

Chapter 3: Socioeconomic Value of Reefs in Palm Beach County

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

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

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

3.1 Residents

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

3.1.1 User Activity

There are two fundamental measures of user activity of natural resources such as the reef systems. First, user activity can be measured by the number of boating trips that individuals take to spend part or a full day visiting the reef system. The number of boating trips is usually called "party-days" since each boat carries one to numerous individuals depending for the most part on the size of the boat. Party-days are measured in this analysis because the party is the principal spending unit. When the average number of individuals in a party is multiplied by the number of party-days, the number of "person-days" is obtained. This second measure of boating activity is important because it determined how many people will be fishing and/or diving on a particular reef. Person-days are of particular significance when estimating the "use value" of the reef system. Both measures of user activity are discussed below.

To measure user activity associated with the reef system, the numbers of party-days and person-days spent on artificial and natural reefs off the coast of Palm Beach County were estimated. Most residents use their own boats to facilitate this recreational pursuit. The use of party boats and charter rentals by residents was not estimated. In 1999-2000, there were 56,924 registered pleasure boats in Palm Beach County according to the Florida Department of Highway Safety and Motor Vehicles (2001). These pleasure craft were divided into the following size classes:

3.0 Socioeconomic Value of Reefs in Palm Beach County

Boat Size Category (Length of Boat in Feet)	Number of Boats	Percentage of Total	Cumulative Percentage
Less than 12 feet	10,900	19%	19%
12 feet to 15' 11"	9,529	17%	36%
16 feet to 25' 11"	28,257	50%	86%
26 feet to 39' 11"	6,612	12%	98%
40 feet to 64' 11"	1,488	2%	100%
65 feet to 109' 11"	129	0%	100%
Greater than 110 ft	9	0%	100%
Total	56,924	100%	

The registered pleasure craft in Palm Beach County is the global universe under consideration. However, two adjustments were made to derive the “target population” for this analysis. First, sampling was restricted to pleasure craft over 16 feet in length. This was due to expert opinion that indicated very few pleasure craft under 16 feet could reach the reef system. Thus, the target population was restricted to pleasure craft 16 feet and longer so that non-reef users would be avoided and to increase the sample size on that segment of the boating population with the highest propensity to use the reef system. Therefore, the target population was reduced from 56,924 registered boats to 36,495 registered boats. However, not everyone with a relatively large boat used an artificial and/or natural reef in the last twelve months. In fact, the survey results indicated that only 53.6 percent of these larger vessels used the Palm Beach County reef system in the last 12 months or 19,561 pleasure craft. Finally, about one-half of one percent of registered boats in the target population had a residence somewhere outside of Palm Beach County, which further reduced the target population of resident boats to 19,463 pleasure craft.

On average, the respondents to the mail survey indicated that over a 12-month period (1999-2000) they and their party used the reef system 40 days. While using the reef system, respondents indicated they were involved with three main recreational activities - fishing, snorkeling, and scuba diving. Based upon this information, it was estimated that during this 12-month period (i.e., 1999-2000), 778,532 “party-days” were spent on the reef system (40 party days times 19,463 pleasure craft).

In conducting the mail survey of resident boaters, reef-users were asked to distribute their 40 reef using party-days in two ways. First, they were asked to distribute their usage among three activities as follows: (1) Fishing, (2) Snorkeling and (3) Scuba Diving. Second, respondents were asked to distribute each of these recreational activities between artificial and natural reefs. Table 3.1.1-1 shows the final distribution of party-days and the derivation of person-days. With respect to party-days, the activity of fishing on artificial and natural reefs constituted 52 percent of all party-days followed by scuba diving (27 percent) and snorkeling (21 percent). For all the recreational activities on reefs, there was an obvious preference for natural reefs as 64 percent of the party-days were concentrated on natural reefs. The strongest intensity of natural reef use was found among the scuba divers where 72 percent of the party-days were spent at natural reefs.

3.0 Socioeconomic Value of Reefs in Palm Beach County

Multiplying the average size of the party by the number of party-days spent on the reef, as summarized in Table 3.1.1-1, resulted in the number of person-days. However, one important adjustment was made to the average party size to account for nonresidents in calculating resident person-days. For this analysis, the number of nonresidents per party (approximately 20 percent) was subtracted out of the average party size. Thus, the number of person-days summarized in Table 3.1.1-1 was determined using the resident party size. The resident party size does not vary appreciably among the various reef-related recreational activities and averages about 3.82 residents per party. Because of this, the distribution of person-days among the activities is similar to the distribution of party-days. For example, saltwater fishing on reefs yielded 1.55 million person-days or 52 percent of all person-days and party-days enjoyed on the reef system off the coast of Palm Beach County during the 12-month period (1999-2000).

The total number of person-days spent on the reefs in Palm Beach County was estimated at about 3 million. While party-days gives a “boater dimension” to activity in and around the reef system, person days yield a “people dimension” to the use of the reef system. The former is especially useful in judging the adequacy of the boating infrastructure such as marinas and boat ramps while the latter is used in calculating recreational value of the reef system. The estimates of user activity will now be used to evaluate the economic contribution of resident reef-users to the Palm Beach County economy.

3.1.2 Economic Contribution

To fully understand the economic contribution of reef use in Palm Beach County, it is important to recognize what factors influence the demand for boating. This will help in understanding the nature of boating in this area and how it relates to the use of artificial and natural reefs. In a study by Bell and Leeworthy (1986), the authors found that the demand for boats in a particular area was influenced by boat prices, population and per capita income. Therefore, the expectation was for a greater demand for boats (i.e. number of registered pleasure craft) in counties with larger populations that are relatively affluent as measured by real per capita income.

The number of registered boats in any county is therefore critical in assessing the adequacy of the boating infrastructure such as boat ramps and artificial and natural reefs. This topic was recently addressed in the 2000 State Comprehensive Outdoor Recreational Plan (2001) issued by the Division of Recreation and Parks, Florida Department of Environmental Protection. However, this report did not assess the adequacy of the reef system in the various regions of Florida. This section will consider only the demand for boating in Palm Beach County, not the adequacy of the boating infrastructure. This will give the reader an overview of boating characteristics in Palm Beach County and valuable information necessary to assess the adequacy of the boating infrastructure. The overview includes a discussion of the county’s population, per capita income, industrial structure and its infrastructure related to saltwater boating. This will also give a background by which to assess the results of this study.

3.0 Socioeconomic Value of Reefs in Palm Beach County

Table 3.1.1-1 (Residents)
Estimated Resident User Activity As Measured by Party-Days and Person-Days on
Artificial and Natural Reefs off Palm Beach County, Florida, 2000

Activity/ Type Of Reef	Number and Distribution of Party-Days by Activity and Reef Type			Number and Distribution of Person-Days by Activity and Reef Type			
	Number of Party-Days	Percentage of Party-Days per Activity by Reef Type	Percentage of Total Party- Days per Activity	Resident Party-Size by Activity	Number of Resident Person- Days ¹ by Activity by Reef Type	Percentage of Person-Days per Activity by Reef Type	Percentage of Total Person-Days per Activity
Fishing			52%	3.83			52%
Artificial	146,000	36%			558,000	36%	
Natural	259,000	64%			992,000	64%	
Subtotal	405,000	100%			1,551,000	100%	
Snorkeling			21%	3.77			21%
Artificial	77,000	47%			290,000	47%	
Natural	87,000	53%			327,000	53%	
Subtotal	164,000	100%			616,000	100%	
Scuba Diving			27%	3.86			27%
Artificial	59,000	28%			227,000	28%	
Natural	151,000	72%			584,000	72%	
Subtotal	210,000	100%			811,000	100%	
All Activities							
Artificial	282,000	36%			1,075,000		
Natural	497,000	64%			1,903,000		
Total	779,000	100%			2,978,000		

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

3.0 Socioeconomic Value of Reefs in Palm Beach County

Palm Beach County is on the southeast coast of Florida bordering the Atlantic Ocean. West Palm Beach is the principal city within this county. In 1999, the resident population was estimated at 1,042,196 individuals; the third largest county in Florida as measured by population. Over the last ten years, the population in Palm Beach County has grown by 20.7 percent making it the thirty-ninth fastest growing county in Florida (out of 67 counties). The County's population is projected to increase by 29.5 percent by the year by 2015.¹ In-migration from Broward County to Palm Beach County, as in the past, will account for over 94 percent of this growth. Thus, this county's population growth will depend heavily on individuals moving into the county.

In 1998, Palm Beach County had a per capita income of \$40,044 placing it third among the 67 counties in the State of Florida. This per capita income was over 49 percent higher than the state average of \$26,845. The higher per capita income in Palm Beach County is largely due to three factors. First, the population receives nearly \$16,000 per capita in dividends, interest and rents. Thus, the holding of capital assets such as stocks, bonds and property largely accounts for the relative affluence of the residents of Palm Beach County. Second, income maintenance programs and retirement benefits exceed the state average and add to the per capita income received by residents of this county. Third, average earnings of those employed exceed the average earnings of workers in Florida by about 12 percent. Palm Beach County appears to be a bimodal population where one segment is characterized by wealthy retirees living off accumulated capital assets while the other segment of the population is employed in industries paying wages above the average when compared to the State of Florida. A relatively high per capita income is a favorable factor leading to the purchase of recreational durable goods such as large pleasure boats capable of reaching artificial and natural reefs in the Atlantic Ocean.

In 1998, there were 493,000 persons employed in Palm Beach County earning \$17.0 billion in wage and salaries. Over the last ten years, employment in this county grew by 20.7 percent, which corresponds exactly to the rate of growth in population as discussed above. Measured by earnings, the largest industries in 1998, were services (35.6 percent); finance, insurance and real estate (13.6 percent); and retail trade (10.2 percent). Of particular note, the county's economy includes a substantial number of persons employed in the tourist-related services such as lodging, amusement and recreation. Nearly 22,000 persons were employed in these industries in Palm Beach County in 1998. The attraction of tourists to the county provides part of the county's economic base as evidenced by boating visitors using artificial and natural reefs along the coasts as discussed later in this chapter.

The infrastructure supporting various coastal or saltwater forms of boating recreation in Palm Beach County include the following (FDEP, 2001)(Pybas, 1997):

1. Boat Ramps: 35 with a total of 46 boating lanes;
2. Marinas: 66 with 2,758 wet slips and moorings;

¹ University of Florida, Bureau of Economic and Business Research.

3.0 Socioeconomic Value of Reefs in Palm Beach County

3. Other Facilities: 2,264 boat dry storage berths;
4. Artificial Reefs: 32 artificial reefs ranging from 0.7 to 3.4 nautical miles from shore.

Using the estimated number of person-days discussed above, the average resident person-days accommodated at each artificial reef was estimated to be 35,000 during the 12-month period (i.e. 1,075,000 person-days on artificial reefs divided by 32 artificial reefs). This amounts to nearly 95 individual reef-users per day. The number of person-days is obviously higher on weekends and lower during the week and does not include visitors, which will be discussed below. It is beyond the scope of this study to speculate on the carrying capacity of each reef or where congestion diminishes user or recreational value.

In 2000, there were 57,000 recreational boats (FDHSMV, 2001) registered in Palm Beach County or 1 boat for every 18 persons. In the State of Florida as a whole, there was 1 registered pleasure boat for every 13 residents. Despite the relatively large population and high per capita income in Palm Beach County and the artificial and natural reefs along its shore, the demand for recreational boating is somewhat less in the county than in the rest of Florida as measured by the ratio of registered boats to population. The county's demand factors combined with the saltwater coastal nature of this county would lead one to predict a much higher ratio of registered boats to people.

The explanation for this finding is usually found on the supply side where there is crowding or congestion at access points to the water (e.g., boat ramps) and access points to the recreational resources such as artificial and natural reefs offshore. This increases the cost of recreational boating and reduces the demand for pleasure boats. The results of this study will be useful to testing "working hypotheses" regarding demand and supply side issues.

Using a mail survey, 3,000 registered boaters in Palm Beach County were contacted at random using the survey instrument provided in Appendix A. The participants' addresses were obtained from a registered boater database compiled on tape by the Florida Department of Highway Safety and Motor Vehicles. Over six hundred registered boaters from Palm Beach County responded to the survey of which 54 percent (330 pleasure craft owners) used reefs in their county of residence in a 12-month period (1999-2000). Thus, the party-days and spending by boaters estimated in this section refers only to those residents who used artificial and/or natural reefs off the Palm Beach County coast during the 12-month period from December 1999 to November 2000.

To estimate the economic contribution of reef-user spending on the Palm Beach County economy, the respondents were asked to estimate party spending during their last boating trip to visit the reef system. It was assumed that each boating trip would involve only one day since the residents are in their own county. The results of the survey allowed the average total spending per party by recreational activity for residents of Palm Beach County to be estimated as follows:

3.0 Socioeconomic Value of Reefs in Palm Beach County

Average Resident Spending per Party for Palm Beach County Reef-Users

Activity	Estimated Spending per Party per Day	Percentage of Residents per Party	Estimated Spending per Resident Party per Day
(1)	(2)	(3)	(4) = (2) * (3)
Fishing	\$377.44	79%	\$298.18
Snorkeling	\$198.42	80%	\$158.74
Scuba Diving	\$273.40	85%	\$232.39

Resident fishers using the county’s reefs spent the most per day while resident snorkelers spent the least per day. Expenditures for fuel, tackle and bait made fishing a more expensive recreational activity than snorkeling. Detailed expenditures on particular items are discussed below and a more disaggregated analysis can be found in the Technical Appendix to this report. Please note that the total resident spending per party-day, as calculated in column 4, does not include spending by visitors. Approximately 15 to 21 percent of the typical party in Palm Beach County includes nonresidents. The simplifying assumption was made that these visitors would pay their fair share of the trip costs. Therefore, visitors are assumed to pay a fair proportion of the trip costs such as boat fuel, restaurants and bait, for example. The resident component probably pays for more than indicated above; however, it was conservatively assumed that costs were equally shared between residents and their guests.

To derive the economic contribution of a particular reef-related recreational activity, one must briefly return to Table 3.1.1-1 discussed above. This table shows the number of party-days and person-days associated with reef use over the past 12-months. For example, the recreational activity of fishing generated about 405,000 party-days on all reefs off Palm Beach County. According to the resident spending per party discussed above, fishers spent \$298 per trip. Thus, annual expenditures for reef-related fishing was estimated at \$120.7 million dollars per year in Palm Beach County (i.e. \$298.18 times 404,837). Based upon the distribution of party-days, about \$43.5 million was spent while using artificial reefs while the balance (\$77.2 million) was spent while using natural reefs by recreational fishers.

Table 3.1.2-1 shows the economic contribution of reef-related recreational pursuits off the Palm Beach County coast. Residents spent an estimated \$195.5 million during the twelve-month period from December 1999 to November 2000. About two-thirds of this amount was spent while using natural reefs (\$126.2 million) while the balance (\$69.3 million) was spent while using the artificial reefs. Nearly 62 percent of total spending or \$120.7 million was spent on reef-related recreational fishing while \$48.8 million (25 percent) was spent on reef-related scuba diving and \$26.0 million (13 percent) was spent on reef-related snorkeling.

It is important that we further clarify the economic contribution of resident boaters from Palm Beach County. The engine of economic growth for any region is found in its export industries such as tourism in Palm Beach County. This has a “multiplier” effect on the region as discussed in the section focused on “visitors”. As income from exports flows through the region, it creates

3.0 Socioeconomic Value of Reefs in Palm Beach County

local income (e.g., money paid for haircuts by residents) and a demand for imports (e.g., TV sets since Palm Beach County does not have TV manufacturers).

The local income is spent on everything from marina services for boats to dining out at local restaurants. Thus, the spending by residents in conjunction with reef use represents the choice of residents to recreate locally as opposed to leaving the area to recreate somewhere else. The reef system keeps the “locals” in the county and enlarges the economy by \$195.5 million in local spending. However, in contrast to visitors entering the county, there is no multiplier effect from residents spending their income locally. Generally, the more money kept in the local economy enlarges the regional multiplier since there is less “leakage” through spending on imports or residents leaving the county for recreational pursuits in other areas such as Key West or Orlando. Just how much the regional multiplier is enlarged is beyond the scope of this study. However, it is safe to say that construction of artificial reefs has the potential of keeping more business in Palm Beach County. For ardent reef-users, the absence of reefs off the coast of Palm Beach County would certainly divert more residents to counties north and south of this area to the economic detriment of the county.

Reef-related local spending discussed above is, in itself, only a vehicle to create jobs and wages in the local community. To evaluate the industries that benefit from this reef-related spending, reef-users were asked to break their spending into 12 categories such as boat fuel, ice, tackle and marina fees. For each of the twelve categories, resident reef-related spending was matched to data published in the 1997 U.S. Census of Business. For example, spending on boat fuel was matched up with gasoline stations in Palm Beach County. It was found that each gasoline station employee “sells” \$312,757 per year out of which they are paid about \$15,000 or about 4.8 percent of their sales. The annual salary may seem low, but this figure represents the average salary of full and part time employees with a relatively low skill level. Thus, one job paying approximately \$15,000 per year is generated for every \$312,757 in gasoline purchased for reef-related recreation by residents.

This rather simple procedure was followed for each of the 12 spending categories. Each category varies greatly in labor intensity. The higher the sales-to-employment ratio, the less labor intensive the industry. For example, restaurants are relatively labor intensive while gasoline stations are highly automated and consequently need relatively few employees.

Table 3.1.2-1 shows the estimated wages and employment generated from resident spending on reef-related recreational activities in Palm Beach County. The \$195.5 million in annual resident reef-related spending generated about \$22.5 million in annual wages supporting 1,503 employees.

3.0 Socioeconomic Value of Reefs in Palm Beach County

**Table 3.1.2-1 (Residents)
Reef-Related Expenditures, Wages and Employment Generated by Resident Boating
Activities in Palm Beach County, Florida, 2000**

Type of Activity/ Type of Reef	Expenditures (Million \$)	Wages (Million \$)	Employment (Number of Full and Part-Time Jobs)
Artificial Reef			
Fishing	\$43.5	\$5.0	330
Snorkeling	\$12.2	\$1.4	103
Scuba Diving	\$13.7	\$1.5	103
Subtotal	\$69.3	\$8.0	536
Percentage Attributed to Artificial Reefs	35%	36%	36%
Natural Reef			
Fishing	\$77.2	\$8.9	587
Snorkeling	\$13.8	\$1.6	116
Scuba Diving	\$35.2	\$3.9	265
Subtotal	\$126.2	\$14.4	968
Percentage Attributable to Natural Reefs	65%	64%	64%
Total All Reefs			
Fishing	\$120.7	\$14.0	917
Snorkeling	\$26.0	\$3.1	218
Scuba Diving	\$48.8	\$5.4	368
Total All Reefs/All Activities	\$195.5	\$22.5	1,503

Note: All Sub-totals and Totals are rounded.

Source: Florida State University

It is also important to examine the industries that benefit from reef-related resident spending. Table 3.1.2-2 shows the 12 spending categories and, as expected, reef-related expenditures are concentrated on running and storing a boat, which is the case in Palm Beach County. Expenditures on boat oil and gas constituted 25 percent of all spending followed by marina slip rentals and dockage fees (18 percent). These two categories account for 43 percent of all reef-related spending. In addition, food and beverages from restaurants and stores were both 8 percent (a total of 16 percent) of total reef-related resident spending. In terms of dollar figures, resident reef-users spent over \$35 million during a 12-month period on items produced by the marina industry. According to the U.S. Census of Business (1997), the marina industry in Palm Beach County grossed about \$99 million in sales. Thus, resident reef-users may account for as much as one-third of these sales. Marina industry sales would also come from resident non-reef-users and visitors keeping their boats in local marinas.

3.0 Socioeconomic Value of Reefs in Palm Beach County

Table 3.1.2-2 (Residents)
Detailed Expenditure Pattern Supporting Employment and Wages by All Resident Reef-Users in Palm Beach County, Florida, 2000

Expenditure Item	Expenditures (Million \$)	Percentage of Total Expenditures	Employment (Number of Full and Part-Time Jobs)	Percentage of Total Employment	Wages (Million \$)	Percentage of Total Wages
1. Boat gas and oil	\$49.62	25%	159	11%	\$2.37	11%
2. Marina slip rentals and dockage fees	\$35.01	18%	313	21%	\$5.98	27%
3. Food and beverages from restaurants/bars	\$16.06	8%	428	28%	\$4.40	20%
4. Food and beverages from stores	\$14.94	8%	109	7%	\$1.57	7%
5. Tackle	\$10.59	5%	76	5%	\$1.35	6%
6. Bait	\$9.16	5%	66	4%	\$1.17	5%
7. Gas for auto	\$9.00	5%	28	2%	\$0.43	2%
8. Ice	\$4.81	2%	15	1%	\$0.23	1%
9. Equipment rentals	\$4.68	2%	31	2%	\$0.66	3%
10. Boat ramp and parking fees	\$3.85	2%	34	2%	\$0.66	3%
11. Sundries (e.g. Sun screen, sea sickness pills, etc.)	\$5.40	3%	35	2%	\$0.51	2%
12. All other	\$32.39	17%	209	14%	\$3.12	14%
Total	\$195.51	100%	1,504	100%	\$22.45	100%

3.0 Socioeconomic Value of Reefs in Palm Beach County

In terms of employment, reef-related resident spending created proportionately more employment in marinas and restaurants because, as discussed above, these industries are relatively labor intensive. Although ranked number one as a component of spending, gasoline stations are a capital-intensive industry not conducive to the creation of jobs. That is, spending on boat oil and gas accounted for one-fourth of all spending, but only one in ten jobs. As might be expected, wages follow employment. That is, the higher the percentage of spending on labor intensive industries, the higher the total wages generated. However, some industries employ highly skilled persons such as marinas where the wages paid are proportionately higher than employment as indicated in Table 3.1.2-2.

3.1.3 Use Value

Natural and artificial reefs contribute to the recreational experience of residents (i.e. fishing, snorkeling and scuba diving). Traveling to and enjoying a reef system involves economic costs including the cost of boat fuel, bait and tackle. This was discussed above. However, the market does not measure the total economic value of reef systems. There is no organized market in which to buy and sell the use of reefs because these resources are not owned by one individual but by society as a whole. Thus, the absence of private property rights creates a challenge in valuing natural and artificial reefs. Yet, the general public does pay for the deployment of artificial reefs and the protection of natural reefs. So, there must be some unmeasured value of providing the reef system to the general public. Since reef-users are attracted to reefs for recreational pursuits, we call this unmeasured value “use value”. For example, one could engage in scuba diving without the benefit of a natural or artificial reef. The addition of a reef presumably adds some “value” to the scuba diver’s recreational experience. More specifically, this analysis evaluates the incremental use value of having a reef system off the shore of Palm Beach County.

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

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

Payment amounts (or cost increases) of \$10, \$50, \$100, \$200, and \$500 were inserted into the survey instrument (where the blank is in the question above). The payment amounts were rotated from respondent to respondent. Thus, some respondents received questions asking about

² See Clawson and Knetch (1966).

3.0 Socioeconomic Value of Reefs in Palm Beach County

a \$10 increase while others were asked about a \$50, \$100 or even \$500 increase in trip cost. The purpose of these questions was to establish the user value per day for artificial and natural reefs.

The above willingness to pay question was asked of each respondent in three forms: (1) natural reefs separately; (2) artificial reefs separately and (3) a combination of natural and artificial reefs. For the combined program, the randomly assigned cost increases presented in the previous paragraph were doubled. Because the primary spending unit is the “party”, the willingness to pay response referred to an increase in trip cost to the entire party.

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

Separate models were estimated for each of the four reef programs (e.g., natural reefs, existing artificial reefs, both natural and artificial reefs and new artificial reefs). For the natural reefs, existing artificial reefs and the combined programs, the only significant differences found were for those with income greater than \$100,000. This group had a higher willingness to pay than other reef users. There were no other differences found. The logit model did not produce different per party per trip values by county, and because party sizes were not significantly different by county the estimated values per person-trip were also the same across counties for each of the reef valuation programs³. The estimated per party per trip (day) values were \$32.55 for the natural reefs, \$11.31 for the artificial reefs and \$12.94 for the combined program.

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

The results are consistent with the idea that natural reefs are preferred to artificial reefs. For Palm Beach County residents, the average per person-day use value of the natural reefs was \$8.50 versus \$2.96 for artificial reefs. Total use is also higher for natural reefs versus artificial reefs. Palm Beach County residents’ natural reef use was over 1.9 million person-days versus about 1.1 million person-days for artificial reefs. This translated into an estimated total annual use value of \$16.2 million for natural reefs and \$3.2 million for artificial reefs. Capitalizing the annual use values using a three percent discount rate yields asset values of about \$539 million for the natural reefs and \$106 million for the artificial reefs. These results are summarized in Table 3.1.3-1.

3.0 Socioeconomic Value of Reefs in Palm Beach County

**Table 3.1.3-1 (Residents)
Estimated Use Value of Artificial and Natural Reefs off the Coast of
Palm Beach County, Florida, 2000**

Reef Type/Activity	Person-days (Millions)	Annual User Value (Millions \$)	User Value Per Person-day (\$)	Asset Value at 3% (Millions \$)
Natural Reef Maintenance	1.903	\$16.18	\$8.50	\$539.3
Snorkeling	0.327	\$2.82	\$8.63	\$94.0
Scuba Diving	0.584	\$4.93	\$8.43	\$164.2
Fishing	0.992	\$8.43	\$8.50	\$281.1
Artificial Reef Maintenance	1.075	\$3.18	\$2.96	\$106.1
Snorkeling	0.290	\$0.87	\$3.00	\$29.0
Scuba Diving	0.227	\$0.66	\$2.93	\$22.2
Fishing	0.558	\$1.65	\$2.95	\$54.9
Natural & Artificial Reef Maintenance	2.978	\$10.07	\$3.38	\$335.8
Snorkeling	0.616	\$2.11	\$3.43	\$70.5
Scuba Diving	0.811	\$2.72	\$3.35	\$90.7
Fishing	1.550	\$5.24	\$3.38	\$174.6
New Artificial Reefs	1.075	\$0.78	\$0.72	\$25.9
Snorkeling	0.290	\$0.28	\$0.95	\$9.2
Scuba Diving	0.227	\$0.21	\$0.93	\$7.1
Fishing	0.558	\$0.29	\$0.52	\$9.6

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 for such things 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 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.

One can see the usefulness of measuring the economic benefits of natural reef systems to policy makers in justifying public budgets for such programs. If protected, the use value for natural

3.0 Socioeconomic Value of Reefs in Palm Beach County

reefs will flow into perpetuity. Using a real discount rate of 3 percent, it is estimated that the capitalized use value of the natural reefs off Palm Beach County is \$539 million. Why is this important? Natural reef systems are not privately owned, but are common property resources. If a region or a nation were preparing a balance sheet showing its assets and liabilities, the asset value of the reef system would need to be included. This analysis provides an estimate of the capitalized value of the natural reef system to reef users. Bear in mind that this value only includes the value that reef users place on the reefs and does not include the values that non-reef users place on the reefs or the economic contribution of the reefs. *The estimation of the value of the reefs to non-reef users was not part of this study.*

As discussed above, artificial reefs have a use value per person of less than that of natural reefs, as one would expect. However, preservation of the existing artificial reef system of Palm Beach County produces an annual use value of over \$3 million. Again, this is for the maintenance of these reefs. The capitalized value of the artificial reef system off Palm Beach County is estimated at \$106 million. If users were obstructed from getting to Palm Beach County's artificial reefs, an estimate of damages to the reef users would be either the annual use value lost if users are temporarily obstructed or the capitalized value if users were permanently cut-off from using the artificial reefs.

The 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 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 used to estimate willingness to pay for a program that provides new artificial reefs found some statistically significant differences in use value as socioeconomic characteristics change. Resident artificial reef users in Palm Beach and Broward counties had higher willingness to pay than resident artificial reef users in Miami-Dade and Monroe counties. Snorkelers and scuba divers had higher use values than those who participated in fishing

3.0 Socioeconomic Value of Reefs in Palm Beach County

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 who use artificial reefs to a low of \$1.98 for fishers who use artificial reefs.

As with the other three programs, the estimated per party per day values were multiplied by the total party-days spent on artificial reefs by artificial reefs users in the county to get total annual use value for the county. The total annual use values were then divided by the total annual person-days of artificial reef use in the county to get an estimate of the value per person-day. This “new artificial reef” 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 52 cents for those fishing to a high of 95 cents for those who participated in snorkeling off Palm Beach County. Across all activities, the average value for new artificial reefs was 72 cents per person-day.

In terms of total annual value among all artificial reef users, fishers have the highest willingness to pay for new artificial reefs. The total amount of artificial reef use more than compensates for the lower value per person-day associated with fishers. Across all activities, total annual user value is over \$777,000 with an asset value of \$25.9 million.

The relatively low marginal willingness to pay of \$0.72 per person-day for artificial reef expansion in comparison to artificial reef maintenance discussed above is somewhat expected. If present users do not feel that congestion on artificial reefs is a problem, they would be expected to value expansion lower than maintenance of the existing artificial reefs. However, their willingness to pay anything for expansion demonstrates some level of unhappiness with the existing number of artificial reefs off Palm Beach County. Perhaps, residents are competing with visitors for choice spots or just getting in the way of fishing and diving when arriving at an artificial reef.

3.1.4 Role of “No-Take” Zones

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

In this section, we examine the opinions of residents on “no take” zones in the Florida Keys and other counties in southeast Florida. 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

3.0 Socioeconomic Value of Reefs in Palm Beach County

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 oppose 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. In each of our four counties, reef-users were asked questions regarding “no-take” zones. The results for Palm Beach County are summarized in Table 3.1.4-1.

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 tool. In addition, the “not in my backyard view” was also tested by asking respondents for their opinions on “no take” zones in Palm Beach County. Over 65 percent of the respondents in Palm Beach County are willing to have “no take” zones off the shore of their county. Respondents are also willing to extend this concept southward to Broward and Miami-Dade Counties with nearly 65 percent supporting this expansion according to the results shown in Table 3.1.4-1.

**Table 3.1.4-1 (Residents)
Opinion of Palm Beach County Residents Regarding "No Take" Zones
For Artificial and Natural Reefs, 2000**

Survey Question (1)	Percent of Respondents Answering "Yes" (2)	Percent of Respondents Answering "No" (3)	Percent of Respondents Answering "Don't Know" (4)	Sample Size (5)
Support existing "NO TAKE" Zones in the Florida Keys	75%	15%	10%	337
Support "NO TAKE" Zones on some reefs off shore of Palm Beach County	65%	23%	12%	335
Support "NO TAKE" Zones on some reefs off shore of Palm Beach, Broward and Miami-Dade Counties	65%	21%	14%	136
	Average for All Responses	Median for all Responses		
What Percent of natural reefs in Palm Beach County should be protected with "No Take" Zones	30%	20%		287

3.0 Socioeconomic Value of Reefs in Palm Beach County

Finally, respondents were asked for their opinion regarding the percent of the reef system that should be included in “no take” zones. Respondents, on average, would be willing to have “no take” zones cover about 30 percent of the natural reefs off the Palm Beach County coast. Because the average may be skewed by exceptionally large answers, we also looked at the median percent of natural reefs respondents felt might be managed by the use of “no-take” zones. The median, or the midpoint between the highest and lowest answer, was 20 percent of the natural reefs. Such results will provide the public with important information regarding resident opinions of “no take” zones in Palm Beach County.

3.1.5 Demographic Information

The mail survey administered to Palm Beach County residents included questions regarding demographic characteristics. The reason for collecting such information was to determine what segment of the population will gain by protecting natural and artificial reefs off the Palm Beach County coast. Respondents were asked to provide some background on both themselves and their boating experience. Thus, the survey was used to collect demographic information as well as develop a boater profile to better understand these people called resident “reef-users” in Palm Beach County. Table 3.1.5-1 presents the results from the mail survey combined with comparable information on the entire Palm Beach County population.

The owners of reef-using registered boats are slightly older than the general population of Palm Beach County. The median age of reef-users is 48 years compared to 45.5 years for the general population. Statistically speaking, there is no real difference between these two groups. However, boating appears to be a male dominated activity with about 91 percent of the respondents indicating they were male compared to the general population of which 48 percent is male. Of course, there is no way to control who fills out the survey instrument once it reaches the boat owner’s residence. However, the survey is directed at the person who owns the boat. With respect to race, white individuals dominate boat ownership with 97 percent of respondents indicating they were white. This is a higher percentage than the general population which is 79 percent white in Palm Beach County. Further, a lesser percentage of respondents characterized themselves as Hispanic/Latino (4 percent) than exists in the general population (12 percent).

Nearly 53 percent of respondents indicated they had a college degree or higher level of education compared to 16 percent of the general population in 1990.³ The education level of the general population is probably much higher today than ten years ago, but may not reach the level of education reported by survey respondents. Since education and income are positively correlated, it is expected that income levels would also be higher for respondents than the general population which was indeed the case as demonstrated with the last demographic statistic in Table 3.1.5-1. The estimated median household income of respondents is about \$72,000 compared to about \$40,000 for the general population.

³ *The U.S. Census Bureau has not yet released the educational levels for counties as part of the 2000 Census.*

3.0 Socioeconomic Value of Reefs in Palm Beach County

Of course, the purchase of a relatively large pleasure craft is also correlated with higher income as found by Bell and Leeworthy (1987) and discussed earlier in this chapter. So, this finding is not unusual.

Using the information on user activity, an estimated minimum of 74,000 residents engaged in a reef-using recreational activity in 2000. This was obtained by multiplying the number of registered boats that are estimated to be involved in reef use (19,464) by the average resident party size of 3.8 individuals. Because the turnover rate of the party is unknown, the term “minimum” is used to qualify the finding. That is, the same residents may not go boating every party trip. There are 859,812 residents in Palm Beach County over 14 years of age (i.e. about that age at which they can become boaters). In addition, it was estimated earlier in this chapter that resident reef-users constitute approximately 8.6 percent of this boater population (73,963/859,812). However, this reef-using population will be higher if party turnover (i.e. different individuals per trip) is considered.

**Table 3.1.5-1 (Residents)
Demographic Characteristics and Boater Profile of Reef-Users in
Palm Beach County Florida, 2000**

Demographic Characteristics of Respondents to Mail Survey	Reef-Users	Palm Beach County Population
Median Age	48	46
Sex		
Male	91%	48%
Female	9%	52%
Race		
White	97%	79%
Black/African American	0%	14%
Hispanic/Latino	4%	12%
Other	3%	7%
Education		
Percentage that completed College Degree or More	53%	16%
Median Household Income	\$71,698	\$39,560
Boater Profile		
Average Years of Residence in Palm Beach County	23	N/A
Average Years of Boating in south Florida	21	N/A
Average Length of Boat Used for Saltwater Activities (ft)	25	N/A
Percentage of Respondents that belong to fishing and/or diving clubs	20%	N/A
Sample Size		336

¹ Latest year that educational level attained by county is available is for 1990 from the U.S. Census Bureau. Source: Florida State University and the U.S. Bureau of the Census (1990, 2000).

3.0 Socioeconomic Value of Reefs in Palm Beach County

The information collected in this section of the survey provides an idea of the characteristics and the magnitude of the population which are served by artificial and natural reefs off the coast of Palm Beach County. This should be valuable information for policy makers at the local and state levels.

Finally, a boater profile for Palm Beach County was developed from the survey results as follows. The typical reef-using boater has lived in Palm Beach County for 23 years and boated for 21 years. As is true of many south Florida residents, boaters moved to this county from other areas, probably out of state. The reef-using boaters in the sample own a pleasure craft of 25 feet in length on average. The weighted average of registered boats 16 feet and over in Palm Beach County is also 25 feet so it appears that the sample is particularly reflective of the population based on average boat length. Nearly 20 percent of the respondents were members of fishing and/or diving clubs. This indicator gives some idea of the intensity and degree of interest in recreational fishing, snorkeling and scuba diving off the coast of Palm Beach County, Florida.

3.2 Visitors

The focus of this section is the socioeconomic value of the reefs associated with visitors to Palm Beach County. 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 Palm Beach County is considered to be a visitor to Palm Beach County. Likewise, a person from New York visiting Palm Beach County is considered to be a visitor to Palm Beach County. This section provides the following values associated with visitors to Palm Beach County: reef user activity, economic contribution of the reefs, use value of the reefs and demographic information. Detailed explanations of the methods and data used to estimate these values for Palm Beach County are provided in Chapter 1: Introduction and Chapter 2: Socioeconomic Values of Reefs in Southeast Florida.

3.2.1 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 number of person-trips was then converted to the number of person-days spent by all visitors to Palm Beach County using information from the General Visitor Survey.

The number of person-trips taken by all visitors to Palm Beach County and the number of person-days these visitors spent in the county during the year 2000-2001, developed in Chapter 2.2.1, is summarized in Table 3.2.1-1.

3.0 Socioeconomic Value of Reefs in Palm Beach County

**Table 3.2.1-1 (Visitors)
Number of Person-Trips and Person Days
All Visitors to Palm Beach County
June 2000 to May 2001**

Measure of Visitation	Summer – 00	Winter – 01	Total
Number of Person-Trips	1,938,327	2,313,013	4,251,340
Number of Person-Days	13,413,018	33,439,901	46,852,919

Visitors took 4.2 million person-trips to Palm Beach County from June 2000 to May 2001 and spent 47 million person-days in the county.

The number of person-trips by all visitors was used as the basis for estimating the number of person-days visitors spent using the artificial and natural reefs in each county. For each season, the number of boating person-trips is equal to the total number of person-trips by all visitors multiplied by the proportion of person-trips taken by visitors who participated in saltwater boating in the county in the past twelve months. This proportion was taken from the General Visitor Survey answer to Question 13 (Which activities and boating modes did you participate in over the past 12 months in this county?) 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 3.2.1-2.

**Table 3.2.1-2 (Visitors)
Person-Trips of Visitors Who Boated
And Visitors Who Used the Reefs in Palm Beach County Over the Past 12 Months**

Season	Total Person Trips to County - All Visitors	Proportion of Person Trips Taken By Visitors Who Boated ^a	Boating Person Trips	Proportion of Boating Person Trips When the Reef was Used for Recreation ^b	Boating Person Trips When the Reef was Used for Recreation
Summer - June 2000 to Nov. 2001	1,938,327	0.16	306,304	0.98	299,522
Winter - December 2000 to May 2001	2,313,013	0.14	330,430	0.98	323,115
Year Round - June 2000 to May 2001	4,251,340		636,734		622,637

^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: $= 1 - (Q6/(Q6+Q7+Q8+Q10))$

3.0 Socioeconomic Value of Reefs in Palm Beach County

Of the 4,250,000 person-trips visitors took to Palm Beach County from June 2000 to May 2001, 16 percent of the trips involved saltwater boating activities in the summer and 14 percent involved saltwater boating activities in the winter. Of the resulting 637,000 boating person-trips by visitors to Palm Beach County, 98 percent of those trips involved recreational reef use. Thus, visitors who used the reefs for recreation in Palm Beach County made about 623,000 person-trips to the county from June 2000 to May 2001.

Next, the total number of person-days that visitor boaters who used the reefs spent visiting the county was estimated. This estimate is the total boating person trips when reefs were used times the average days per visit by boaters who used the reefs. The average days per visit by boaters who used the reefs was obtained from the responses 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 obtain number of days. The average number of days and the total person days reef users spent in Palm Beach county in 2000-2001 are provided in Table 3.2.1-3.

**Table 3.2.1-3 (Visitors)
Average Number of Days Visiting Palm Beach County and Total Person
Days in Palm Beach County by Visitor Boaters Who Used the Reefs
June 2000 to May 2001**

County	Average Days Visiting the County Per Trip	Total Person Days Spent Visiting the County
Palm Beach	5.36	3,336,923

Reef-using boaters who visited Palm Beach County spent an average of 5.36 days in the county during their trip. As a result, these visitors spent 3.3 million person-days in Palm Beach County from June 2000 to May 2001.

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

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

3.0 Socioeconomic Value of Reefs in Palm Beach County

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 for those operators who provide services in Palm Beach County.

The proportion of visitor days that visitor boaters who use the reefs participated in fishing and diving/snorkeling and the proportion of fishing days and scuba/snorkeling dives that visitor boaters spent on the artificial, natural and no reefs for Palm Beach County are presented in Table 3.2.1-4.

Table 3.2.1-4 (Visitors)
Saltwater Recreational Activities from All Boating Modes
Percent of Visitor Person-Days That Reef-Using Boaters Participated in the
Saltwater Recreation Activity and Percent of Fishing Days or Dives Spent on
Artificial, Natural and No Reefs from Visitor Boater Survey
Palm Beach County

Activity	Total Respondents	Percent of All Visitor Days	Percent of Activity Days or Dives On:			
			Artificial Reefs	Natural Reefs	No Reefs	Sum of Percentages
Fishing ^a	490	10%	21%	45%	34%	100%
Scuba Diving/Snorkeling ^b	490	32%	25%	74%	1%	100%

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

Visitor boaters who came to Palm Beach County to use the reefs spent 10 percent of their visiting days participating in saltwater fishing from either a charter, party, rental or private boat. Of these fishing days, 21 percent of days were spent fishing near artificial reefs, 45 percent of days were spent fishing near natural reefs and 34 percent of days were spent fishing near no reefs. Also, 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 dives were spent on artificial reefs, 74 percent of dives were spent on natural reefs, and 1 percent of dives were spent on no reefs.

3.0 Socioeconomic Value of Reefs in Palm Beach County

These percentages are based on the visitor responses to the survey. The breakdown between artificial and natural reef use for charter boat and party boat fishing was taken from the responses to the charter boat survey. The breakdown between artificial and natural reef use for all other activities and boat modes were taken from the visitor responses to the survey.

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 3.2.1-3) times the proportion of person-days that these visitors spent participating in each activity-boat mode. Then the number of person-days spent in each saltwater boating activity-boat mode was allocated to artificial and natural reefs based on either the proportion of days or the proportion of dives spent in that activity-boat mode on or near artificial versus natural reefs. Proportion of days was used for all activities except scuba diving and snorkeling where the proportion of dives was used to provide a more accurate indicator of reef use.

A summary of the total person-days visitors spent participating in reef-related recreation by type of activity and by type of reef in Palm Beach County is provided in Table 3.2.1-5. The total person-days visitors spent participating in each saltwater activity and boat mode by type of reef is provided in Table 3.2.1-6.

Visitors to Palm Beach County spent about 1,260,000 person-days on the reef system from June 2000 to May 2001. About 330,000 of these days were spent on artificial reefs and about 931,000 of these days were spent on natural reefs.

**Table 3.2.1-5 (Visitors)
Number of Visitor 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	37,000	91,000	127,000
Scuba Diving	238,000	682,000	920,000
Fishing	55,000	158,000	214,000
Glass Bottom Boat Sightseeing	0	0	0
Total	330,000	931,000	1,261,000

3.0 Socioeconomic Value of Reefs in Palm Beach County

Table 3.2.1-6 (Visitors)
Number of Person-Days Visitors Spent Participating in Saltwater Boating Activities and Boating Modes and Type of Reef Used - 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	23,000	0	0	23,000
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

3.2.2 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 Palm Beach County. From this information, a picture of the average itemized expenditures per person per fishing or diving day and by boating mode was estimated.

The average itemized per person expenditures by those who participated in each activity and boat mode in Palm Beach County are provided in Table 3.2.2-1. Palm Beach County reef-using visitors who went saltwater fishing on their own boat, a friend's boat or a rental boat spent, on average, \$195 per person per day on the day that they went fishing. This amount is comprised of \$59 for boat fuel, \$28 for tackle, \$31 for marina fees, \$7 for lodging, \$12 for food and beverages at stores and \$23 for food and beverages at restaurants and bars, among other items.

The average expenditure of persons who fished on charter boats was \$263 per person per day. About \$96 was the cost of the charter boat while \$29 was spent on lodging, \$34 was spent on food and beverages at restaurants and bars, \$31 was spent on automobile gasoline, \$29 was spent on auto rental, and \$29 was spent on shopping.

Persons who fished on party boats spent considerably less per day than other fishers. Average daily expenditures were \$116 per person which included \$24 for the party boat fee, \$18 for lodging, \$14 for food and beverages at stores, \$30 for food and beverages at restaurants, \$11 for auto rental and \$11 for shopping.

Palm Beach County reef-using visitors who went scuba diving or snorkeling on their own boat, a friend's boat or a rental boat spent, on average, \$137 per person per day on the day they went diving. This amount is comprised of \$38 for boat fuel, \$15 for ramp fees, \$21 for marina fees, \$18 for food and beverages at stores and \$19 for food and beverages at restaurants and bars.

Visitors who went diving on charter or party boats spent the same amount per day as those using a private or rental boat. They 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 \$22 per day for food and beverages in restaurants and bars, among other items.

The lodging expenditure item includes lodging costs for hotels, motels and campgrounds or if the respondent paid by the day or by the week. The \$21 per person per day for lodging by divers who use charter or party boats 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, 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.

3.0 Socioeconomic Value of Reefs in Palm Beach County

**Table 3.2.2-1 (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. This sum was divided by the total number of respondents and party members who spent or benefited from the expenditures.

^b Boat rental is included under Equipment Rental.

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

3.0 Socioeconomic Value of Reefs in Palm Beach County

The expenditures per person per day were multiplied by the number of person-days by boating mode and reef type to obtain an estimate of the total expenditures associated with reef related activities in Palm Beach County. The itemized total expenditures associated with reef use in 2000-2001 are provided in Table 3.2.2-2. Visitors who used the reefs in Palm Beach County spent \$184 million on reef-related expenditures. Of this amount \$48 million was associated with artificial reef-related expenditures and \$136 million was associated with natural reef-related expenditures.

**Table 3.2.2-2 (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

The reef-related visitor expenditures were then used to estimate the economic contribution of artificial and natural reefs to Palm Beach County. 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

3.0 Socioeconomic Value of Reefs in Palm Beach County

wherein additional income and employment is created as the income earned by the reef-related industries is re-spent within the county. These additional effects of reef-related expenditures are called indirect and induced. Indirect effects are generated as the reef-related industries purchase goods and services from other industries in the county. Induced effects are created when the employees of the direct and indirect industries spend their money in the county.

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 County using the IMPLAN Regional Input-Output Model. This model uses detailed data on the economy of the county to estimate economic multipliers and to model the impact of reef-related expenditures on the economy.

The economic contribution of the reefs to Palm Beach County is provided in Table 3.2.2-3. The sales contribution is defined as the value of the additional output produced in the county due to the reef-related expenditures. The total income contribution is defined as the sum of employee compensation, proprietor's income, interest, rents, and profits generated as a result of the reef-related expenditures. Income is the money that stays in the county's economy. The employment contribution is the number of full-time and part-time jobs created due to the reef-related expenditures. The indirect business tax contribution is the sum of the additional excise taxes, property taxes, fees, licenses, and sales taxes collected due to the reef-related expenditures.

Table 3.2.2-3 (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

3.0 Socioeconomic Value of Reefs in Palm Beach County

Reef-related expenditures by visitors to Palm Beach County during the period June 2000 to May 2001 resulted in \$309 million in sales to county businesses. These sales generated \$172 million in income and 4,800 jobs. About \$23 million in indirect business taxes were collected as a result. About 25 percent of these values were the result of artificial reef-related expenditures and 75 percent of these values were the result of natural reef-related expenditures.

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

The visitor reef-user values associated with maintaining the reefs in their existing conditions for Palm Beach County is provided in Table 3.2.3-1. Use value per person day means the value per person day of artificial, natural or all reef use, as specified in the table. The respondent was asked to state yes, no or don't know to a specified payment to maintain the artificial reefs, the natural reefs and a combined program that would protect both types of reefs. The scenario provided to the respondent was as follows:

“Local and state government agencies are considering different approaches to maintaining the health and condition of the natural and artificial reefs in southeast Florida. One plan focuses on providing greater protection for natural reefs by maintaining water quality, limiting damage to natural reefs from anchoring, and preventing overuse of the natural reefs. A second plan focuses on protecting the artificial reefs by maintaining water quality, limiting damage to artificial reefs from anchoring and preventing overuse of the artificial reefs.

Both of these plans will involve increased costs to local businesses that will ultimately be passed on to both residents and visitors in southeast Florida. We are doing this survey because local government agencies want to know whether you support one, both or none of these plans and if you would be willing to incur higher costs to pay for these plans. Please keep in mind that whether you support these plans or not would not have any effect on you ability to participate in any boating activity or other recreation in southeast Florida.”

Then the respondent was asked a yes or no question regarding the natural reef plan, the artificial reef plan and both plans. For example, the question regarding both plans read: “Suppose that both of the above plans to maintain the natural and artificial reefs in southeast Florida were put together in a combined program. Consider once again your total trip cost for your last trip to use the reefs in southeast Florida including travel expenses, lodging, and all boating expenses. If

3.0 Socioeconomic Value of Reefs in Palm Beach County

your total costs for this trip would have been \$_____ higher, would you be willing to pay this amount to maintain the artificial and natural reefs?”

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

Values for all reefs were taken from statistical analysis of responses to Question 38 of Visitor Boater Survey⁴: “Suppose that both of the above plans to maintain the natural and artificial reefs in southeast Florida were put together into a combined program...If your total costs for this trip would have been \$___ higher, would you have been willing to pay this amount to maintain the artificial and natural reefs.” Values for artificial reefs were taken from statistical analysis of responses to Question 36 pertaining only to a program to maintain the existing artificial reefs in their current condition. Values for natural reefs were taken from statistical analysis of responses to Question 34 pertaining only to a program to maintain the natural reefs in their current condition.

Chapter 2.2.2 provides a general description of the procedures used to analyze the use value responses and the procedures used to estimate the user values presented here. For a more technical discussion, please see this report’s Technical Appendix which is a separate document. This report describes the methods used to derive the values presented here and provides alternative estimates using different estimation methods. Here we present the estimates of total annual use value, use value per person-day, and the asset value of the reefs derived using the logit model.

The results are consistent with the idea that natural reefs are preferred to artificial reefs. For Palm Beach County visitors, the average per person-day value of the natural reefs was \$27.85 versus \$17.89 for artificial reefs. Total use is also higher for natural versus artificial reefs. Palm Beach County visitors’ natural reef use was almost 931 thousand person-days versus 330 thousand person-days for artificial reefs. This translated into an estimate of total annual use value of over \$25.9 million for natural reefs and \$5.9 million for artificial reefs. Capitalizing the annual use values, using a three percent discount rate, yields asset values of about \$864 million for the natural reefs and \$197 million for the artificial reefs.

Annual use value represents the annual flow of total use value (i.e., the recreational benefits) to the reef-using public. From a public policy point of view, government spends money on the protection and management of the valuable resources of the natural and artificial reefs. This includes investments for such things 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

⁴ For a complete description of the contingent valuation questions, please refer to the Visitor Boater Survey and the Blue Card (which is white in this report but labeled “Blue Card” in Appendix B).

3.0 Socioeconomic Value of Reefs in Palm Beach County

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 use 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.

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 associated with Palm Beach County reefs, both artificial and natural, is \$701 million. Bear in mind that this value only includes the value that visitor reef users place on the reefs and does not include the values that resident reef users and non-reef-users place on the reefs or the economic contribution of the reefs. *The estimation of the value of reefs to non-reef users was not part of this study.*

Table 3.2.3-1 (Visitors)
Annual Value of Reefs To Reef Users and Capitalized Value
Data Represents June 2000 to May 2001
Visitor Reef-Users in Palm Beach County

Item	All Reefs – Artificial and Natural	Artificial Reefs	Natural Reefs
Number of Person-Days of Reef Use	1,260,787	330,112	930,675
Use Value Per Person-Day (\$2000)	\$16.68	\$17.89	\$27.85
Annual Use Value - (\$2000)	\$21,032,312	\$5,906,311	\$25,919,931
Capitalized Value @ 3 percent Discount Rate (\$2000)	\$701,077,067	\$196,877,033	\$863,997,700

Reef users’ willingness to pay to invest in and maintain “new” artificial reefs is provided in Table 3.2.3-2. The use value per person-day is the value per day or a portion of a day of artificial reef use. Reef users are willing to pay \$4 million annually for this program in Palm Beach County. Scuba divers have the highest value for new artificial reefs of all user types.

3.0 Socioeconomic Value of Reefs in Palm Beach County

Table 3.2.3-2 (Visitors)
Estimated Use Value of Investing in and Maintaining "New" Artificial Reefs in the County
Visitor Reef-Users in Palm Beach County

Item	Value
Number of Person-Days of Artificial Reef Use	330,112
Use Value Per Person-Day for "New" Artificial Reefs (\$2000)	\$12.01
Annual Use Values for "New" Artificial Reefs	\$3,964,467
Capitalized Value @ 3 percent Discount Rate (\$2000)	\$132,148,900
<i>Note: Use value per person-day is the use value for a whole day or a portion of a day of artificial reef use.</i>	

The value of reefs by reef type and activity type for Palm Beach County is provided in Table 3.2.3-3.

Table 3.2.3-3 (Visitors)
Value of Reefs to Visitors to Palm Beach County, by Reef Type and Activity, 2000-2001

Reef Type/Activity	Person-Days	Annual User Value (\$)	User Value Per Person-Day (\$)
Natural Reefs	930,675	\$25,919,931	\$27.85
Snorkeling	90,544	\$1,343,878	\$14.84
Scuba Diving	681,802	\$22,378,144	\$32.82
Fishing	158,329	\$2,197,909	\$13.88
Artificial Reefs	330,112	\$5,906,311	\$17.89
Snorkeling	36,940	\$362,444	\$9.81
Scuba Diving	237,921	\$4,812,227	\$20.23
Fishing	55,252	\$731,639	\$13.24
Natural & Artificial Reefs	1,260,787	\$21,032,312	\$16.68
Snorkeling	127,484	\$963,029	\$7.55
Scuba Diving	919,723	\$18,396,328	\$20.00
Fishing	213,580	\$1,672,955	\$7.83
New Artificial Reefs	330,112	\$3,964,467	\$12.01
Snorkeling	36,940	\$155,683	\$4.21
Scuba Diving	237,921	\$3,494,556	\$14.69
Fishing	55,252	\$314,228	\$5.69

3.2.4 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 Palm Beach County are summarized in Table 3.2.4-1.

**Table 3.2.4-1 (Visitors)
Demographic Characteristics of Visitor Reef-Users in Palm Beach County, 2000**

Characteristic	Value
Median Age of Respondent – Years	41
Sex of Respondent	
Male	79%
Female	21%
Race of Respondent	
White	94%
Black	2%
Other	4%
Percent Hispanic / Latino	5%
Median Household Income	\$87,500
Average Years Boating in Southeast Florida	9.2
Average Length of Own Boat Used in Saltwater Boating in Feet	25
Percent of Respondents Who Belong to Fishing and/or Diving Clubs	24%

3.3 Total – Residents and Visitors

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

3.3.1 User Activity

The numbers of person-days spent using the reefs in Palm Beach County by reef type and population (residents and visitors) are summarized in Table 3.3.1-1. Visitors and residents spent 4.2 million person-days using artificial and natural reefs in Palm Beach County during the 12 month period from June 2000 to May 2001. Residents spent 3.0 million person-days and visitors spent 1.2 million person-days. Reef users spent 1.4 million person-days using artificial reefs and 2.8 million person-days using natural reefs. A summary of reef use by type of activity is provided in Table 3.3.1-2.

**Table 3.3.1-1
Number of Person-Days Spent on Artificial and
Natural Reefs in Palm Beach County
Residents and Visitors
In Millions**

Population	Artificial Reefs	Natural Reefs	All Reefs
Residents	1.08	1.90	2.98
Visitors	0.33	0.93	1.26
Total	1.41	2.83	4.24

**Table 3.3.1-2
Number of Person-Days Spent Using Reefs in Palm Beach County
By Recreational Activity
Residents and Visitors
In Millions**

Activity	Residents	Visitors	Total
Snorkeling	0.62	0.13	0.75
Scuba Diving	0.81	0.92	1.73
Fishing	1.55	0.21	1.76
Total	2.98	1.26	4.24

Diving is a bit more prevalent than fishing in Palm Beach County. Fishing comprises 1.8 million person-days while scuba diving and snorkeling comprise 1.7 million person-days and about 750,000 person-days, respectively. Resident reef-related recreation comprises 70 percent of total reef-related recreation by residents and visitors in Palm Beach County. Residents spend significantly more days fishing and more days snorkeling than do visitors.

3.3.2 Economic Contribution

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

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

3.0 Socioeconomic Value of Reefs in Palm Beach County

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

The economic contributions of the artificial, natural and all reefs to Palm Beach County are provided in Tables 3.3.2-1 through 3.3.2-3. The sales contribution is defined as the value of the additional output produced in the county due to the reef-related expenditures. The total income contribution is defined as the sum of employee compensation, proprietor's income, interest, rents, and profits generated as a result of the reef-related expenditures. The employment contribution is the number of full-time and part-time jobs created due to the reef-related expenditures.

All reef-related expenditures in Palm Beach County generated \$505 million in sales during the 12-month period from June 2000 to May 2001. These sales resulted in \$194 million in income to Palm Beach County residents and provided 6,300 jobs in Palm Beach County. Artificial reef-related expenditures accounted for 30 percent of the economic contribution of all reefs and natural reef-related expenditures accounted for 70 percent of the economic contribution.

**Table 3.3.2-1
Economic Contribution of Artificial Reef-Related Expenditures
to Palm Beach County
June 2000 to May 2001 – In Millions of 2000 dollars**

Round of Spending	Contribution to:		
	Sales	Income ^b	Employment ^c
Direct ^a			
Resident	\$69.30	\$8.00	536
Visitor	\$48.14	\$25.00	849
Total	\$117.44	\$33.00	1,385
Indirect	\$13.62	\$7.40	142
Induced	\$19.41	\$12.20	253
Total	\$150.47	\$52.60	1,780
^a The direct contribution is the actual expenditures made in the county.			
^b Total income includes employee compensation, proprietor's income, interest, rents and profits			
^c Employment includes the number of full-time and part-time jobs.			

Table 3.3.2-2
Economic Contribution of Natural Reef-Related Expenditures
to Palm Beach County
June 2000 to May 2001 – In Millions of 2000 dollars

Round of Spending	Contribution to:		
	Sales	Income ^b	Employment ^c
Direct ^a			
Resident	\$126.20	\$14.40	968
Visitor	\$135.65	\$72.00	2,439
Total	\$261.85	\$86.40	3,407
Indirect	\$37.91	\$21.00	401
Induced	\$54.63	\$34.00	712
Total	\$354.39	\$141.40	4,520
^a The direct contribution is the actual expenditures made in the county.			
^b Total income includes employee compensation, proprietor's income, interest, rents and profits			
^c Employment includes the number of full-time and part-time jobs.			

Table 3.3.2-3
Economic Contribution of All Reef-Related Expenditures
to Palm Beach County
June 2000 to May 2001 – In Millions of 2000 dollars

Round of Spending	Contribution to:		
	Sales	Income ^b	Employment ^c
Direct ^a			
Resident	\$195.50	\$22.50	1,503
Visitor	\$183.79	\$97.00	3,288
Total	\$379.29	\$119.50	4,791
Indirect	\$51.52	\$28.40	543
Induced	\$74.04	\$46.20	965
Total	\$504.85	\$194.10	6,299
^a The direct contribution is the actual expenditures made in the county.			
^b Total income includes employee compensation, proprietor's income, interest, rents and profits			
^c Employment includes the number of full-time and part-time jobs.			

3.3.3 Use Value

In this study, four types of use values were estimated: (1) the value to natural reef users of maintaining the natural reefs in their existing condition; (2) the value to artificial reef users of maintaining the artificial reefs in their existing condition; (3) the value to all reef users of maintaining both the artificial and natural reefs in their existing condition; and (4) the value of adding and maintaining additional artificial reefs. In general, use value is the maximum amount

3.0 Socioeconomic Value of Reefs in Palm Beach County

of money that reef users are willing to pay to maintain the reefs in their existing condition and to add more artificial reefs to the system. Use value is presented in terms of per person per day of reef use and in aggregate for all users of the reef system.

The annual value Palm Beach County visitors and residents place on protecting the reefs in their existing condition and the associated capitalized value is presented in Table 3.3.3-1. The annual value visitor and resident reef-users place on investing in and maintaining “new” artificial reefs is presented in Table 3.3.3-2. These values were explained in Sections 3.1.3 and 3.2.3.

Table 3.3.3-1
Annual Use Value Associated with Protecting Reefs in their Existing Condition and
Capitalized Value associated With Reef Use
Data Represents June 2000 to May 2001
Palm Beach County, Florida

Item	Residents	Visitors	Total
All Reefs - Artificial and Natural			
Number of Person-Days of Reef Use (millions)	2.98	1.26	4.24
Use Value Per Person-Day	\$3.38	\$16.68	\$7.34
Annual Use Value - (million dollars)	\$10.7	\$21.03	\$31.10
Capitalized Value @ 3 percent Discount Rate (million dollars)	\$335.8	\$701.08	\$1,036.88
Artificial Reefs			
Number of Person-Days of Artificial Reef Use (millions)	1.08	0.33	1.41
Use Value Per Person-Day	\$2.96	\$17.89	\$6.47
Annual Use Value - (million dollars)	\$3.18	\$5.91	\$9.09
Capitalized Value @ 3 percent Discount Rate (million dollars)	\$106.10	\$196.88	\$302.98
Natural Reefs			
Number of Person-Days of Reef Use (millions)	1.90	0.93	2.83
Use Value Per Person-Day	\$8.50	\$27.85	\$14.86
Annual Use Value - (million dollars)	\$16.18	\$25.92	\$42.10
Capitalized Value @ 3 percent Discount Rate (million dollars)	\$539.30	\$864.00	\$1,403.30

**Table 3.3.3-2
Estimated Value to Reef Users From Investing in and
Maintaining "New" Artificial Reefs
Palm Beach County, Florida**

Item	Residents	Visitors	Total
Number of Person-Days of Artificial Reef Use (millions)	1.08	0.33	1.41
Use Value Per Person-Day for "New" Artificial Reefs	\$0.72	\$12.01	\$3.37
Annual Use Values for "New" Artificial Reefs (million dollars)	\$0.78	\$3.96	\$4.74
Capitalized Value @ 3 percent Discount Rate (million dollars)	\$25.90	\$132.10	\$158.00

3.3.4 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 Table 3.3.4-1. A comparison of the demographics indicate that resident and visitors are very similar in terms of age, race, income, and membership in fishing and/or diving clubs.

3.0 Socioeconomic Value of Reefs in Palm Beach County

**Table 3.3.4-1
Demographic Characteristics of Resident and Visitor Reef-Users in
Palm Beach County, 2000**

	Resident Reef-Users			Visitor Reef-Users		
Median Age of Respondent	48			41		
Sex Of Respondent	Percent			Percent		
Male	91%			79%		
Female	9%			21%		
	% of Resident Reef-Users			% of Visitor Reef-Users		
	White	Black	Other	White	Black	Other
Race Of Respondent	97%	0%	3%	94%	2%	4%
	% of Resident Reef-Users			% of Visitor Reef-Users		
Percent Hispanic/Latino	4%			5%		
	Resident Reef-Users			Visitor Reef-Users		
Median Household Income	\$71,695			\$87,500		
	Residents			Visitors		
Average Years Boating in South Florida	21			9.2		
	Residents			Visitors		
Average Length of Boat Used for Salt Water Activities in Feet	25			25		
	Residents			Visitors		
% of Respondents Who Belong to Fishing and/or Diving Clubs	20%			24%		