

The Economic Value of Turneffe Atoll

Full Report



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August 2011

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THE ECONOMIC VALUE OF TURNEFFE ATOLL

Introduction

Few places in the world are blessed with the diverse marine resources found at Belize's Turneffe Atoll. Turneffe supports both a vibrant tourism economy and a productive commercial fishery. Additionally, the atoll provides valuable protection from storm damage for the mainland, particularly for Belize City.

Over 60% of Belize's tourists participate in marine activities during their stay in Belize. As one of Belize's major marine tourism destinations, Turneffe Atoll is an important component of the Belize tourism economy. With at least 60 named dive sites, Turneffe is visited by divers from around the world who either stay at one of the all-inclusive resorts on the atoll or travel to Turneffe from as far away as San Pedro, Caye Caulker or Placentia. Turneffe's back-reef flats, creeks, channels and seagrasses offer world-renowned sport fishing for bonefish, permit, tarpon and several other species. Turneffe Atoll has been recognized by experts as one to the World's seven best bonefishing destinations and one of the ten best permit fishing destinations. Turneffe Atoll is also home to many threatened and endangered species including the American saltwater crocodile, Antillean manatee, Hawksbill turtle, goliath grouper, and Nassau grouper making it a centerpiece for eco-tourism and marine research.

For generations, Turneffe Atoll has supported an important commercial fishery. Although this fishery appears to have experienced a significant decline over the past decade, it continues to be an important part of Belize's economy and an important source of jobs in Belize.

Reefs and mangroves dampen the effects of tropical storms and hurricanes by protecting mainland property from damage. This storm protection is a valuable benefit related to Turneffe Atoll; and Turneffe's location, directly East of Belize City, makes its ability to moderate storm damage particularly important. These benefits are recognized as essential when considering offshore planning and development decisions (Deitrich 2006; Sadovy 2005).

Much of Belize's offshore area, including portions of Lighthouse Atoll and Glover's Reef Atoll, is protected under the National Protected Areas System Plan. Although Turneffe Atoll has long been recognized as a conservation priority, as emphasized in the GAP Analysis by Meerman (2005), Turneffe Atoll currently enjoys no definitive management structure or protected status.

Related Research

Although there is extensive tourism and commercial fishing activity associated with Turneffe Atoll, and the atoll offers significant storm protection benefits for Belize City, little information has been published on the overall economic value of the atoll. A recent study by Cooper, Burke and Bood (2009) examined the tourism, fisheries and storm protection values associated with the coral reefs and mangrove forests of Belize. Their study employed the use of the Belize Tourism Board's 2006 Motivation and Expenditure Survey (BTB 2007) to identify the percentage of tourists engaging in snorkeling, diving and sport fishing, and their related

expenditures to estimate the economic impact of these activities. To date, however, there has not been any attempt to quantify these benefits specifically for Turneffe Atoll.

Cooper et. al. (2009) estimated that 64% of Belize's tourists participate in some form of marine recreational activity during their stay in Belize. Snorkeling accounted for the greatest proportion of marine tourist activities (59%) followed by diving (27%) and sport fishing (16.5%).

A study by Fedler and Hayes (2008) estimated the economic impact of fishing for bonefish, permit and tarpon throughout Belize. Data for this study was derived from interviews with independent guides and information provided by fishing lodges/resorts. This study found that sport fishing for bonefish, permit and tarpon in Belize accounted for US\$21.4 million in direct expenditures with an additional \$3.8 million spent on other activities and services while in the country. The total direct and indirect economic effect of fishing for these three species in Belize totaled US\$56.5 million per year.

The value of Belize's commercial conch, lobster and finfish fisheries was examined in the study by Cooper et. al.(2009). They used 2007 data from fisheries cooperative sales and estimates of local sales to quantify the value of the commercial harvest associated with coral reefs and mangroves. The vast majority of the commercial fish sales came from lobster (61%). Conch comprised 22% of the sales and finfish 16%. Wild shrimp and crabs account for 1% of commercial sales. Overall, they estimated that the commercial fishery in Belize was valued at US\$14.2 million to US\$15.5 million.

The value of shoreline protection from Belize reefs and mangroves is a unique and valuable addition to the report by Cooper et. al. (2009). A modified "avoided damages" approach was used to estimate the value of this service along coastal segments protected by coral reefs or mangroves. The procedure they used involved estimating the likely economic losses (in property value) to a coastal area from a given storm event, both with and without reefs and mangroves present. This difference represented the "avoided damages" owed to the presence of reefs and mangroves. The method was developed jointly by the Institute of Marine Affairs in Trinidad and Tobago and World Resources Institute and employed a GIS analytical modeling component as well as an economic component. This method was selected because reliable estimates for the replacement cost of man-made structures are very limited. The avoided damages approach has the additional benefit of producing analytical results that can support informed coastal planning and development.

The results of the damage avoidance analysis showed that the annual value of protection related to coral reefs was about US\$150 million per year and protection from mangroves was estimated at US\$139 million per year. Combining these values results in an annual total of US\$289 million per year for shoreline protection from coral reefs and mangroves in Belize.

Study Objectives

- To identify tourism businesses using Turneffe Atoll.
- To survey businesses to determine the extent of to which businesses use Turneffe Atoll for Scuba diving, sport fishing and eco-tourism.
- To estimate the economic impact of overnight tourists visiting Turneffe Atoll.
- To estimate the value of the commercial fishery at Turneffe Atoll.
- To estimate the value of storm damages avoided by Belize due to Turneffe Atoll's coral reefs and mangrove forests.

Methods

Tourism

To estimate the economic contribution associated with Turneffe Atoll's tourism, we used a different approach than the studies mentioned above. BTB's Motivation and Economic Survey data are not collected with sufficient detail to identify Scuba divers, sports fishers and eco-tourists visiting Turneffe's resorts or traveling to Turneffe from elsewhere in Belize. To achieve this level of detail, it was necessary to contact relevant businesses throughout Belize and collect information directly from them.

To this end, a variety of methods were used to identify tourism-related businesses that use Turneffe Atoll. These businesses include hotels, resorts, dive shops, live-aboard boats and independent tour operators. To identify these businesses, a list of potential Turneffe users was developed through Internet searches, reviews of diving and sport fishing publications, BTB website listings, tourism-related brochures, and interviews with knowledgeable individuals in the industry. These procedures yielded a list of 103 businesses that either advertised sport fishing, diving or eco-tourism at Turneffe Atoll or offered these services without specifically mentioning Turneffe.

Pertinent contact information, as well as any information about diving rates, sport fishing rates, and all-inclusive package rates was collected for each business. This list of businesses was used as the basis for an Internet survey. A summary of the project was provided to each business and basic information, outlined above, was collected. Contacts were also asked if they knew of other businesses that used Turneffe; and if so, they were added to the list and contacted for inclusion in the study. If the business did not take guests to Turneffe to dive, sport fish or tour, the business was dropped from the list.

Once the list was completed, an invitation to participate in the online survey was e-mailed to each of the businesses. The invitation provided a brief overview of the project and the information being requested. An active survey link was included in the e-mail taking the recipient directly to the online survey. Once the recipient entered the survey they were asked to provide the following information about their operation.

- Type of business – hotel, resort, all-inclusive resort, independent dive shop, independent eco-tour operator, or research facility.

- Types of tourist activities offered – Scuba diving, snorkeling, sport fishing, or eco-touring.
- Diving activity – number of trips during the past 12 months to Turneffe Atoll and average number of guests per trip.
- Sport Fishing activity – number of people sport fishing at Turneffe and average number of days they fished Turneffe.
- Eco-tourism activity – number of trips to Turneffe and average number of guests per trip.

To estimate visitor expenditures, Scuba diving, sport fishing and eco-tourism activities were analyzed separately due to their unique participation and expenditure characteristics. Each of these three tourism activities were then divided into two groups related to their expenditure patterns: guests staying at all-inclusive resorts located on Turneffe Atoll and “daily vacationers” staying elsewhere in Belize and visiting Turneffe for a only a portion of their tourism activities while in Belize.

The majority of diving at Turneffe Atoll originates from independent dive shops, dive shops operated by hotels or resorts outside of Turneffe, all-inclusive resorts outside of Turneffe or live aboard dive boats. A smaller percentage of diving activity is derived from the all-inclusive resorts on Turneffe. The opposite is true for sport fishing and eco-touring with most of these tourists staying at all-inclusive resorts on the atoll and relatively few traveling from off-atoll locations to fish or eco-tour. Tourists from cruise ships also utilize Turneffe Atoll for diving and snorkeling excursions; however, these tourists were not included in this analysis as they do not stay overnight in Belize.

Expenditures for divers, sport fishers and eco-tourists staying at all-inclusive resorts on Turneffe Atoll were based on the average of high and low season package prices. These average prices were disaggregated into activity costs and accommodation costs. Accommodation costs were estimated by using the average nightly lodging cost for all-inclusive resorts reported by Cooper et al. (2009). This nightly lodging cost was multiplied by 7 nights - the average stay for all-inclusive resort guests. This amount was then subtracted from the average package price for diving, sport fishing or eco-touring package prices to produce the Turneffe Tourism Activity cost and a separate Accommodations cost for each activity. All-inclusive resort visitors also make expenditures for other items not included in their package price while in Belize. These expenditures include tips for resort employees, bar bills, equipment rental, gifts, and other goods and services. These expenditures were calculated using the BTB expenditure estimate, reported by Cooper et al. (2009), for all-inclusive resort guests.

Daily diving, daily sport fishing and daily eco-touring expenditures were aggregated into four categories – Turneffe Tourism Activity, Non-Turneffe Tourism Activities, Accommodations, and Other Expenditures. Turneffe Activity expenditures were based on the advertised prices for a daily diving, daily sport fishing and daily eco-touring trips to Turneffe. Non-Turneffe Tourism Activity expenditures were based BTB data analyzed by Cooper et al. (2009) Accommodation expenditures were based on the average per night lodging expenditure reported for divers, sport fishers and eco-tourists in the BTB data. Finally, the Other Expenditure category was a combination of BTB data pooling other visitor expenditures not contained in the previous three categories, including food.

For each daily expenditure category, expenditures were calculated on a per-day basis. This allowed for computational consistency among the expenditure categories and across diving, sport fishing and eco-tourism activities. It was also necessary in order to calculate that portion of daily tourist expenditures directly related to the time they spent at Turneffe Atoll. For example, daily diving tourists in this study spent an average of 2.43 days diving at Turneffe Atoll. While expenditures during these 2.43 days are specifically related to their stay at Turneffe Atoll, expenditures for the remainder of their 7 day stay in Belize should be treated differently. Thus, two sets of expenditures are presented in the tables below. The first set shows the Total Trip Expenditures made by Turneffe Atoll visitors during their entire stay in Belize. The second set of expenditures show the portion of overall trip expenditures specifically related to the days spent at Turneffe Atoll. Because diving tourists spent an average of 2.43 days at Turneffe, 2.43 was multiplied by the average daily accommodations cost to yield that proportion of accommodations spending specifically attributable to diving at Turneffe. Likewise Other Expenditures were similarly allocated to Turneffe-Related Expenditures to properly categorize this spending.

Commercial Fisheries

Estimating the economic contribution of commercial fishing at Turneffe Atoll is largely based on data from Belize's fishing cooperatives as reported to the Belize Fisheries Department. Cooperative sales, including prices paid for products, are collected by location, including Turneffe Atoll. This data is reported in various publications such as Villanueva (2009) and the data in this analysis was confirmed by Fisheries. Interviews with Turneffe fishermen were also utilized as a source of information.

Shoreline Protection

The annualized value of shoreline protection provided by Turneffe Atoll is an important consideration in quantifying the benefits associated with the atoll. Estimates presented in this report were derived from the extensive work on quantifying shoreline protection values by Cooper et. al. (2009). It is important to capture this value for Turneffe Atoll as the atoll plays a very significant role in helping to protect Belize City during storm events. In the Cooper et. al. (2009) study, protection values were calculated separately for coral reef protection and mangrove forest protection. This study uses their overall annual value of protection provided by reefs and mangroves to estimate the value attributable to Turneffe. This value was derived by multiplying Belize's overall value for reef and mangrove protection by the percentages of reef and mangrove cover for Turneffe.

Economic Impact

Estimating the total economic impact of tourism activities associated with Turneffe Atoll entails quantifying the relevant direct expenditures by tourists and the "multiplier" or secondary effects related to these direct expenditures. Total economic impact is comprised of three components: direct effects, indirect effects and induced effects. **Direct Effects** are the on-site or immediate expenditures such as lodging, sport fishing tackle, meals, guide fees and taxes.

Indirect Effects refer to the increase in economic activity that occurs when a contractor, vendor or manufacturer receives payment for goods or services and in turn is able to pay others who support their business. This includes payments to bankers, accountants, grocery store owners, marina operators, fuel suppliers and others. **Induced Effects** are changes in spending patterns that are caused by the increased wealth and income of those persons directly and indirectly employed by resorts, lodges, hotels, restaurants, dive shops, or as independent fishing guides. This includes spending on food, clothing, housing, transportation and other goods and services by those directly or indirectly employed by the tourism-related businesses, including retail sales, medical services, insurance services, income and sales taxes, and much more. These Indirect and Induced Effects together are often referred to as **Value Added** impacts. The sum of these three effects yields a **Total Economic Effect**.

Economic Multipliers

Estimating the indirect and induced effects of expenditures by tourists in Belize is somewhat challenging due to the absence of economic input-output models developed from extensive econometric data specifically for Belize. Similar studies have been performed in other countries to assess the economic effects of government policies, changes in economic activity, and private sector development. The values developed from such studies not only account for the direct effects of expenditures, but also can estimate the personal income and employment derived from the expenditures. In many countries, these values have been estimated through the use of economic modeling programs such as IMPLAN (Minnesota IMPAN Group 2007) and RIMS II (Bureau of Economic Analysis 1997).

Given the unavailability of such models for Belize, an approximated value of 1.22 was used for this study. This value was used by Fedler and Hayes (2008) in their study of bonefish, permit and tarpon anglers which was based on values reported in sport fishing and tourism studies from the United States and other countries, and from tourism statistics provided by the Belize Tourism Board. This relatively low output multiplier was similar to those found for other countries with an elevated dependence on imports, which is also the case in Belize. Imports cause leakages in the economy as capital flows to other countries to purchase goods and services not produced within that country, thus reducing the indirect and induced impacts of expenditures.

Income and job multipliers for Belize were available directly from Belize Tourism Board data on tourist-related income, expenditures, and jobs in 2006. Both Belizean coefficients for income (0.5290) and for jobs (0.000033) were comparable to those found in several recreational fishing and tourism studies in the U.S. and other countries.

Results

There are two types of tourism businesses that utilize Turneffe Atoll (Table 1). The first are all-inclusive resorts located on Turneffe Atoll that provide tourism activities as part of a package price. The second are businesses providing tourism activities at Turneffe on a daily basis. These businesses are not located on Turneffe Atoll and they schedule daily trips to Turneffe Atoll from a variety of locations.

The initial identification of diving businesses in Belize resulted in 5 all-inclusive diving resorts at Turneffe and 62 daily diving businesses utilizing the atoll (Table 1). Each of these 67 businesses was sent an invitation to fill out an online survey. Of these initial invitations, 5 all-inclusive resorts from Turneffe and 40 businesses doing daily diving trips to Turneffe indicated that they scheduled diving trips to Turneffe Atoll during the previous 12 months. These were, therefore, denoted as “Qualified Businesses. 80% of the Qualified all-inclusive diving businesses and 73% of the Qualified daily diving businesses responded to the Survey.

The majority of sport fishing and eco-tourism at Turneffe Atoll is done by all-inclusive businesses located on Turneffe Atoll. However, several sport fishing and eco-tourism businesses were identified that schedule daily trips to Turneffe. Sixty-seven percent of the qualified all-inclusive sport fishing businesses completed a survey, while 100% of the all-inclusive eco-tourism businesses did so (Table 1). Two-thirds of the qualified businesses offering daily sport fishing and trips 63% of those offering daily eco-tourism trips to Turneffe responded to the survey.

Table 1: Response rates for different tourism businesses using Turneffe Atoll

Tourism Business	Initial Contacts	Qualified Businesses	Survey Respondents	Response Rate
Turneffe Atoll All-Inclusive diving	4	4	4	100%
Daily diving trips	63	41	29	70%
All-Inclusive sport fishing & live-aboards	4	4	3	75%
Daily sport fishing trips	9	6	4	67%
All-Inclusive eco-tourism	4	4	4	100%
Daily eco-tourism trips	19	9	5	55%
Total	103	68	49	78%

It should be noted that the business identification process was ongoing throughout the project. That is, the business identification process initially included contacts from tourist brochures, Internet website searches, Belize Tourism Board business listings, Belize Tourism Industry Association member listings, but also included other contacts as they were encountered over the course of the project. Some referrals were obtained from survey respondents who were asked to list businesses in their area that might schedule diving, fishing or eco-tourism trips to Turneffe. These additional leads were then added to the Initial Contact List (if absent from the list) and were evaluated to determine if they were Qualified Businesses.

The number of divers, sport fishers and eco-tourists identified in the tables below represent actual data from businesses completing the online survey or providing information during a telephone interview. No attempt was made to estimate participant numbers for non-responding businesses. This being the case, the census of tourism businesses utilizing Turneffe Atoll is likely incomplete and therefore underestimates the full extent of tourism related economic benefits from Turneffe Atoll.

Turneffe Diving Activity

To obtain an accurate view of the economic contribution of diving tourism at Turneffe Atoll, daily divers who visited Turneffe for only a portion of their vacation in Belize were evaluated separately from divers who spent their entire vacation in Belize at Turneffe. Because we cannot determine whether these daily divers' primary motivation for visiting Belize was to dive Turneffe Atoll, these two groups were analyzed separately.

The first section of Table 2 shows expenditures for divers staying at all-inclusive resorts located on Turneffe Atoll. To assess the impact of divers staying at these resorts, the high season and low season package prices were averaged to create a single price for estimating total expenditures. The business survey did not ask respondents to break down their trips by season and, thus, an average price was used for this calculation. An estimated 1,387 divers stayed at all-inclusive Turneffe Atoll resorts during 2010 (Table 2).

In order to calculate the taxes paid by divers staying at all-inclusive Turneffe resorts, it was necessary to split the lodging portion from the average package price of US\$2,258. This was accomplished by multiplying the average accommodation nightly rate of US\$90 by the average number of nights stayed (7) and subtracting this product (US\$630) from the package price. The remaining portion of the package price (US\$1,628) represented spending for diving activities, food, transportation, transfers and other items included in the package price. This portion of the package price minus lodging was then divided by seven (average length of stay) to produce an average daily activity rate to maintain computational consistency throughout all the results tables and estimate the Turneffe-related portion of diver expenditures.

Divers staying at all-inclusive resorts located at Turneffe spent about US\$2.2 million for diving, food and other items included in their package price during 2010 (Table 2), and they spent an additional US\$873,810 on accommodations. Based on data from the Cooper et. al. (2009) study, divers staying at all-inclusive resorts spend an average of US\$231 per visit, or US\$33 per day, on other goods and services while in Belize that are not included in the package price. This spending, totaling US\$320,397, includes such things as tips for resort employees, bar bills, equipment rental, gifts and other goods and services not included in the package price. Divers at Turneffe-based all-inclusive resorts accounted for US\$3.4 million in tourist expenditures while in Belize. These expenditures are all Turneffe Related Expenditures as shown in Table 2.

Also shown in Table 2 are divers visiting Turneffe for daily diving excursions. These divers came from as far as away as Ambergris Caye in the north and Placentia in the south. They stayed in various accommodations or on live aboard dive boats. The 6,894 daily divers visiting Turneffe were calculated by summing the number of divers reported by the pertinent businesses responding to our survey.

To calculate diving expenditures for daily divers, the advertised cost of a dive trip to Turneffe was used for each business. If the price for a business was not available, the average price for all businesses (\$182) was used. Data from responding business indicated that these tourists average

2.43 dive trips to Turneffe during their 7 day stay in Belize. Diving expenditures related to their 2.43 days at Turneffe totaled slightly more than US\$3.0 million while tourism activity expenditures for the remainder of their stay in Belize amounted to US\$3.4 million.

Table 2: Estimated number of Turneffe Atoll Scuba divers and diving expenditures for 2010 (\$US)

Expenditure Category	Divers	Average Days per Diver	Average Daily Expenditure	Total Trip Expenditures	Turneffe-Related Expenditures
All-Inclusive Resort Located on Turneffe					
Turneffe Diving	1,387	7.00	\$232	\$2,252,488	\$2,252,488
Accommodations	1,387	7.00	\$90	\$873,810	\$873,810
Other Expenditures	1,387	7.00	\$33	\$320,397	\$320,397
Subtotal				\$3,446,695	\$3,446,695
Daily Diving at Turneffe					
Turneffe Daily Diving	6,894	2.43	\$182	\$3,048,940	\$3,048,940
Non-Turneffe Tourism Activities	6,894	4.57	\$108	\$3,402,603	\$0
Accommodations	6,894	7.00	\$87	\$4,198,446	\$1,457,461
Other Expenditures	6,894	7.00	\$65	\$3,136,770	\$1,088,907
Subtotal				\$13,786,759	\$5,595,308
Total				\$17,233,454	\$9,042,003

Based upon BTB data, tourists visiting Belize stay between seven and eight days on average. For this study, it was assumed that all diving visitors stayed seven nights in Belize. To estimate the cost of accommodations for daily diving tourists, the average lodging cost reported by Cooper et. al. (2009) was used since it is based on BTB 2006 *Visitor Motivation and Expenditure Survey* data for divers. Accommodation expenditures for divers making trips to Turneffe were estimated to be nearly US\$4.2 million (Table 2). Only the portion of accommodation expenditures related to their 2.43 days of diving at Turneffe was designated as a Turneffe-Related Expenditure (US\$1.4 million).

The final category of expenditures for daily divers at Turneffe (Other Expenditures) includes spending for food, transportation, incidental items, gifts and other activities. Divers average about US\$65 per day for these purchases which accounted for more than US\$3.1 million in expenditures.

Overall, divers making excursions to Turneffe Atoll from elsewhere in Belize, spent an estimated US\$17.2 million while vacationing in Belize. The portion of these diver's expenditures attributable to the time they specifically spent at Turneffe was calculated separately and is shown in the "Turneffe-Related Expenditures" column in Table 2. These expenditures specifically related to diving at Turneffe totaled about US\$5.6 million during 2010 and represented 41% of these diver's overall expenditures while in Belize.

Overall, Turneffe divers spent US\$17.2 million while vacationing in Belize. Expenditures made only during the specific days spent diving at Turneffe Atoll were estimated to be \$9.0 million or 52% of these divers' total tourism expenditures of US\$17.2 million while in Belize.

Turneffe Sport Fishing Activity

Most of the sport fishing on Turneffe Atoll is done by guests staying at all-inclusive resorts on the atoll. Responses to our survey indicated that 1,250 sport fishers stayed at all-inclusive Turneffe Atoll resorts in 2010 (Table 3). Again, the high and low season prices from these resorts were averaged (US\$2,919 per week) to create an average week-long fishing package price. The accommodation component was then backed out, as noted above, to determine the activity portion of the package. As shown in Table 3, sport fishing at Turneffe all-inclusive resorts accounted for US\$2.8 million in expenditures for food, transportation and fishing services. Sport fishers spent an additional US\$787,500 for accommodations and approximately US\$288,750 for other things not included in the package price during their week-long stay at the resort. Expenditures for sport fishing at Turneffe totaled US\$3.9 million at all-inclusive Turneffe resorts. All of these expenditures were considered Turneffe Atoll-related tourism.

Some businesses not located on Turneffe Atoll also took sport fishers to the atoll on a day-to-day basis (Table 3). The three businesses responding to the survey estimated they took 267 sport fishers to the atoll during 2010. Total expenditures by tourists traveling to Turneffe Atoll from somewhere else in Belize to sport fish totaled nearly one-half million dollars. About 33% of these expenditures (US\$163,404) can be directly attributed to fishing at Turneffe.

Table 3: Estimated expenditures for 2010 by all-inclusive and daily Sport Fishers (\$US)

Expenditure Category	Sport Fishers	Average Days	Average Daily Expenditure	Total Trip Expenditures	Turneffe-Related Expenditures
All-Inclusive Resorts Located on Turneffe					
Turneffe Sport Fishing	1,250	7.0	\$327	\$2,861,250	\$2,861,250
Accommodations	1,250	7.0	\$90	\$787,500	\$787,500
Other Expenditures	1,250	7.0	\$33	\$288,750	\$288,750
Subtotal				\$3,937,500	\$3,937,500
Daily Fishing at Turneffe					
Turneffe Daily Fishing	267	2.0	\$150	\$80,100	\$80,100
Non-Turneffe Tourism Activities	267	5.0	\$96	\$128,160	\$0
Accommodations	267	7.0	\$86	\$160,734	\$45,924
Other Expenditures	267	7.0	\$70	\$130,830	\$37,380
Subtotal				\$499,824	\$163,404
Total				\$4,437,324	\$4,100,904

During 2010, total trip expenditures by tourists who went sport fishing at Turneffe Atoll during their stay in Belize totaled US\$4.4 million. US\$3.9 million, or 88% of these expenditures

were at all-inclusive resorts located on the atoll. US\$4.1 million, or 92% of the US\$4.4 million total, was specifically related to sport fishing at Turneffe.

Turneffe Eco-Tourism & Snorkeling Activity

Like sport fishing, eco-tourism at Turneffe is primarily the province of the resorts on the atoll. However, five businesses not located at Turneffe responded that they had taken eco-tourism trips to Turneffe during the previous 12 months. The number of eco-tourists visiting the atoll from all-inclusive resorts numbered 1,221 according to the business survey (Table 4). The average of high and low season inclusive package prices (US\$1,889) was again used to estimate tourist spending. After subtracting the accommodations portion from the package price, an average daily price of US\$179 for eco-touring, food and other items included in the package price was derived. Activities and food accounted for US\$1.5 million in eco-tourism expenditures, while accommodations added another US\$769,230. With the addition of the other non-package expenditures eco-tourists made of US\$282,051, the total impact of eco-tourism on Turneffe Atoll by tourists staying at all-inclusive resorts was more than US\$2.5 million.

Daily eco-tourism visitors to Turneffe, by those staying elsewhere in Belize during 2010, numbered 512 according to survey respondents (Table 4). These tourists spent US\$43,520 directly for eco-tours (including snorkeling) on the atoll. They spent over US\$850,000 on other tourism activities, accommodations, and other expenditures while in Belize. About 14% or US\$123,392 of the daily spending by eco-tourists visiting Turneffe can be attributed directly to their eco-tourism activity on Turneffe.

Table 4: Estimated expenditures for 2010 all-inclusive and daily Eco-tourism (\$US)

Expenditure Category	Eco-Tourists	Average Days	Average Price Per Day	Total Trip Expenditures	Turneffe-Related Expenditures
All-Inclusive Resorts Located on Turneffe					
Turneffe Eco-touring	1,221	7.0	\$179	\$1,529,913	\$1,529,913
Accommodations	1,221	7.0	\$90	\$769,230	\$769,230
Other Expenditures	1,221	7.0	\$33	\$282,051	\$282,051
Subtotal				\$2,581,194	\$2,581,194
Daily Eco-tourism					
Turneffe Daily Eco-touring	512	1.0	\$85	\$43,520	\$43,520
Non-Turneffe Tourism Activities	512	6.0	\$96	\$294,912	\$0
Accommodations	512	7.0	\$86	\$308,224	\$44,032
Other Expenditures	512	7.0	\$70	\$250,880	\$35,840
Subtotal				\$897,536	\$123,392
Total				\$3,478,730	\$2,704,586

Total trip expenditures by eco-tourists visiting Turneffe Atoll during their stay in Belize was estimated at nearly US\$3.5 million. Spending related directly to Turneffe eco-touring accounted for US\$2.7 million or 78% of tourist’s total expenditures while in Belize.

Taxes Generated

Six separate taxes collected in Belize were included in this analysis: Hotel Tax, Goods and Services Tax (GST), Business Tax, Departure Tax, fuel taxes and Fishing Licenses (Table 5). Hotel Taxes were estimated separately for the all-inclusive resort visitors and daily visitors. For those staying at all-inclusive resorts, the average nightly hotel rate was used to determine the accommodations portion of the package price. For daily divers, sport fishers and eco-tourists, accommodation expenditures in the tables above were used to calculate Hotel Taxes. These rates were multiplied by the tax rate of 9% to determine the Hotel Tax. This resulted in an estimated US\$639,000 in revenue from tourists visiting Turneffe during a portion of their stay in Belize and US\$358,000 for the days they specifically spent at Turneffe.

The GST rate of 12.5% was applied to all expenditures aside from accommodations. For both all-inclusive visitors and daily visitors, this GST rate was applied to Turneffe tourism activity, non-Turneffe tourism activity and other activity expenditure categories. This resulted in an estimated US\$2.2 million in revenue from tourists visiting Turneffe during a portion of their stay in Belize and US\$1.4 million for the days they specifically spent at Turneffe.

The 1.75% Business Tax is levied on the total sales including accommodations. This tax generated an estimated US\$440,000 in revenue from tourists visiting Turneffe during a portion of their stay in Belize and US\$277,000 in revenue specifically related to their days spent at Turneffe.

The departure tax of US\$35 per person was applied to the 15,013 divers, anglers and eco-tourists visiting Turneffe. This tax generated US\$403,000.

Table 5: Summary of taxes generated by Turneffe Atoll tourism (\$US)

Type of Tax	Taxes for Total Trip Expenditures	Taxes for Turneffe-Related Expenditures
Hotel Tax (9%)	\$638,815	\$358,016
Goods and Services Tax (GST) (12.5%)	\$2,256,446	\$1,483,692
Business Tax (1.75%)	\$440,116	\$277,331
Departure Tax (\$35)	\$403,585	\$403,585
Fuel Taxes	\$1,380,708	\$870,027
Fishing License Fees	\$37,925	\$37,926
Total Taxes	\$5,157,595	\$3,430,577

Fuel taxes generated from boats traveling to and from Turneffe as well as those used by the resorts on the atoll were calculated from fuel tax estimates reported in Fedler and Hayes (2008).

This study showed that 5.49% of all business expenditures for fishing were for fuel taxes. Using this percentage, an estimated US\$1.3 million in fuel taxes were generated by all tourists visiting Turneffe during their stay in Belize with US\$870,000 specifically related to their days spent at Turneffe.

Finally, the recently enacted fishing license fee of US\$25 per week resulted in an estimated US\$37,926 being spent by the 1,517 Turneffe sport fishers.

Overall, tourism associated with Turneffe Atoll generated about US\$5.1 million in tax revenues for the government of Belize, while expenditures specifically related to the days tourists spent at Turneffe provided the government with US\$3.4 million in tax revenues.

Summary of Turneffe Tourism Impacts

A summary of Turneffe Atoll’s annual overnight tourism related economic contribution is shown in Table 6. Tourists visiting Turneffe Atoll during their stay in Belize spent over US\$30.3 million with 63% of this, or US\$19.2 million, related specifically to the time these tourists spent at Turneffe.

The Value Added or multiplier effects of these tourist expenditures extended the overall benefits from Turneffe-related overnight tourism by another US\$6.6 million and the benefits related specifically to the time tourists spent at Turneffe by approximately US\$4.2 million. The multiplier of 1.22, as discussed earlier, may undervalue the magnitude of these ripple effects from tourist spending as suggested by Cooper et. al. (2009), who used a range of multipliers from 1.2 to 1.4.

The total economic effect of all spending by overnight tourists visiting Turneffe Atoll during their visit to Belize was approximately US\$36.9 million. The total economic effect of spending by overnight tourists related specifically to their time at Turneffe Atoll exceeded US\$23.5 million.

Table 6: Summary of Turneffe Atoll Tourism direct economic and value added impacts (USD)		
Economic Component	Total Trip Expenditures	Turneffe-Specific Expenditures
Turneffe diving, fishing and eco-tourism activity	\$9,816,211	\$9,816,211
Non-Turneffe tourism activity	\$3,825,675	\$0
Accommodations	\$7,097,944	\$3,977,957
Other Expenditures	\$4,409,678	\$2,053,325
Taxes and licenses	\$5,157,595	\$3,430,578
Total direct impact	\$30,307,103	\$19,278,071
Value Added Multiplier	\$6,667,563	\$4,241,176
Total Economic Impact	\$36,974,666	\$23,519,247

Tourism Jobs and Personal Income

An important component of an economic impact analysis is estimating the jobs supported by the economic activity and the personal income derived by workers. Using job and income multipliers from the Belize Tourism Board reports (BTB 2007), the US\$47.2 million in total tourism impacts from Turneffe Atoll results in 1,220 full-time equivalent jobs being supported and US\$14,560,000 in personal income going to workers employed in tourism and associated industries. The impacts associated with the expenditures specifically related to the days these tourists spent at Turneffe Atoll were 776 jobs and US\$12,442,000 in personal income.

Turneffe Commercial Fisheries

For centuries, Turneffe Atoll has been a productive commercial fishery providing nutrition, jobs and foreign exchange for Belize. In recent decades, Turneffe's commercial fishing has primarily focused on lobster, conch and finfish.

Total amounts of lobster and conch sold to Belize's fishing cooperatives from 2004-2009, as reported to the Belize Fisheries Department, is shown in Table 7. Also shown in Table 7 are lobster and conch sales to cooperatives from Turneffe Atoll. Nationally, the sale of lobster tails to cooperatives remained relatively stable between 2004 and 2009 with the national sale of lobster tails to cooperatives declining 3.6%. Over the same period, sales to cooperatives from the Turneffe lobster fishery declined by 70.4 percent. As a percentage of the national cooperative sales, Turneffe's total declined from 20.4% to 6.2% over the same six-year period.

Because of a severe price decline for lobster tails in 2009, the overall value of these sales, nationally, was reduced by 22.0% from 2004 to 2009 (Table 7). The value of Turneffe lobster sales through the cooperatives declined by 76.1% during the same period – from US\$1.5 million to about US\$365,000

Sale of lobster head meat was somewhat more variable over the six year period (Table 7) but this has minor role in the value of Belizean fisheries. The national sale of lobster head meat to cooperatives declined by 65.9%, while the Turneffe sales to cooperatives declined by 55.8%. Turneffe's portion of the sales of lobster head meat varied widely across the 2004 to 2009 time frame. However, there was a steady increase in prices over the six years which mitigated some of the effects of the harvest declines both nationally and for Turneffe fishermen.

Nationally, the amount of conch sold through the cooperatives increased by 18% from 2004 to 2009, while Turneffe's sales to cooperatives declined by 56.7%. This resulted in an increased national sales value to cooperatives of 33.1% and a corresponding decrease of 51.2% in value for Turneffe.

While sales to cooperatives represent the majority of lobster and conch sales in Belize, fishermen also sell a portion of their catch locally. As Cooper, et. al. (2009) point out, there is little documentation on the percentage of catch that goes directly to local markets, hotels and restaurants. Through interviews and published surveys of local fishermen they estimated that

15% of the lobster and 5% of the conch harvested goes to buyers outside the cooperatives. Interviews with Turneffe Atoll fishermen generally confirm these numbers with several indicating that 90% of Turneffe’s legal lobster and conch production goes through the cooperatives.

Table 7: National and Turneffe Atoll sales of Lobster and Conch to fisheries cooperatives: 2004 - 2009						
	Lobster Tails (lbs)			Price/lb.	Value (USD)	
	Nationally	Turneffe	% Turneffe		Nationally	Turneffe
2004	504,672	102,792	20.4%	\$14.84	\$7,490,118	\$1,525,593
2005	456,920	49,793	10.9%	\$14.97	\$6,841,800	\$745,592
2006	383,960	61,848	16.1%	\$19.00	\$7,295,240	\$1,175,112
2007	440,080	70,496	16.0%	\$19.39	\$8,531,400	\$1,366,627
2008	407,610	30,749	7.5%	\$17.00	\$6,929,370	\$522,733
2009	486,600	30,402	6.2%	\$12.00	\$5,839,200	\$364,824
	Lobster Head Meat (lbs)			Price/lb.	Value (USD)	
	Nationally	Turneffe	% Turneffe		Nationally	Turneffe
2004	33,275	6,741	20.3%	\$2.44	\$81,066	\$16,423
2005	36,250	2,517	6.9%	\$3.50	\$126,875	\$8,810
2006	21,630	3,981	18.4%	\$3.50	\$75,705	\$13,934
2007	23,450	4,691	20.0%	\$3.61	\$84,600	\$16,924
2008	16,700	2,515	15.1%	\$4.05	\$67,638	\$10,184
2009	11,350	2,979	26.2%	\$4.20	\$47,675	\$12,513
	Conch Meat (lbs)			Price/lb.	Value (USD)	
	Nationally	Turneffe	% Turneffe		Nationally	Turneffe
2004	622,637	33,813	5.4%	\$4.88	\$3,040,772	\$165,130
2005	633,070	20,969	3.3%	\$7.20	\$4,559,169	\$151,012
2006	692,303	24,851	3.6%	\$5.76	\$3,986,859	\$143,110
2007	574,756	21,109	3.7%	\$5.23	\$3,005,774	\$110,393
2008	614,051	13,405	2.2%	\$5.29	\$3,245,766	\$70,856
2009	736,018	14,639	2.0%	\$5.50	\$4,048,099	\$80,515
Total 2009					\$9,934,974	\$457,852

Lobster and conch sales to local fish markets, restaurants and others, which are not accounted for in the cooperative statistics (Table 7), are reflected in the totals listed in Table 8. Up to 15% of the legal lobster and 5% of the legal conch catch is not reflected in cooperative production. Non-cooperative sales of legal lobster and conch, therefore, added approximately US\$1.0 million to national sales and US\$60,000 to Turneffe sales. These additions bring the total value of the legal lobster and conch fisheries to approximately US\$11.0 million nationally and US\$518,000 for Turneffe Atoll.

Interviews with Turneffe’s fishermen revealed that a substantial amount of undersized, and therefore illegal, lobster and conch is harvested from Turneffe Atoll. This catch is obviously not

sold through the cooperatives and it is obviously not quantifiable. Some Turneffe fishermen feel that as much as 40-50% of Turneffe's lobster and conch is sold as undersized catch which is a major concern for the health of the commercial fishery.

Table 8: Fisheries cooperative and local sales of lobster and conch for 2009 (USD)		
Cooperative and Local Sales	Country-Wide	Turneffe
Lobster Cooperative Sales	\$5,886,875	\$377,337
Local Lobster Sales	\$883,031	\$56,601
Subtotal	\$6,769,906	\$433,938
Conch Cooperative Sales	\$4,048,099	\$80,515
Local Conch Sales	\$202,405	\$4,026
Subtotal	\$4,250,504	\$84,541
Total	\$11,020,410	\$518,479

Data on Belize's finfish harvest has become difficult to obtain in recent years. Epstein (2008), indicated that this is related to three factors. First, the absence of an export market for finfish. Second, the local market for finfish products is not substantial enough for the cooperatives to receive and distribute finfish profitably. Finally, the Belize Department of Fisheries has not required commercial fishers to report their finfish harvest in several years.

Finfish catch from Turneffe Atoll is, likewise, difficult to quantify. Through interviews with Turneffe commercial fishermen, we are aware that there is still significant finfish production from Turneffe for sale to local markets, restaurants and others. On the other hand, fishermen indicate that Turneffe's finfish catches have significantly declined.

Table 9 shows the country's finfish production from 1977 through 2009. Harvest varied widely over the 32 years, but was consistently above 500,000 pounds through 1992. During the next 10 years, the average reported harvest was 184,000 pounds per year. Since 2003, the reported harvest has diminished to less than 10,000 pounds per year. It is quite likely that the current finfish harvest is substantially higher than the reported number, but the lack of sales through the cooperatives hampers any definitive estimates of the amount of fish delivered to local markets from Turneffe or elsewhere.

As a result of the unknown quantity of finfish being harvested and sold to local markets, no reliable estimation of the value of this catch can be made. The only way to make such an estimate would be to survey individual commercial fishers to obtain their catch and price data. For purposes of this report, we recognize that there may be a meaningful harvest of finfish from Turneffe Atoll and that this would contribute to the overall value of the atoll and to the economy of Belize. However, there is not enough data to reliably determine what that value might be.

A few commercial fishers residing at Turneffe Atoll focus on snapper commonly found on deep-water pinnacles offshore from the atoll and harvest of these fish could be added to the

overall economic impact of Turneffe Atoll. These Turneffe-based commercial fisherman report catches of up to 100,000 pounds of deep-water snapper annually. At the market price of US\$2.00 per pound, the contribution from his fishery would be about US\$200,000.

Table 9: Belize finfish production: 1977-2009

Year	Whole Fish	Fish Fillets	Year	Whole Fish	Fish Fillets
1977	955,722	123,002	1994	199,255	60,499
1978	822,835	70,937	1995	252,307	43,386
1979	590,374	60,941	1996	145,510	53,782
1980	723,482	57,267	1997	175,495	47,376
1981	610,244	24,840	1998	193,757	50,408
1982	802,673	40,009	1999	183,110	38,666
1983	1,003,785	57,520	2000	109,575	28,205
1984	533,910	67,386	2001	81,528	41,498
1985	501,659	84,707	2002	135,026	48,294
1986	713,133	99,522	2003	21,124	54,769
1987	893,821	63,083	2004	20,616	38,226
1988	809,422	52,763	2005	16,583	35,048
1989	599,441	36,057	2006	9,111	43,206
1990	537,436	56,586	2007	9,534	59,587
1991	695,382	87,558	2008	6,880	35,469
1992	526,912	86,191	2009	8,576	13,645
1993	362,194	58,169			

Source: Villanueva 2009

Commercial Fishing Licenses

Based on Fisheries Department data, the number of licensed commercial fishing boats nationally increased by one percent from 2004 to 2009 while the number of licensed commercial fishers increased by 39% (Table 10).

Table 10: Number of commercial fishing boat licenses and commercial fishers by year

Year Issued	2004	2005	2006	2007	2008	2009
Fishers	1,731	2,026	2,131	2,110	2,267	2,759
Boat	621	652	653	593	643	628

Source: Villanueva 2009

Commercial Fishing jobs

Utilizing standardized economic models to calculate the full-time jobs generated by Turneffe’s commercial fishery would significantly underestimated the number of jobs this industry provides. Approximately 25 fishing camps are located on Turneffe Atoll and a reasonable estimate would be 2 – 4 jobs related to each fish camp. Roughly 15 sailing vessels, with 8 – 10 fishermen per vessel, fish Turneffe; and an unknown number of other motorized vessels do as well. It is particularly difficult to quantify the number of full-time, Turneffe-related commercial fishing jobs as many Turneffe’s fishermen also fish other areas and often visit the atoll for limited periods of time.

Shoreline Protection

Estimating the value of storm prevention benefits related to Turneffe Atoll builds on the work by Cooper et. al. (2009). Readers are referred to their report for full details on the methodology for calculating the protection values. Essentially, they estimated annual “damages avoided” due to the presence of coral reefs or mangroves. The estimates were based on the value of vulnerable property protected by coral reefs or mangroves. They estimated that the annual value of shoreline protection in Belize is US\$150 million from coral reefs and US\$139 million from mangroves. The average value of shoreline protection from coral reefs is estimated at US\$1,292 per acre and value from mangroves is estimated at US\$587 per acre.

As shown in Table 11, Belize has about 116,136 acres of coral reefs and 237,094 acres of mangroves (Stockbridge 2011). Turneffe Atoll possesses about 14.7% of the coral reefs in Belize and 11.7% of the country’s mangrove forests (Stockbridge 2011). Utilizing these statistics, the value of Turneffe Atoll’s storm protection related to its coral reefs totals US\$22.0

Table 11: Annual value of Turneffe Atoll shoreline protection services provided by coral reefs and mangroves (USD)

	Total Acreage	Turneffe Acreage	% Turneffe	Value / Acre	Total Value
Coral Reef	116,136	17,072	14.7%	\$1,292	\$22,057,024
Mangrove	237,094	27,740	11.7%	\$587	\$16,255,640
Total					\$38,312,664

million per year and its value related to mangroves totals US\$16.2 million per year. These are estimates of damages avoided based on a 25 year storm event. The total annual value of damages avoided is US\$38.3 million.

Summary of Turneffe Atoll Economic Benefits

A summary of the total economic contribution to Belize by Turneffe Atoll is presented in Table 12. The greatest economic contribution by Turneffe comes from its recreational value. Outstanding Scuba diving and sport fishing, as well as the unique and diverse wildlife draws

tourists from around the world resulting in tourism related benefits totaling US\$36.9 million annually. Although the economic contribution from Turneffe’s commercial fishery has diminished over the past several years, the commercial fishery plays an important role in the economics of the atoll. Additionally, Turneffe plays a significant role in protecting the Belize mainland, and particularly Belize City, from storms. Overall, the annual economic contribution of Turneffe Atoll to Belize exceeds US\$75.8 million. When considering only direct tourist expenditures related to Turneffe Atoll tourism activities, fisheries impacts, and storm protection values, the annual economic contribution of the atoll is slightly more than US\$62.3 million.

Table 12: Total economic contribution of Turneffe Atoll to Belize (USD)

Tourism	Total Belize Trip Expenditures	Turneffe Expenditures
Turneffe activity expenditures	\$9,816,211	\$9,816,211
Non-Turneffe activity expenditures	\$3,825,675	\$0
Accommodations	\$7,097,944	\$3,977,957
Other Expenditures	\$4,409,678	\$2,053,325
Taxes and service charges	\$5,157,595	\$3,430,578
Total Direct Impact	\$30,307,103	\$19,278,071
Value Added Impact	\$6,667,563	\$4,241,176
Tourism Value	\$36,974,666	\$23,519,247
Fisheries	Value	Value
Cooperative Lobster	\$377,337	\$377,337
Cooperative Conch	\$80,515	\$80,515
Lobster and conch sold outside of Cooperatives	\$60,627	\$60,627
Fisheries Value	\$518,479	\$518,479
Shoreline Protection	Value	Value
Annual value of protection from coral reefs	\$22,057,024	\$22,057,024
Annual value of protection from mangroves	\$16,283,380	\$16,283,380
Potentially Avoided Damages	\$38,340,404	\$38,340,404
Annual Value of Turneffe Benefits	\$75,833,549	\$62,378,130

Discussion and Conclusions

This study benefited immeasurably from the cooperation of business owners and managers who provided information on their use of Turneffe Atoll for Scuba diving, sport fishing and eco-tourism. Without their information an accurate estimate of Turneffe’s tourism would not have been possible. Likewise, data provided from the Belize Fisheries Department was crucial in evaluating the value of Turneffe Atoll’s commercial fishery.

The tourism related economic contribution in this report were based on the data provided by Belizean businesses that either responded to an online survey or provided information from telephone interviews. All tourism businesses in Belize utilizing Turneffe Atoll may not have been identified and some of the businesses identified as using Turneffe did not provide information. The tourism related economic impacts in this report were based solely on the data provided by the responding businesses and the values reported in this analysis should, therefore, be viewed as conservative. We are also aware that around 1,300 Scuba divers and snorkelers annually visit Turneffe Atoll from cruise ships. As this analysis only considered overnight visitors, the contribution of cruise ship divers, sport fishers and eco-tourists was not estimated in this analysis. These omissions likely resulted in a 10-20% reduction in Scuba diver, sport fishing and eco-tourism visitation estimates.

The economic contribution from Turneffe's tourism industry was presented in two separate ways in this report. The first reflects total expenditures by tourists who visited Turneffe during part of their stay in Belize. The second reflects only expenditures related specifically to the time spent Scuba diving, sport fishing or eco-touring at Turneffe. It is important to represent both the overall impact of Turneffe's tourism and the impact related to the specific days spent at Turneffe.

The estimated US\$36.9 million total economic contribution from tourism attributed to the largest atoll in Belize is quite substantial. Further, the US\$23.5 million in direct contributions associated with Turneffe Atoll tourism are a testament to the attraction of the high quality Scuba, fishing and eco-touring opportunities available at the atoll.

An important component of this economic analysis was the number of jobs created by the economic activity at Turneffe. Tourist expenditures associated with Turneffe Atoll support 1,220 full-time equivalent jobs and the personal income associated with these jobs totaled US\$19.6 million. Jobs created through Turneffe's commercial fishing industry are difficult to analyze with standardized economic models, as these models would generally underestimate the number of jobs provided. At any given time, it is likely that 100 - 200 individuals are employed through Turneffe Atoll's commercial fishing industry.

Scuba diving at Turneffe draws the largest number of tourists and generates the largest tourism related economic contribution. Divers from all-inclusive diving resorts at Turneffe Atoll and businesses from San Pedro to Placencia dive over 60 named sites around Turneffe Atoll. Divers spending some portion of their vacation in Belize diving at Turneffe spent US\$17.2 million during their entire stays in Belize. Approximately US\$9.0 million of these expenditures were specifically related to their days diving at Turneffe. Again, these benefits are spread across businesses throughout the country which is important from an economic development perspective.

Turneffe Atoll is well-known by sport fishermen and women around the world. The Atoll offers expansive back-reef flats with large schools of bonefish and permit as well as numerous creeks and channels for tarpon fishing. The abundance of these three species offers sport fishers a rare opportunity for a Grand Slam: bonefish, permit and tarpon all caught in one day.

Sport fishing at Turneffe Atoll is a significant tourism draw with sport fishers staying at all-inclusive resorts on the atoll and visiting from other areas of Belize. Sport fishers fishing at Turneffe Atoll spent US\$4.4 million during their stay in Belize with US\$4.1 million of this spending specifically related to sport fishing at Turneffe.

Recent protection of bonefish, permit and tarpon by the Belizean government underscores the country's commitment to protecting its valuable sport fishing resources. This action has been recognized by sport fishers from many other countries and serves to enhance the perception of the high quality fishing experiences offered at Turneffe and throughout Belize.

The diversity of marine and bird life on Turneffe Atoll makes it a draw for marine eco-tourism. Eco-tourists visiting Turneffe spent nearly US\$3.4 million during their stay in Belize with US\$2.7 million of this spending specifically related to eco-touring at Turneffe.

The commercial fishery at Turneffe appears to have seen a significant decline over the past several years. The sale of lobster from Turneffe Atoll fishermen to Belize's Cooperatives in 2009 was only one-fourth the value of 2004 sales, and conch sales decreased by over 50% over that same time period. The overall economic contribution from the conch and lobster fishery at Turneffe in 2010, exclusive of finfish, is estimated to be US\$518,479.

Additional economic contributions from Turneffe's commercial fishery are generated from the sale of finfish to local markets and restaurants. However, finfish data has not been recorded by the cooperatives nor the Belize Fisheries Department in recent years. Thus it could not be included in this analysis. Commercial fishermen from Turneffe indicate that up to 100,000 pounds of deep-water snapper are harvested from pinnacles near Turneffe. The annual value of this harvest at local markets would be about US\$200,000.

This study benefitted from the analysis of the value of coral reefs and mangroves for storm protection by Cooper et. al. (2009). Their extensive analysis for the country of Belize allowed for an estimate related to Turneffe Atoll. Based on a 25 year major storm event, the annualized value of storm protection and damages avoided by Turneffe Atoll was US\$38 million. While the benefits of storm protection do not accrue directly to the economy of Belize, they do represent a valuable asset for Belize, particularly as it relates to the protection of Belize City.

Overall, Turneffe Atoll's total annual economic contribution to Belize's economy from tourism, commercial fisheries and shoreline protection is substantial. When including all expenditures made by tourists visiting Turneffe during their stay in Belize, the economic contribution of Turneffe Atoll is US\$75.8 million per year. By apportioning tourist expenditures based only on the days tourists visited Turneffe, the contribution of tourism, fisheries and shoreline protection to Belize's economy is US\$62.3 million per year.

Other potential economic contributors including research and education, non-tourism related development and cruise ship tourism were not considered in this analysis.

Sustainability of this economic contribution is an important consideration. Our analysis of the tourism contribution reveals nothing to suggest that this impact is not sustainable and, in fact,

it is likely that the annual tourism contribution can be expanded and remain sustainable. The apparent decline of the Turneffe's commercial fishery since 2004, however, leads us to conclude that this is not a sustainable economic situation and that the annual economic impact from commercial fishing at Turneffe Atoll will continue to decline without intervention. The value of shoreline protection is sustainable insofar as the integrity of both reefs and mangrove forests are maintained over time. Further, the protection value of Turneffe Atoll will only increasing with further development in and around Belize City.

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