ECONOMY OF THE ISLAND OF ECO-TOURISM: THE ROLE OF SHARK-DIVING AND SHARK HARVESTING

Natal, 2015
ECONOMY OF THE ISLAND OF ECO-TOURISM: THE ROLE OF SHARK-DIVING AND SHARK HARVESTING

Dissertação apresentada à Coordenação do Curso de Pós-graduação em Ecologia da Universidade Federal do Rio Grande do Norte, em cumprimento às exigências para obtenção do Grau de Mestre.

**Orientadora:** Prof.ª Dr.ª Adriana Rosa Carvalho

**Co-orientador:** Prof. Dr. Ricardo Clapis Garla

Natal, 2015
Pires, Natalia de Medeiros. 

39 f.: il.

Coorientador: Prof. Dr. Ricardo Clapis Garla.


Sumário

Lista de Figuras .................................................................................................................. 4
Lista de Tabelas .................................................................................................................. 5
Abstract. .............................................................................................................................. 7
Introduction ......................................................................................................................... 8
Methods ............................................................................................................................... 11
  Study Area ........................................................................................................................ 11
  Data collection .................................................................................................................. 13
  Economic estimates ......................................................................................................... 14
    Travel Cost Method ......................................................................................................... 15
    Social benefits from sharks ............................................................................................ 16
    Predictors of Expenditure .............................................................................................. 18
Results .................................................................................................................................. 19
  Overview on tourists and diving activity in Noronha ...................................................... 19
  Expenditures of tourists .................................................................................................... 20
  Economic benefits generated to the island ....................................................................... 23
    Economic valuation by the travel cost method ............................................................... 23
  Economic benefit transferred to the local economy ....................................................... 23
    By the industry of tourism .............................................................................................. 23
    By shark diving ............................................................................................................... 24
  Socio-economic benefits just from shark diving and shark harvesting ....................... 26
  Predictors of expenditure ............................................................................................... 27
Discussion ............................................................................................................................ 29
Acknowledgments ............................................................................................................... 32
References ............................................................................................................................ 33
Appendix ............................................................................................................................... 37
Lista de Figuras

Figure 1. Location of the study area and boundaries of protected areas: the Environmental Protection Area (APA) defined by the isobath of 50 m deep and the Marine Protected Area (PARNAMAR). ................................................................. 12

Figure 2. Description of the direct use values estimated, the type of use assessed and the method/information used to each target public interviewed. ......................................................... 14

Figure 3. Monthly flow of tourists (black line, N=189,775) and monthly number of scuba diving (grey line, N=73,653) conducted in Fernando de Noronha from 2011 to 2013. Source: ADEFN and ICMBio. ................................................................. 19

Figure 4. Mean daily individual expenditures and per trip (± Std. Error) by different categories of expenses incurred by tourists visiting Fernando de Noronha among 2011 and 2013. ....................................................................................... 21

Figure 5. Demand curve for visitation rate of tourists visiting Fernando de Noronha from 2011 to 2013. ....................................................................................... 23

Figure 6. Values for total revenues generated by the entire tourism activities. .......... 24

Figure 7. Total economic benefits generated by shark diving to (1) dive operators, (2) government and to (3) Fishers. ................................................................. 25

Figure 8. Estimated contribution of distance (a), income (b) and days of stay (c) to the daily expenses. ....................................................................................... 28
Table 1. Economic sectors assessed to the estimates and the number of interviewees providing the information collected at each sampled sector. (Env. Mgt Authority = Environmental Management Authority).

Table 2. Zones defined according to political regions to estimate travel costs and description of each region/zone.

Table 3. Economic estimates by region based on information provided by visitants of Fernando de Noronha island (Vrate – visitation rate; CS – consumer surplus).

Table 4. Current and potential economic gains from shark diving in Noronha.

Table I. Description of variables and constants used to calculate parameters and estimates of economic benefits related to the tourism and shark-diving in Noronha.

Table II. Description of formulas and sources of data used to calculate parameters and estimates of economic benefits related to the tourism and shark-diving in Noronha.
Manuscrito a ser submetido ao Periódico Marine Policy
Economy of the island of eco-tourism: the role of shark-diving and shark harvesting

N. M. Pires\textsuperscript{A}, A. R. Carvalho\textsuperscript{B}, R. C. Garla\textsuperscript{C}

\textsuperscript{A} Post-graduation Program in Ecology at Universidade Federal do Rio Grande do Norte, RN - Brazil. E-mail: nataliampires@hotmail.com
\textsuperscript{B} Department of Ecology at Universidade Federal do Rio Grande do Norte, RN - Brazil. E-mail: acarvalho.ufrn@gmail.com
\textsuperscript{C} E-mail: rgarla@hotmail.com

Abstract. Beyond its importance in maintaining ecosystems, sharks provide services that play important socioeconomic roles. The rise in their exploitation as a tourism resource in recent years has highlighted economic potential of non-destructive uses of sharks and the extent of economic losses associated to declines in their population. In this paper, we present estimates for use value of sharks in Fernando de Noronha Island - the only ecotouristic site offering shark diving experience in the Atlantic coast of South America. Through the Travel Cost Method we estimate the total touristic use value aggregated to Noronha Island by the travel cost was up to USD 91 million annually, of which USD 73.8 million are transferred to the local economy. Interviewing people from five economic sectors, we show shark-diving contribute with USD 2.6 million per year to Noronha’s economy. Shark-diving provides USD 81.1 thousand of income to employed islanders, USD 132.9 thousand to government in taxes and USD 4.8 thousand to fishers due to the increase in fish consumption demanded by shark divers. We discover, though, that fishers who actually are still involved in shark fishing earn more by catching sharks than selling other fish for consumption by shark divers. We conclude, however, that the non-consumptive use of sharks is most likely to benefit large number of people by generating and money flow if compared to the shark fishing, providing economic arguments to promote the conservation of these species.

Keywords: conservation, economic, valuation, \textit{Chondrichthyes}, socio-economic value, ecosystem service
Introduction

Shark populations perform important functions to human communities worldwide. From an ecological point of view, sharks hold indirect-use values providing services that play important socioeconomic role. The presence of apex predators such as sharks results in higher productivity and biomass in the marine ecosystem (Friedlander & DeMartini, 2002) since fish species targeted by sharks direct more energy to reproduction, increasing the abundance in the fish community (Sandin et al., 2010). Besides, the depletion of populations of sharks result in trophic cascades in marine ecosystems, given the increase in population of their prey, affecting the biomass of other organisms (Myers et al., 2007; Heithaus et al., 2008).

In a strictly economic view, sharks may represent a source of protein and products such as leather, cartilage, oil, and fins that are important for several communities in many countries (Camhi et al., 1998). In addition, during the last three decades the non-destructive use of shark populations as an economic activity has been under rapid development globally, providing higher incomes to an increasing number of people who rely on their exploitation as a tourism resource (Gallagher & Hammerschlag, 2011).

This potential has increased the number of economic value assessments of shark diving in sites with a high incidence of sharks, such as the Caribbean (Cline, 2008), Micronesia (Vianna et al., 2010), South Africa (Dicken & Hosking, 2009; Dicken, 2014), Maldives (Cagua et al., 2014) and Australia (Stoeckl et al., 2010; Catlin et al., 2010). Such evaluations have demonstrated the economic potential of non-destructive uses of sharks and the economic strengthening that sharks bring to local tourism. Shark-diving tourists have shown a higher spending pattern both daily and per trip if compared to other tourists. This particular tourist segment can be targeted by marketing programs, leading to greater local benefits while minimizing ecological impacts (Jones et al. 2009; Dearden et al.
A better understanding of the socio-demographics and travel-related variables which influence tourist expenditures has allowed travel markets to create effective and viable management strategies to anticipate possible scenarios.

On a local scale, the commercial value of sharks as tourism resources far exceeds their value as fishery products, given one dead shark provides income for a single fisher only once, whereas an individual shark alive produces a continuous income flow that benefits several economic sectors for many years (De la Cruz Modino et al., 2010). However, the first global assessment of the economic value of shark-diving put its value at around USD 314 million, while the revenue generated by shark fishing is estimated at USD 630 million (Cisneros-Montemayor et al., 2013). The large difference among estimates is likely due to the spatial range of the two activities, since fishing is an activity spread throughout the world, whereas the shark tourism is restricted to those sites where diving is currently well developed and sharks are present. Furthermore, there are no assessments of many sites where sharks are resident or migratory species and the development of shark watching as an economic activity is possible (Cisneros-Montemayor et al., 2013).

In fact, out of 260 sites proper to shark watching mentioned in "The Shark Watcher's Handbook" (Cawardine & Watterson, 2002), only 83 have shark ecotourism operations, with economic data on sharks as tourism resource available for only 31 (Gallagher & Hammerschlag, 2011). This shark-diving industry has been jeopardized by the decline of sharks caused worldwide due to a variety of human activities, but the absence of wide-ranging economic data on shark watching makes it unfeasible to predict the extent of economic losses associated to this decline.

The main pressures faced by shark species are incidental and directed fishery, including shark finning that removes approximately 100 million sharks per year to supply
the Asian market (Worm et al., 2013). Besides this, habitat degradation, pollution, climate change, and mislabeling of shark meat (Simpfendorfer et al., 2011; Bornatowski et al., 2014) are additional threats faced by shark populations globally. The low growth and reproductive rates, the late sexual maturity and limited offspring when compared to bony fishes (Camhi et al., 1998) decreases their ability to respond to reductions in their populations (Musick et al., 2000) increasing the vulnerability of most shark species.

This is the scenario for the insular shelf surrounding the Fernando de Noronha Archipelago (Noronha), northeastern Brazil. Noronha is the only site with shark dive operations in the Atlantic Coast of South America and so far, the economic benefits generated by diving activities, including shark watching, were never assessed, hampering its inclusion in the global value of sharks estimated by Cisneros-Montemayor et al. (2013). The Caribbean reef *Carcharhinus perezi*, nurse *Ginglymostoma acirratum*, and lemon *Negaprion brevirostris* are the most common sharks in the region. Occasionally tiger shark *Galeocerdo cuvier* and silk shark *Carcharhinus falciformis* can also be sighted. Shark fisheries were active in Noronha from 1992 to 1997 severely depleting shark populations according to local dive operators. Just *Carcharhinus perezi* comprised 60% of the total shark caught during the last 18 months of shark fishery operations in the island (Garla et al., 2006). Recreational and commercial fishers (Garla, 2004) report landings of small sharks (neonates and juveniles) and mislabeling also exists.

In this paper, we estimated the use value of Noronha Island and the use value of sharks by the industry of ecotourism. Through these estimates, we aimed to verify the hypothesis on (1) higher revenues generated by shark watching than by shark fishery and (2) higher earnings provided to the island by shark divers tourists than by non-divers tourists. Additionally we expect to answer the following questions: (i) what is the proportion of tourists visiting the archipelago interested in observing sharks? (ii) what
share of the use value of the island is due to shark tourism? (iii) which variables best predict expenditures of tourists visiting the island? (iii) what is the potential economic contribution through non-destructive direct use of the three shark species that occur in the archipelago? We hope to supply valuable information on the economic benefits of non-destructive use of sharks and promote better understanding on this economic activity and on management and conservation actions that would support shark ecotourism worldwide.

Methods
Study Area
Fernando de Noronha Archipelago (hereafter referred to as Noronha) is an isolated group of one large volcanic island and 19 small islands that covers a 26 km² area on the Eastern Atlantic, located 345 km off the north-eastern coast of Brazil. About 60% of the main island of the archipelago and the insular shelf within the 50 m depth isobaths constitute a Marine Protected Area (MPA) established in 1988 (Figure 1). The remaining 40% constitute an Environmental Protection Area planned to promote the sustainable use of natural resources by a population of 2,800 inhabitants (IBGE, 2014).
The Gross Domestic Product (GDP) is estimated at USD 13.3 million (IBGE, 2010) generated mainly by tourism activities developed by nearly 60 thousand visitants annually.

Diving is one of the main attractions and receives approximately 24 thousand people annually (ICMBIO, unpublished). Noronha has warm clear waters and is a nursery and parturition area for resident species of inshore sharks, namely the Caribbean, nurse and lemon sharks (Garla et al., 2006; Garla et al., 2009). Thus, Noronha provides opportunistic encounters, without the use of provisioning (feeding) for shark attraction. Neonate, juvenile and adult lemon sharks can be observed in shallow waters (<0.5 m of depth) in the main beaches of Noronha with a simple snorkelling while caribbean and nurse sharks are better seeing with scuba gear, very common at higher depths.
Data collection

To estimate the direct economic use value of the island and the direct economic use value of sharks, information was collected by interviewing people from five economic sectors (Table 1).

Table 1. Economic sectors assessed and number of interviewees providing the information collected at each sampled sector. (Env. Mgt Authority = Environmental Management Authority).

<table>
<thead>
<tr>
<th>Economic sector</th>
<th>Date</th>
<th>Number of informants</th>
<th>Information collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tourists</td>
<td>Jul/2012, Jan/2014</td>
<td>621</td>
<td>Demographic characteristics, motivations to visit the island, knowledge of the local shark occurrence, interest in shark diving, diving and other expenses while in Noronha.</td>
</tr>
<tr>
<td>Fishers</td>
<td>Jan 2014</td>
<td>15</td>
<td>Production, fishing income, target species and interaction levels with sharks.</td>
</tr>
<tr>
<td>Restaurant owners</td>
<td>Jan 2014</td>
<td>2</td>
<td>Annual income, number of employees and salary values, product sales associated with sharks, number of fishermen supplying shark meat; market volume and prices</td>
</tr>
<tr>
<td>Dive operators and photo producers</td>
<td>Jan 2014</td>
<td>6</td>
<td>Average annual gross income, company's operating costs, wages received by tourism professionals and taxes generated to the government.</td>
</tr>
<tr>
<td>Dive guides</td>
<td>Jul, Aug 2012</td>
<td>20</td>
<td>Number of clients and tourist preferences, estimated income, main dive attractions, popular dive sites for shark diving, shark species commonly observed.</td>
</tr>
<tr>
<td>Env. Mgt Authority</td>
<td>Jan 2014</td>
<td>Representative Authority</td>
<td>Monthly number of scuba diving operations and number of visitants in the island from 2011 to 2013</td>
</tr>
</tbody>
</table>

Tourists in general were approached while waiting for their departing flight at the airport of Noronha. Most tourists (N = 425) filled out a form and 196 tourists were interviewed face-to-face to assess those people directly interested in shark observation and collect information on more specific expenses. Information on their expenses to visit Noronha was used to estimate the economic use value of the island through the travel cost method. Expenses of divers and non-divers tourists (including taxes while visiting Noronha) were used to estimate the social benefits of shark watching (Figure 2). Fishers
were interviewed at the port when arriving from fishing trips. Owners of restaurants, shops, dive operators, dive guides and management authority were interviewed both during working hours and after work.

Figure 2. Description of the direct use values estimated, the type of use assessed and the method/information used to each target public interviewed.

Two Environmental Management Authorities were also contacted. The local office of the Brazilian Environmental Agency (ICMBIO) provided the number of tourists scuba-diving per month from 2011 to 2013. The Fernando de Noronha Administration (ADEFN) informed the total number of visitants for the same period.

**Economic estimates**

The economic value of the island aggregated by tourism activity was calculated through the Travel Cost Method (Hotelling, 1947). The method proposed by Vianna et al. (2012) was used to estimate the socioeconomic value generated by fishing, diving and
shark watching activities. Only the proportion of tourists who declared shark watching as their main motivation to visit Noronha was used to assess socioeconomic benefits of sharks. All values were converted to US dollars according to the exchange rate on October 22nd 2014 (USD 1.00 = BRL 2.47).

**Travel Cost Method**

The Travel Cost Method proposed by Hotelling (1947) was used to determine the recreational value of a site based on the time and money spent to visit it (Pascual et al., 2010). The places of origin of tourists visiting Noronha were grouped into distance classes (zones), assuming that tourists of a given zone have similar trip costs. The method assumes that the farther the tourists reside, the lower is their visitation rate, because of an increase in the travel costs (Motta, 1998). Tourists who have purchased travel packages to Noronha that included other destinations were excluded from the sample to avoid a multiple-destinations bias.

This method also assumes that the displacement to a tourism location includes a cost related to the distance traveled (mobility cost) and the time spent during the trip (cost of time). The information about distances travelled was estimated using the Google Maps route tool (www.maps.google.com.br, accessed March 2014). To estimate the value of the time spent traveling, travel hours were multiplied by the value of each working-hour, considering the average income reported by respondents and assuming a 40-hour workweek.

A visitation rate was calculated for each zone, by the formula \((TV_i/1000) = [(V_i/n) \times N \times 1000]/P\) where \(TV_i/1000\) = rate of visits per 1,000 people per year; \(V_i\) = number of visitors from zone \(i\); \(n\) = sample size; \(N\) = total number of visitors per year; and \(P\) = total population of zone \(i\) (IBGE, 2010).

A demand curve was plotted using the visitation rate and the travel cost data,
which reflects the variation on the demand for an asset or service according to changes in its price. As the travel cost increases, the demand for visitation tends to decrease.

Finally, the consumer surplus (CS) that represents the difference between the willingness of tourists to pay and the price they actually pay for the trip was estimated using the formula:

$$EC_{(i)} = \int_{\frac{V_i}{T_i}}^{T_m} df$$

Whose analytical solution is:

$$EC_{(i)} = V_i \cdot (T_m - T_i)$$ and $EC = \text{consumer surplus}$; $V_i = \text{number of visitors of the } i^{th} \text{ population zone}$; $T_i = \text{current travel cost of the } i^{th} \text{ population}$; and $T_m = \text{maximum travel cost}$.

In order to determine the economic benefit from tourism, the total estimated travel cost was obtained multiplying the sum of consumer surplus from each zone by the number of tourists received per year.

**Social benefits from sharks**

Social benefits from shark watching were determined through a market valuation technique using expenses of tourists interested in shark watching, the per capita income reverted to the community and the value of taxes paid by the diving activity (see also Vianna et al., 2012).

The information on variables, formulas and parameters used in this calculation model are detailed in the Appendix (Tables I and II). The number of divers and total of tourists visiting Noronha used in this estimate were calculated based on data from 2011-2013. The five main parameters required were:

**Revenue from Shark-divers.** This is based on the average expenses per trip of divers, the number of divers per year, and the proportion of divers interested in sharks (estimated from the questionnaires). It includes accommodation, food, diving and others costs,
such as souvenirs and tours while in Noronha. Air tickets are not included in this calculation, given there is little or no flow of those expenses to the local economy.

**Indirect value of shark diving to fisher (FishCons)**. Represent the income produced to fishers by selling their catches to divers interested in sharks via a chain of commerce (restaurants, hotels, fish market). This value is estimated considering the average annual income of fishers, the proportion of fish sold to tourists, and the number of tourists interested in shark watching. The value is then compared to the profits provided by selling shark meat in Noronha.

**Direct community income from shark diving (Employ)**. This parameter estimates the economic benefit of salaries paid to employees in dive operators. It was calculated using the average diver expenditure on dives, the share of the diving industry receipt allocated to the payment of salaries, the proportion of tourists interested in shark watching and the number of divers per year visiting Noronha.

**Tax revenues from shark diving**. Taxes paid by tourists interested in shark diving, including the environmental preservation fee (compulsory for all tourists and charged according to the amount of days spent in Noronha) and the payment of a permit to access protected areas. The estimate also considers a revenue tax of 5% on most expenditures made by shark divers paid by businesses to government.

**Cost of shark-diving operation**. This parameter estimates the general costs of dive operators with fuel, equipment maintenance, licenses, wages and extras. The number of divers per year and the proportion of divers interested in sharks are used for this.

**Potential Scenarios**

To evaluate the potential for ecotourism of sharks in Fernando de Noronha two future scenarios were foreseen, assuming shark conservation actions take place and encourage diving for observation, bringing an increase in the number of shark-divers. They are calculated based on proportion of tourists who would be interested in diving
with sharks and the present economic context. From the current situation, the first scenario is built based on the percentage of tourists who declared having decided to dive due to the likelihood of shark watching while diving. The second scenario considers the percentage of tourists who are interested in seeing sharks in countries where such practice is widespread (as Australia and South Africa).

Predictors of Expenditure

Aiming to predict which features might determine the tourists willingness to spend money on the island, twelve variables were selected: (1) age, (2) sex, (3) income, (4) length of stay, (5) distance from their origin to Noronha, (6) motivation to visit the island or to dive, (7) knowledge of destinations alternative to Noronha, (8) number of visits to Noronha, (9) diving activity, (10) interest in observing sharks, (11) knowledge of Noronha as shark nursery area and (12) awareness that the island is the best place to spot sharks in Brazil.

Generalized additive models (GAMs) were used to relate expenditures to these different factors. GAMs are often used for their ability to deal with non-linear and non-monotonic relationships between the response variable and the explanatory variables (Hastie & Tibshirani 1986; Wood, 2006). GAM models were developed using the ‘mgcv’ package in R (Wood, 2013). We applied a gaussian distribution using the default thin plate regression splines as the smoothing function (Wood, 2003) and limiting of smoothing to 4 degrees of freedom for each spline to avoid overfitting (Forney, 2000).

Variable selection was performed with forward and backward stepwise selection of variables and all the possible interaction terms, based on Akaike Information Criterion (AIC), Un-Biased Risk Estimator (UBRE) and deviance explained. The principle of parsimony was applied to limit the number of interaction terms, i.e., any term was added if the benefit in performance was too small compared to the cost of increasing the model complexity.

This analysis does not include interviewees under 18 yrs old, assumed as the
minimum age for people be considered economically active. Analyses were done using free software R 3.1.1 (R Core Team, 2014).

Results

Overview on tourists and diving activity in Noronha

In average up to 63,258 tourists visited Noronha annually from 2011 to 2013. A minimum of 3500 tourists traveled to Noronha monthly even during the low visited months. During this period, the three companies for scuba diving operating in Noronha leaded in average 24551 dive activities. Even though Noronha present good conditions for diving all year round, frequency of dives were higher on October and November than on May-June, when the frequency of tourist visits was slightly lower (Figure 3).

![Figure 3. Monthly flow of tourists (black line, N=189,775) and monthly number of scuba diving (grey line, N=73,653) conducted in Fernando de Noronha from 2011 to 2013. Source: ADEFN and ICMBio.](image)

A survey of over 425 tourists interviewed in Noronha indicated that Brazilians from the southeast accounted for 50% of inbound visits to the island, mainly arriving from São Paulo (28%). Roughly the same proportion of male (48%) and female (52%) tourists aging around 35 years old (ranged from 6 to 69 yrs old) visited Noronha. Most interviewees were visiting the island for the first time (83%).
The motivations for the trip were sightseeing (66%), visiting the beaches (61%) or diving (46%). Over half the interviewees were aware of the role of the island as mating and nursery area for sharks but many (68%) were unaware of the potential of Noronha as the best shark viewing area in the country.

Interviewees indicated high interest (40%) or modest interest (28%) in watching sharks. This implies roughly 25,300 tourists interested in shark watching annually and 1,400 tourists per month moderately interested in shark watching. Few tourists showed slight interest in seeing sharks (11%) or were not interested on shark viewing (14%) while 7% of interviewees were unable to provide an answer on this issue.

However, following the first days in the island, 23% of tourists declared having decided to dive due to the likelihood of shark watching while diving. Additionally, throughout face-to-face interviews, 7% of tourists (from 196 respondents) declared shark-diving as their main motivation for visiting the island. Accordingly, all estimates of economic benefits produced by sharks were based on the abovementioned proportion of tourists interested in shark diving prior to visiting the island.

**Expenditures of tourists**

From an average monthly income of USD 4,341.00/person (≈ 15 minimum salaries in BRL currency), tourists spent an average of USD 246.80 on daily expenses. The mean expenses per trip were USD 1,349.45 for a mean length of stay around 5.5 days, even though mostly stays lasted for four days (Figure 4).

All tourists were categorized in one of eighteen zones of distance according to the federative division of Brazil. To all zones the annual frequency of visits ranged around one (Table 2). Foreign tourists (n = 8) were mainly from Australia, the USA, Canada, Portugal, Switzerland and France. These were not included in the estimates due to their low number in the sample and higher costs incurred to reach the island.
Figure 4. Mean daily individual expenditures and per trip (± Std. Error) by different categories of expenses incurred by tourists visiting Fernando de Noronha between 2011 and 2013.

Table 2. Zones defined according to federative units to estimate travel costs and description of each region/zone.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Distance class (km)</th>
<th>Number of tourists</th>
<th>Minutes of trip (Mean ± SE)</th>
<th>Frequency of visits (Mean ± SE)</th>
<th>Total population/zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>742.53</td>
<td>5</td>
<td>110(±0)</td>
<td>1.2 (±0.032)</td>
<td>3300935</td>
</tr>
<tr>
<td>BA</td>
<td>1218.66 - 1944.66</td>
<td>12</td>
<td>300(±17)</td>
<td>1.8 (±0.14)</td>
<td>15044137</td>
</tr>
<tr>
<td>CE</td>
<td>810.92</td>
<td>5</td>
<td>125(±0)</td>
<td>1.0 (±0)</td>
<td>8778576</td>
</tr>
<tr>
<td>DF</td>
<td>2199.25</td>
<td>3</td>
<td>210(±0)</td>
<td>1.6 (±0.084)</td>
<td>2789761</td>
</tr>
<tr>
<td>ES</td>
<td>2025.33</td>
<td>5</td>
<td>280(±0)</td>
<td>1.0 (±0)</td>
<td>3839366</td>
</tr>
<tr>
<td>GO</td>
<td>2376.85</td>
<td>6</td>
<td>300(±0)</td>
<td>1.0 (±0)</td>
<td>6434048</td>
</tr>
<tr>
<td>MA</td>
<td>1751.16 - 2527.16</td>
<td>3</td>
<td>465(±28)</td>
<td>1.0 (±0)</td>
<td>6794301</td>
</tr>
<tr>
<td>MG</td>
<td>2185.34 - 2800.34</td>
<td>15</td>
<td>252(±12)</td>
<td>1.1 (±0.02)</td>
<td>20593356</td>
</tr>
<tr>
<td>MT</td>
<td>3000.03</td>
<td>2</td>
<td>355(±0)</td>
<td>1.0 (±0)</td>
<td>3182113</td>
</tr>
<tr>
<td>PB</td>
<td>662.03</td>
<td>3</td>
<td>167(±0)</td>
<td>1.0 (±0)</td>
<td>3914421</td>
</tr>
<tr>
<td>PE</td>
<td>542.03 - 1016.03</td>
<td>33</td>
<td>107(±8)</td>
<td>1.6 (±0.10)</td>
<td>9208550</td>
</tr>
<tr>
<td>PI</td>
<td>1478.17</td>
<td>2</td>
<td>165(±0)</td>
<td>1.0 (±0)</td>
<td>3184166</td>
</tr>
<tr>
<td>PR</td>
<td>3005.5</td>
<td>6</td>
<td>335(±0)</td>
<td>1.1 (±0.02)</td>
<td>10997465</td>
</tr>
</tbody>
</table>
Annual benefit provided by the island to all tourists is high (CS - consumer surplus = USD 1452.24/year) mainly in the southeastern states (SP, RJ and MG) (Table 3). Even though the Northeastern states (RN, AL, PE, CE, PB) are closer to Noronha Island, the state of São Paulo (SP) had the highest visitation rate and higher consumer surplus (Table 3) but also the higher travel cost (Figure 5).

Table 3. Economic estimates by region based on information provided by visitants of Fernando de Noronha island (Vrate – visitation rate; CS – consumer surplus).

<table>
<thead>
<tr>
<th>Zone</th>
<th>Travel cost (± SE) (USD)</th>
<th>Time cost (± SE) (USD)</th>
<th>Vrate/1000</th>
<th>CSurplus</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>624.62 (± 4)</td>
<td>49.60 (± 1)</td>
<td>0.001</td>
<td>7.65</td>
</tr>
<tr>
<td>BA</td>
<td>1505.67 (± 114)</td>
<td>298.62 (± 24)</td>
<td>0.01</td>
<td>66.80</td>
</tr>
<tr>
<td>CE</td>
<td>698.79 (± 10)</td>
<td>50.28 (± 2)</td>
<td>0.003</td>
<td>20.12</td>
</tr>
<tr>
<td>DF</td>
<td>1390.00 (± 37)</td>
<td>144.53 (± 2)</td>
<td>0.0007</td>
<td>3.28</td>
</tr>
<tr>
<td>ES</td>
<td>809.72 (± 11)</td>
<td>121.01 (± 2)</td>
<td>0.001</td>
<td>8.50</td>
</tr>
<tr>
<td>GO</td>
<td>1273.16 (± 9)</td>
<td>131.21 (± 4)</td>
<td>0.003</td>
<td>15.55</td>
</tr>
<tr>
<td>MA</td>
<td>885.95 (± 25)</td>
<td>206.84 (± 23)</td>
<td>0.001</td>
<td>8.74</td>
</tr>
<tr>
<td>MG</td>
<td>1047.09 (± 29)</td>
<td>148.54 (± 11)</td>
<td>0.02</td>
<td>129.96</td>
</tr>
<tr>
<td>MT</td>
<td>839.07 (± 0)</td>
<td>89.80 (± 0)</td>
<td>0.0005</td>
<td>2.82</td>
</tr>
<tr>
<td>PB</td>
<td>800.93 (± 4)</td>
<td>38.34 (± 1)</td>
<td>0.0009</td>
<td>5.30</td>
</tr>
<tr>
<td>PE</td>
<td>630.81 (± 15)</td>
<td>28.22 (± 3)</td>
<td>0.02</td>
<td>141.30</td>
</tr>
<tr>
<td>PI</td>
<td>1037.25 (± 0)</td>
<td>41.75 (± 0)</td>
<td>0.0005</td>
<td>2.74</td>
</tr>
<tr>
<td>PR</td>
<td>1208.38 (± 28)</td>
<td>98.50 (± 14)</td>
<td>0.005</td>
<td>27.13</td>
</tr>
<tr>
<td>RJ</td>
<td>1074.13 (± 32)</td>
<td>127.85 (± 15)</td>
<td>0.03</td>
<td>164.78</td>
</tr>
<tr>
<td>RN</td>
<td>545.26 (± 23)</td>
<td>18.99 (± 2)</td>
<td>0.002</td>
<td>12.79</td>
</tr>
<tr>
<td>RS</td>
<td>1238.06 (± 40)</td>
<td>124.45 (± 11)</td>
<td>0.004</td>
<td>22.67</td>
</tr>
<tr>
<td>SC</td>
<td>1691.30 (± 18)</td>
<td>349.88 (± 63)</td>
<td>0.002</td>
<td>9.27</td>
</tr>
<tr>
<td>SP</td>
<td>1430.32 (± 60)</td>
<td>111.82 (± 14)</td>
<td>0.17</td>
<td>802.83</td>
</tr>
</tbody>
</table>

The demand curve indicated that visitation rates were constant and not influenced by travel costs (Figure 5). The state of São Paulo is an outlier and has been removed for
hindering the graphical analysis.

Figure 5. Demand curve for visitation rate of tourists visiting Fernando de Noronha from 2011 to 2013.

**Economic benefits generated to the island**

*Economic valuation by the travel cost method*

The total touristic use value of Noronha Island according to the travel cost method was up to USD 91 million. This value represents the total expenses incurred by every tourist visiting Noronha and is assumed as the willingness of tourists to pay for the island. However, part of these costs represents expenses assumed before coming to the island (for instance by purchasing flight tickets). Hence, estimates in the next section represent the amount of money effectively transferred by tourism and tourists to the local economy.

**Economic benefit transferred to the local economy**

*By the industry of tourism*

The economic benefit generated to Noronha by the industry of tourism was USD 73.8 million annually. From this total, USD 1.6 million represents the sum of taxes paid
annually by tourists to the Park Authority (tax of admission into the park area and the tax for environmental preservation of the island). The remaining amount (USD 72.2 million) indicates the sum received annually by all commercial shops providing any service related to the touristic activities.

Figure 6. Values for total revenues for the entire tourism activities. Values presented are the revenues from tourist expenses excluding taxes (left) and the revenue from taxes paid by tourists (right). Both are further divided into divers, non-divers and shark-divers tourists.

The revenue from these touristic services are roughly half due to activities performed by non-divers tourists (49.6%) and half (50.4%) due to activities developed by the 24 thousand diving tourists visiting the island annually (Figure 6).

By shark diving

Based on the 7% of interviewed tourists interested in shark diving, it was possible to assume that close to 4,400 tourists arrive in Noronha annually aiming to shark dive. This indicates an economic benefit generated to Noronha by shark diving of roughly USD
However, shark diving provides income and revenue to all sectors involved in tourism, including islanders employed by dive operators and fishers. If all those sectors that benefit from shark diving are taken into account, the total revenue produced by shark diving in the island reaches up to USD 2.6 million (Figure 7), of which 94.43% is passed to dive operators, 5.02% to government and 0.55% to fishers.
Socio-economic benefits just from shark diving and shark harvesting

Shark diving generated a total of USD 132.9 thousand in taxes. This corresponded to USD 43,973.00/year in taxes paid by shark divers to the Park Authority and around USD 88.9 thousand paid to the government in the form of taxes upon the revenue of dive operators and other shops providing services to shark divers.

Shark diving activity also supplied a total of USD 81,147.00 annually in payments to islanders employed by dive operators.

The interest on sharks also indirectly benefited fishers by increasing the demand for bony fishes in restaurants. This benefit may reach up the conservative estimate of USD 195.00 annually per fisher if considering just the 7% of tourists mainly motivated by shark watching to visit the island. This may sum over USD 4,875.00 of annual benefit to all 25 fishers exploiting fishery resources in the island. Considering just half of the 40% of tourists that declared high interest in shark viewing, this value rises to USD 557.14/year per fisher, to a total of USD 13,928.50 for these 25 fishers. The revenue from the destructive use of sharks through incidental fishery and by selling sharks to local restaurants indicated an individual income of USD 968.00 for 10 fishers who are still involved in shark fishing. This value may come to a total of over USD 9,684.00 annually to those fishers.

Potential Scenarios

The current scenario, based on tourist declaring shark-diving as their main motivation for visiting the island, provides USD 2.6 million from shark-related activities, as shown in Figure 7. In the first foreseen scenario, if 20% of tourists were shark divers, this benefit would reach USD 7.8 million / year (Table 4). If there was a marketing programs and diving with sharks consolidate in Noronha, in a second scenario that could attract 40% of shark divers, the gain attributed to the presence of sharks could reach USD 15 million / year.
Table 4: Current and potential economic gains from shark diving in Noronha

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Total Benefits From Shark Diving (USD)</th>
<th>Dive operators (USD)</th>
<th>Government (USD)</th>
<th>FishCons (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atual (7%)</td>
<td>2.6 million</td>
<td>2.5 million</td>
<td>132.9 thousand</td>
<td>4.8 thousand</td>
</tr>
<tr>
<td>20%</td>
<td>7.8 million</td>
<td>7.4 million</td>
<td>379.7 thousand</td>
<td>13.7 thousand</td>
</tr>
<tr>
<td>40%</td>
<td>15 million</td>
<td>14.2 million</td>
<td>759.4 thousand</td>
<td>27.4 thousand</td>
</tr>
</tbody>
</table>

**Predictors of expenditure**

The final model explained 41.5% of total variance and underlined income \( (p = 0.001) \), length of stay \( (p = 0.008) \) and distance \( (p = 0.01) \) as the predictors for daily expenses. Expenses were higher among tourists with higher incomes. Expenses became even higher among tourists earning more than USD 8000.00 monthly.

The length of stay in the island was significant in determining expenses that were constant until five days of stay. However, daily expenses increase if the permanence in Noronha extends for more than 15 days (Figure 8). Travel distances of over 2,500 km also raise daily expenses. Furthermore, tourists from more distant areas tend to have higher incomes and consequently higher daily expenses.
Figure 8. Estimated contribution of distance (a), income (b) and days of stay (c) to the daily expenses. The dotted curves are the 95% confidence limit. Each vertical bar at the base of the graph denotes an observation with that value.
Discussion

Interest in shark-diving has been raised world-wide promoting an increase in the number of visitors at shark watching sites of almost 30% during the last 20 years (Gallagher and Hammerschlag, 2011; Cisneros-Montemayor et al., 2013). In all sites offering shark-watching opportunities, diving has supplied millions of dollars to local and regional economies (Clua et al., 2011). Yet, global estimates on economic contribution of shark watching operations are highly unclear, since the economic benefits of shark watching remain unknown for many sites (Cisneros-Montemayor et al., 2013).

In this paper we present an estimate of use value for Fernando de Noronha Island and for the shark watching activity developed in the island. Results shown that even though shark-diving industry is not present in the island, 2.8% of the island’s use value is due to the direct and non-consumptive use of sharks for shark watching. Considering that turtles, coral reef fish and dolphins account for the main interest in marine wildlife observation (Techera and Klein, 2013) and that activities of local diving operators are not led by shark watching, the value achieved by sharks indicates the important role of shark species as a tourism asset at Noronha.

The economic social benefits of shark watching in Noronha (2.6 million annually) are relevant mainly if compared to the value achieved by shark-diving industries established for years at the main shark watching sites such as in South Africa (~1.8 million annually; Dicken and Hosking, 2009), French Polinesia (~5.4 million annually) or in Palau, Western Australia (~1.9 million; Vianna et al., 2012). However, it must be noted that other aspects besides the presence of sharks on the island are taken into account by shark divers in their choice of travel destination, making it possible that this value can overlap with other resources and environmental attractions present on the island.

Despite the growing attention given to sharks worldwide (Clua et al., 2011), the
lack of information on this activity in Noronha does not allow us to confirm if the interest on shark watching has been raised in the island. Indeed, recent analysis of shark diving operations around the world did not include Noronha as a promising area for shark watching, mainly because of this lack of information on the economic and tourism potential of the island as shark spot. (Gallagher & Hammerchalag, 2011).

The entire touristic sectors benefit more from shark watching than from shark fishing, though not the fishers, as hypothesized in the paper. However this is not essentially due to market values or demand for shark since in Noronha shark finning never existed and the demand for shark meat is limited (just three restaurants have shark meat as menu option). This unbalanced distribution of earnings is most frequently caused by local people lacking the necessary qualifications to supply the services required by the tourism industry (Viana et al., 2012). This scenario weakens the awareness of fishers about shark conservation once they may feel they do not benefit from ecotourism.

Currently, participation in shark watching and in the benefits produced by the activity underlines awareness and support for conservation (Garrod & Wilson, 2003). There is also evidence in the literature that fishers may increase their earnings by supporting the shark-diving industry (for instance by supplying fish to restaurants) rather than competing with this industry for the same resource by exploiting sharks (Vianna et al., 2012). As a rule, economic estimates on shark watching and on shark diving aim to underscore the higher value of live sharks over dead sharks for the local economy, including for fishers if they are properly engaged in the tourism activities, either directly or indirectly (Clua et al., 2011).

Specifying prices that reflect values attributed to natural resources and assessing these values for each society level are amid the main challenges to valuating environmental assets and services (Motta, 1998; Vianna et al., 2012). Despite estimates
here implying lower benefits to fishers, diving operators mobilized from 2011 to 2013 USD 81 thousand annually in salary payments. Part of these payments is directed to the acquisition of material assets and several services in the island. (e.g. as maintenance, feeding), distributing the economic benefit throughout the island. Therefore, the non-consumptive use of sharks is most likely to benefit a larger number of people by generating more flow of money if compared to the shark fishing.

A pleasing level of diving experience compels divers to return to specific destinations if they can be assured in meeting the marine wildlife they seek (Jones et al., 2009) and guarantees the continuation of social benefits generated by shark watching. Besides, divers are often willing to pay more for natural assets they are interested in watching (Dearden et al., 2006). Specifically in Noronha the mean expenses of divers (USD 1,483.24/trip) exceeds expenses of non-divers (USD 925.46/trip) and the mean income of divers is higher than the mean income of non-divers underscoring the role of income as a predictor of expenditures incurred by tourists. Additionally, the willingness to pay for diving experiences is likely to be the same for shark divers and divers as a whole, since their mean income is roughly the same (USD 4,492.00 x USD 4,446.15). Furthermore, given that reef sharks can display high levels of site fidelity (Garla et al., 2006) so will be the divers visiting this site and spending money on their nature-based activities.

The tropical character of Noronha, its scenic beauty and the quality of the beaches and waves make the island an attractive destination for tourists in general and surfers, regardless of their diving skills and the diversity of marine life. As a result, tourism is a major source of revenue for the island. However, our findings pointed losses ranging from USD 2.6 million (considering 7% of shark divers among tourists) to USD 15 million (considering 40% of shark divers among tourists) if just tourists interested in shark
watching keep from visiting Noronha due to the depletion in shark population. Considering the percentage of tourists declaring having decided to dive due to the likelihood of shark watching and the number of interviewees that indicated high interest (40%) in watching sharks, the potential scenarios are plausible and show the economic loss that an untapped resource environmental can cause. From an economic point of view, this is an important issue to be taken into account when discussing conservation strategies in the island.

The values presented here referred only to use value of the island and use value (by ecotourism) of sharks. However, other nature-based assets are important to provide income to different sectors of the local economy. Furthermore, the economic benefit of shark watching activity to Noronha is likely underestimated since wages and salaries were quantified just for jobs in diving operators, not for jobs created in different sectors of the tourism industry such as hotels, restaurants and souvenir shops. However, as the value of the island or any of its environmental products was never assessed before, these findings are valuable for future decision making on economics and conservation in the island. If the island were established as shark watching site in the future the number of visits to shark watching would likely increase, improving the participation of local people in the activity and in its profits. As a result, direct and indirect values of sharks would increase contributing to the understanding of the value of sharks alive to the local economies.

Acknowledgments

We are grateful to Ana Helena Bevillacqua, Natalia Roos and Gustavo Paterno for their help in the field work. We thank ICMbio and ADEFN for providing data and the administration of Fernando de Noronha Airport for granting access to the passenger terminal. This study was funded by Conselho Nacional de Pesquisa e Tecnologia (CNPQ), which provided grants to N. M. Pires. We thank Venticinque, E. M., Cardoso, M. Z., Lopes,
P. F. M., Angelini, R., Guariento, R. D and Penna, N.R. for important comments on early versions of this manuscript.

References


## Appendix

Table I. Description of variables and constants used to calculate parameters and estimates of economic benefits related to the tourism and shark-diving in Noronha.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Constants and estimates</th>
<th>Description</th>
<th>Values</th>
<th>Units</th>
<th>Source</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Number of divers per year</td>
<td>Sum of number of divers</td>
<td>24551</td>
<td>No./Year</td>
<td>ICMBio</td>
<td>Average of 3 years (2011, 2012 and 2013)</td>
</tr>
<tr>
<td>FI</td>
<td>Fisher income</td>
<td>Average income from fishing × days fishing</td>
<td>7904.93</td>
<td>USD/Year</td>
<td>Fisher questionnaire</td>
<td></td>
</tr>
<tr>
<td>ND</td>
<td>Number of non-diving tourists per year</td>
<td>T-D</td>
<td>38707</td>
<td>No./Year</td>
<td>ICMBio and ADEFN</td>
<td></td>
</tr>
<tr>
<td>NSDP</td>
<td>National shark-diving parameter</td>
<td>(SDP×D)/T</td>
<td>0.027</td>
<td>-</td>
<td>ICMBio</td>
<td></td>
</tr>
<tr>
<td>SDP</td>
<td>Shark-diving parameter</td>
<td>Shark divers/D</td>
<td>0.07</td>
<td>-</td>
<td>Tourist questionnaires</td>
<td>Shark diver is defined as a diver who visits Noronha mainly or specifically to dive with sharks</td>
</tr>
<tr>
<td>T</td>
<td>Annual number of tourists</td>
<td>Average number of tourists visiting Noronha from 2011 to 2013</td>
<td>63258</td>
<td>No./Year</td>
<td>ADEFN</td>
<td>Average of 3 years (2011, 2012 and 2013)</td>
</tr>
<tr>
<td>TAX</td>
<td>Tourist taxes</td>
<td>Access to protected areas + Environmental preservation fee</td>
<td>25.58</td>
<td>USD/Day</td>
<td>ICMBio</td>
<td>Environmental preservation fee ≈ USD/Day 19.37  Access to protected areas = USD 30.27 (Brazilian) e USD 60.53 (Foreign)</td>
</tr>
<tr>
<td>TFP</td>
<td>Tourism fish market parameter</td>
<td>Percentage of fish sold to tourists “TP”</td>
<td>0.90</td>
<td>-</td>
<td>Restaurant and fisher questionnaires</td>
<td></td>
</tr>
<tr>
<td>TP</td>
<td>Tourism parameter</td>
<td>T/(População local +T)</td>
<td>0.96</td>
<td>-</td>
<td>ADEFN e IBGE</td>
<td>Indicates the percentage of sales that can be attributed to tourists instead of local consumers</td>
</tr>
<tr>
<td>W</td>
<td>Wages parameter</td>
<td>Percentage of revenues of dive industry addressed to pay wages</td>
<td>0.29</td>
<td>-</td>
<td>Operator and dive guides questionnaires</td>
<td></td>
</tr>
<tr>
<td>BT</td>
<td>Business revenue tax</td>
<td>Five percent of business revenues</td>
<td>0.05</td>
<td>-</td>
<td>Operator questionnaires</td>
<td>Represents the percentage of total revenues spent by dive operators on: fuel, maintenance, licenses, wages and extra costs of dive operation</td>
</tr>
<tr>
<td>C</td>
<td>Diving costs parameter</td>
<td>Percentage of revenues of the dive industry used to pay costs of diving operation</td>
<td>0.71</td>
<td>-</td>
<td>Operator questionnaires</td>
<td></td>
</tr>
</tbody>
</table>
Table II. Description of formulas and sources of data used to calculate parameters and estimates of economic benefits related to the tourism and shark-diving in Noronha.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Variables</th>
<th>Formula</th>
<th>Values</th>
<th>Units</th>
<th>Source</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Business revenues from tourism</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRD</td>
<td>Business revenues from divers</td>
<td>D×DET</td>
<td>36.4 million</td>
<td>USD/Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRND</td>
<td>Business revenues from non-divers</td>
<td>ND×NDE</td>
<td>35.8 million</td>
<td>USD/Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRS</td>
<td>Business revenues from shark divers</td>
<td>BRD×SDP</td>
<td>2.5 million</td>
<td>USD/Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRT</td>
<td>Business revenues from tourism activities</td>
<td>BRD+BRND</td>
<td>72.2 million</td>
<td>USD/Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Economic benefits from shark diving</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCIDI</td>
<td>Direct community income from dive industry</td>
<td>D×DED×W</td>
<td>1.15 million</td>
<td>USD/Year</td>
<td>Operator questionnaires</td>
<td>Represents the expenditure of dive industry on wages</td>
</tr>
<tr>
<td>Employment</td>
<td>Direct community income from shark diving</td>
<td>DCIDI×SDP</td>
<td>81.1 thousand</td>
<td>USD/Year</td>
<td>Operator questionnaires</td>
<td>Expenditure of the shark-diving industry on salaries</td>
</tr>
<tr>
<td>FishCons</td>
<td>Indirect value of shark diving to fisher</td>
<td>FL×TFP×NSDP</td>
<td>195.00</td>
<td>USD/Year</td>
<td>Fisher questionnaire</td>
<td></td>
</tr>
<tr>
<td>CSDO</td>
<td>Cost of shark-diving operation</td>
<td>Diving expenses×D×C×SDP</td>
<td>172 thousand</td>
<td>USD/Year</td>
<td>Operator questionnaires</td>
<td>Represents the expenditure of shark diving operations on: fuel, maintenance, licenses, wages and extra costs of dive operation</td>
</tr>
<tr>
<td><strong>Tax revenues from shark diving</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTSD</td>
<td>Taxes paid by shark divers</td>
<td>SDP×D×TAX</td>
<td>43.9 thousand</td>
<td>USD/Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TaxBusiness</td>
<td>Business revenue tax from shark diving</td>
<td>(SDP×DxBT× Diving expenses)+ (NSD×T+Accomodation expenses)+ (NSD×T×BT×Other expenses)</td>
<td>88.9 thousand</td>
<td>USD/Year</td>
<td></td>
<td>BRTSD is the sum of revenue taxes from shark divers from diving and other expenses</td>
</tr>
<tr>
<td>TTRSD</td>
<td>Total tax revenues from shark diving</td>
<td>DTSD+BRTSD</td>
<td>132.9 thousand</td>
<td>USD/Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total revenues</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRD</td>
<td>Total revenues from divers</td>
<td>D×TDET</td>
<td>37.0 million</td>
<td>USD/Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRND</td>
<td>Total revenues from non-divers</td>
<td>ND×TNDE</td>
<td>36.8 million</td>
<td>USD/Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRS</td>
<td>Total revenues from sharks</td>
<td>TRD×SDP</td>
<td>2.59 million</td>
<td>USD/Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expenditures</td>
<td>Description</td>
<td>Unit</td>
<td>Value</td>
<td>Notes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------------------------------------</td>
<td>------------</td>
<td>---------</td>
<td>----------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRT</td>
<td>Total revenues from tourism</td>
<td></td>
<td>73.8 million</td>
<td>USD/Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDE</td>
<td>Daily diver expenditure</td>
<td>DET/Length of stay</td>
<td>264.50</td>
<td>USD/Day</td>
<td>Tourist questionnaires</td>
<td>Average expenditure of a diver on dives per trip</td>
</tr>
<tr>
<td>DED</td>
<td>Diver expenditure on dives</td>
<td>Sum of diving expenses/Respondents</td>
<td>162.81</td>
<td>USD/Trip</td>
<td>Tourist questionnaires</td>
<td>Average expenditure of a diver on dives per trip</td>
</tr>
<tr>
<td>DNDE</td>
<td>Daily non-diver expenditure</td>
<td>NDE/Length of stay</td>
<td>191.46</td>
<td>USD/Day</td>
<td>Tourist questionnaires</td>
<td>Average of the total expenditures in the specified categories by non-divers. “Extra” includes extras expenses during the trip not specified in the other categories (i.e. souvenirs, landbased tours, etc)</td>
</tr>
<tr>
<td>NDE</td>
<td>Non-diver expenditure per trip</td>
<td>Accommodation expenses + Extra expenses + Tours</td>
<td>925.46</td>
<td>USD/Trip</td>
<td>Tourist questionnaires</td>
<td>Average of the total expenditures in the specified categories by non-divers. “Extra” includes extras expenses during the trip not specified in the other categories (i.e. souvenirs, landbased tours, etc)</td>
</tr>
<tr>
<td>TNDE</td>
<td>Total non-diver expenditure per trip</td>
<td>NDE+TAX</td>
<td>951.04</td>
<td>USD/Trip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DET</td>
<td>Diver expenditure per trip</td>
<td>Accommodation expenses + Diving expenses + Extra expenses</td>
<td>1483.24</td>
<td>USD/Trip</td>
<td>Tourist questionnaires</td>
<td>Average of the total expenditures in the specified categories by divers. “Extra” includes extras expenses during the trip not specified in the other categories (i.e. souvenirs, landbased tours, etc)</td>
</tr>
<tr>
<td>TDET</td>
<td>Total diver expenditure per trip</td>
<td>DET+TAX</td>
<td>1508.83</td>
<td>USD/Trip</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>