect the artificial and natural reefs are considered separately, visitor and resident reef users are willing to pay \$9.75 million to protect the artificial reefs and \$57.49 million to protect the natural reefs.

The sum of the values for the individual reef programs can be different from the value for the combined programs. This is because some respondents are not willing to pay the sum of the values for the individual programs to finance the combined programs. This is primarily due to income constraints as higher bid values are provided to the respondents. So bear in mind that willingness to pay for the combined programs is a different scenario from willingness to pay for the individual programs.

The capitalized value of the reef user values is the present value of the annual values calculated at three percent discount rate. It represents the “stock” value analogous to land market values. The capitalized reef user value for all southeast Florida reefs is between \$8.5 billion and \$10.5 billion. 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. *From previous studies of resource valuation, the total value to non-reef users is likely to be much larger than the total value to reef users. The estimation of this value was not part of this study.*

Reef users’ willingness to pay to invest in and maintain “new” artificial reefs is provided in Table 2.3.3-2. The use value per person-day is the value per day or a portion of a day of artificial reef use. In Palm Beach County, reef users are willing to pay \$4.7 million annually for this program in Palm Beach County. Broward County reef users are willing to pay \$15.7 million per year while Miami-Dade County reef users are willing to pay \$4.1 million per year. Monroe County reef users are willing to pay \$2.3 million annually per year to fund this program in Monroe County.

Table 2.3.3-1 (Residents and Visitors)
Annual Use Value From June 2000 to May 2001 and Capitalized Value associated With Reef Use
Southeast Florida

Item	Palm Beach County	Broward County	Miami-Dade County	Monroe County	Total
All Reefs - Artificial and Natural					
Person-Days of Reef Use (in millions)	4.24	9.44	9.17	5.46	28.30
Use Value Per Person-Day	\$7.34	\$13.35	\$5.12	\$9.48	\$9.04
Annual Use Value in million dollars	\$31.11	\$126.03	\$46.93	\$51.78	\$255.81
Capitalized Value @ 3 percent Discount Rate in billion dollars	\$1.0	\$4.2	\$1.6	\$1.7	\$8.5
Artificial Reefs					
Person-Days of Reef Use (in millions)	1.41	3.98	2.95	1.58	9.91
Use Value Per Person-Day	\$6.47	\$14.07	\$3.50	\$6.18	\$8.59
Annual Use Value in million dollars	\$9.09	\$55.94	\$10.33	\$9.75	\$85.13
Capitalized Value @ 3 percent Discount Rate in billion dollars	\$0.3	\$1.9	\$0.3	\$0.3	\$2.8
Natural Reefs					
Person-Days of Reef Use (in millions)	2.83	5.46	6.21	3.88	18.39
Use Value Per Person-Day	\$14.86	\$15.16	\$7.54	\$14.82	\$12.47
Annual Use Value in million dollars	\$42.10	\$82.88	\$46.86	\$57.46	\$229.24
Capitalized Value @ 3 percent Discount Rate in billion dollars	\$1.4	\$2.8	\$1.6	\$1.9	\$7.6

^a Use Value per Person per Day is the average among the counties.

Note: Use value per person day means per person day of artificial, natural or all reef use. Values for all reefs taken from statistical analysis of responses to Question 38 of Visitor Boater Survey: Suppose that both of the above plans to maintain the natural and artificial reefs in southeast Florida were put together into a combined program...If you 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 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 taken from statistical analysis of responses to Question 34 pertaining only to a program to maintain the natural reefs in their current condition. Therefore, the sum of the values for the individual reef programs will be less than the value for both programs.

**Table 2.3.3-2 (Residents and Visitors)
Estimated Use Value of Investing in and Maintaining "New" Artificial Reefs
Southeast Florida**

Item	Palm Beach County	Broward County	Miami-Dade County	Monroe County	Total
Person-Days of Artificial Reef Use (in millions)	1.41	3.98	2.95	1.58	9.91
Use Value Per Person-Day for "New" Artificial Reefs	\$3.37	\$3.95	\$1.38	\$1.46	\$2.54
Annual Use Values for "New" Artificial Reefs in million dollars	\$4.74	\$15.70	\$4.07	\$2.31	\$26.82
Capitalized Value @ 3 percent Discount Rate in million dollars	\$157.8	\$523.4	\$135.8	\$76.9	\$894.0

^a Use Value per Person per Day is the average among the counties.

Note: Use value per person-day is a day or portion of a day of artificial reef use.

2.3.4 Demographic Information

This section summarizes and compares the demographic characteristics of visitor and resident reef users. These characteristics were obtained from the resident boater survey and the visitor boater survey. They are summarized in Tables 2.3.4-1 and 2.3.4-2.

Table 2.3.4-1
Demographic Characteristics of Resident and Visitor Reef-Users in Southeast Florida, 2000

Median Age of Respondent	Resident Reef-Users			Visitor Reef-Users		
Palm Beach	48			41		
Broward	48			39		
Miami-Dade	46			41		
Monroe	54			44		
Sex Of Respondent	Resident Reef-Users			Visitor Reef-Users		
	Male	Female		Male	Female	
Palm Beach	91%	9%		79%	21%	
Broward	92%	8%		77%	23%	
Miami-Dade	93%	7%		75%	25%	
Monroe	86%	14%		70%	30%	
Race Of Respondent	Resident Reef-Users			Visitor Reef-Users		
	White	Black	Other	White	Black	Other
Palm Beach	97%	0%	3%	94%	2%	4%
Broward	93%	2%	5%	89%	7%	4%
Miami-Dade	88%	1%	11%	83%	7%	10%
Monroe	94%	0.2%	5.8%	95%	2%	3%
Percent Hispanic/Latino	Resident Reef-Users			Visitor Reef-Users		
Palm Beach	4%			5%		
Broward	5%			13%		
Miami-Dade	33%			29%		
Monroe	7%			8%		
Median Household Income	Resident Reef-Users			Visitor Reef-Users		
Palm Beach	\$71,695			\$87,500		
Broward	\$72,310			\$87,500		
Miami-Dade	\$69,722			\$55		
Monroe	\$56,393			\$87,500		

Table 2.3.4-2
Boater Profile of Resident and Visitor Reef-Users in Southeast Florida, 2000
Average Years Boating in South Florida

County	Residents	Visitors
Palm Beach	21	9.2
Broward	22	6.7
Miami-Dade	25	6.7
Monroe	22	7.4

Average Length of Boat Used for Salt Water Activities in Feet

County	Residents	Visitors
Palm Beach	25	25
Broward	25	27
Miami-Dade	23	26
Monroe	24	22

Percentage of Respondents Who Belong to Fishing and/or Diving Clubs

County	Residents	Visitors
Palm Beach	20%	24%
Broward	19%	12%
Miami-Dade	18%	6%
Monroe	15%	11%