

EVIDENCE OF INCREASED ECONOMIC BENEFITS FROM SHARK-DIVING TOURISM IN THE MALDIVES

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ABSTRACT

Shark-diving tourism is a fast-growing industry that provides socio-economic benefits to local communities. We used surveys of dive tourists and dive operators to estimate the economic contribution of the shark-diving tourism in the Maldives. The direct business revenue from shark divers was estimated to be US\$14.4 million. Revenues to local businesses associated with travel expenses of shark divers were estimated to be US\$51.4 million. Further economic benefits from shark-diving occurred in form of annual business tax revenues of US\$7.2 million and annual salaries to employees working in the diving industry of US\$4.1 million. We compared these values with the business revenues from shark-diving from the same location in 1992 in order to assess how the shark-diving industry has expanded over time. Our results indicate that the business revenues of this industry have almost doubled (when inflation adjusted) over the last 24 years confirming its economic growth and importance for the Maldives. Effective management of shark dive operations is crucial for maintaining the value and sustainability of this tourism industry to improve ongoing conservation efforts for shark populations.

Keywords: shark conservation; dive tourism; sanctuary; ecotourism; market value; environmental management

1 INTRODUCTION

Viewing of wildlife is one of the most profitable and fastest-growing sectors within the tourism industry (Kruger, 2005; Wearing and Neil, 2009). Revenue from this type of tourism is particularly important in developing countries where it can generate substantial income for local communities and contribute towards funding conservation efforts for the associated wildlife. Although wildlife tourism can also have negative impacts on target species (Krüger 2005), it is increasingly acknowledged as a viable alternative to the extractive use of wildlife (Higginbottom and Tribe 2004; Huveneers and Robbins 2014). Within this industry (Cisneros-Montemayor et al. 2013), shark-diving is a popular activity and is defined as scuba diving and snorkeling that focuses on viewing sharks in their natural habitat. Worldwide, almost 600,000 people participate in this activity each year and this number is expected to double in the next 20 years (Cisneros-Montemayor et al. 2013). In many shark-diving destinations, such as French Polynesia (Clua et al. 2011), Palau (Vianna et al. 2012), Australia (Huveneers et al. 2017), and the Bahamas (Haas, Fedler,

and Brooks 2017), the industry generates tens of millions of dollars in revenue to local and regional economies. In addition, benefits flow to other sectors of the economy through expenses paid by divers for hotels, transport, and restaurants. Shark-dive tourism creates about 10,000 jobs worldwide (Gallagher and Hammerschlag 2011) and generates business tax revenues that enable governments to improve the social welfare of communities (Vianna et al. 2012; Vianna et al. 2018).

The growing importance of shark-diving to the economies of many nations occurs in a context where overfishing has caused a major decline in the abundance of numerous shark species worldwide (Camhi 1998; Worm et al. 2013). This decline has negative impacts on the resilience of marine ecosystems (Barley, Meekan, and Meeuwig 2017; Ruppert et al. 2013), with implications for the livelihoods and food security of coastal communities (Myers et al. 2007). The depletion of shark populations can, moreover, threaten the shark-diving industry. In the Maldives, for example, unsustainable shark fishing during the early 1990s resulted in decreasing numbers of sharks at dive sites, which in turn caused a drop in visits by tourists and considerable economic losses to the local dive-tourism industry (Anderson and Ahmed 1993; Anderson and Waheed 1999). In response, the Government of the Maldives announced a nationwide ban on all shark fisheries and exports of shark products and implemented a shark sanctuary in 2010 (Ali and Sinan 2015; Government of the Maldives 2010).

Today, tourism is the main economic driver of the Maldives and also generates the majority of its employment. Diving and snorkeling are the most popular tourism activities (Maldives Tourism Survey 2015) and observation of manta rays and sharks is a very important component of the dive tourism industry (Cagua et al. 2014; Anderson et al. 2011). In 1992, shark-diving generated approximately US\$2.3 million in direct business revenue, compared to an annual revenue of US\$0.5 million from local shark fisheries (Anderson and Ahmed 1993). This income from tourism is likely to be greater today, because the number of shark divers has increased significantly on a global scale (Cisneros-Montemayor et al. 2013). However, there is a lack of any means to determine the rate of growth of the industry, or to forecast its likely importance in the future, because there are few economic studies that have repeated surveys in the same area over time (however see: Haas et al., 2017; Zimmerhackel et al., 2018). This work addresses this issue by estimating the economic contribution of the shark-diving industry to the Maldives and comparing these values to results from 1992 (Anderson and Ahmed 1993). In so doing, this study provides some of the first long-term insights on economic trends that can be used to examine the relative importance of the industry through time, and to validate predictions of increasing economic returns based on changes in visitor numbers to the Maldives.

It is important that sanctuary managers have up-to-date information about the socio-economic values of the shark-diving industry in the Maldives, as such values have implications for conservation strategies. Accurate and robust figures on revenues are important in a situation where there are growing challenges to sanctuary status and to the conservation of shark populations. For example, there is currently no import ban

on shark products in the Maldives, which might offer the potential for a black market trade in souvenirs such as shark jaws caught from local stocks and sold under the cover of imported products. Moreover, some fishers complain that increases in the numbers of sharks due to the sanctuary are creating problems with depredation of their catches and have applied political pressure to remove legal protections (co-author's observation). There is also likely to be some illegal fishing of sharks occurring in the region (Ward-Paige and Worm 2017), although the scale of this problem has not been quantified. Information on the value of the shark-diving industry may provide justification for continued shark conservation.

The objective of this study was to assess the current economic contribution of the shark-diving industry in the Maldives. For this purpose, surveys with dive operators and dive tourists were used to estimate the business revenues, direct community income and business taxes that are associated with shark-diving. This study contributes to the understanding of the development of the economic contribution of the shark-diving tourism by comparing its' current and historical values. Results of this work can provide data to demonstrate the economic benefits of long-term protection for sharks in the Maldives.

2 METHODS

2.1 Study Site

The Republic of the Maldives lies in the central Indian Ocean and is composed of about 1,200 islands distributed in 20 administrative atolls (Figure 1). About 200 islands are inhabited and approximately 122 are designated as resort islands; the remainder are nominally uninhabited, although many do in fact have a small number of workers living there. With an Exclusive Economic Zone of 900,000 km² and very little land area, the economy of the Maldives relies heavily on their marine resources. Tourism is the main economic sector of the country and made up 24% of gross domestic product in 2015 (Ministry of Tourism 2016). This part of the economy has grown markedly during the last decades as tourist arrivals increased more than fivefold from 23,852 in 1992 to 1,286,135 in 2016 (Ministry of Tourism, 2016). About six per cent of the tourist arrivals come to the Maldives with the main purpose of going diving, which means that there were approximately 77,168 dive tourists in 2016. Currently, there are 184 registered dive operators of which the majority offer shark dives (Ministry of Tourism, 2016). The current study focused on dive tourism in five different atolls (Baa, Lhaviyani, Male, North Ari and South Ari) of the central area in the Maldives (Figure 1). These atolls contain almost 90% of dive operators in the country and receive—due to the proximity to the international airport in Male—the vast majority of tourist arrivals.

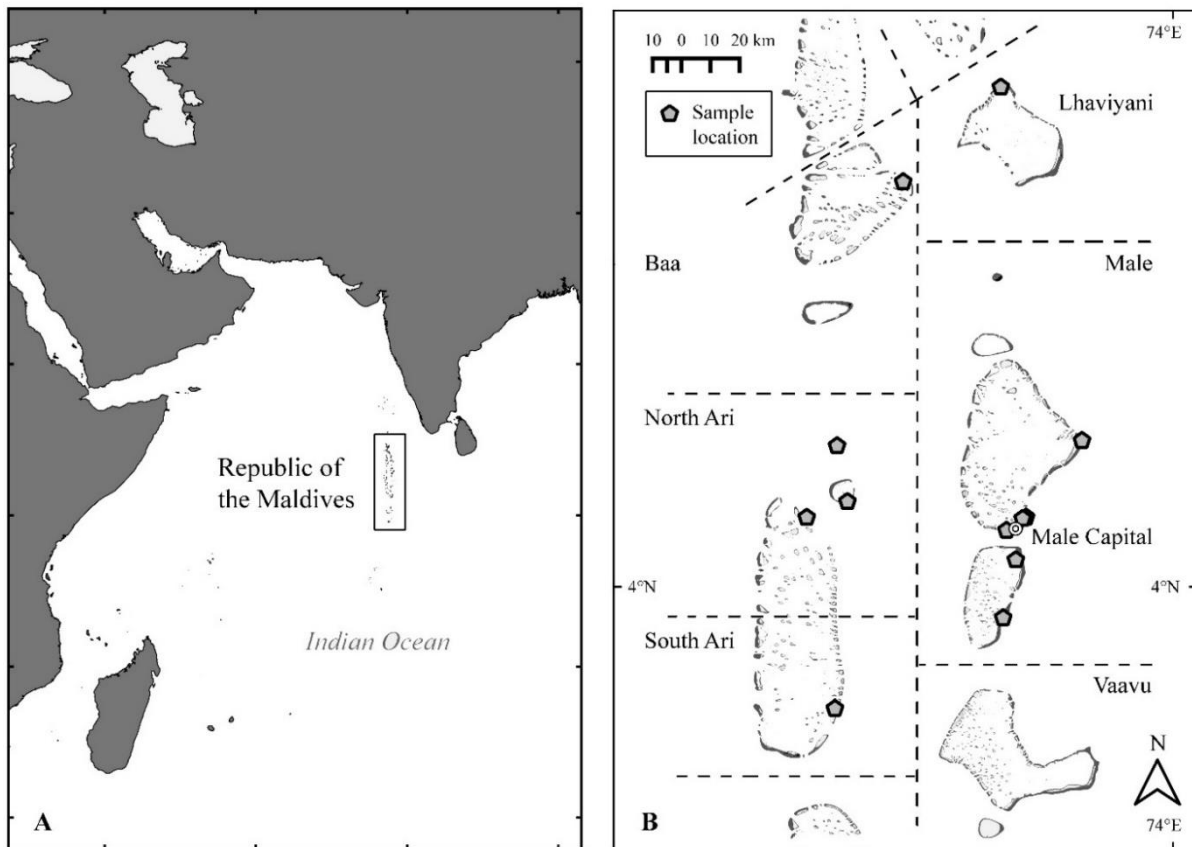


Figure 1: (A) The Republic of the Maldives and (B) central atolls with sample sites

Due to the large area of the Maldives, there are a variety of shark-dive operations throughout the atolls. The shark-diving industry in the Maldives is mainly focused on the observation of sharks in their natural habitat and usually does not include shark feeding or the use of bait to attract sharks to a certain dive site. Today, dive operators advertise approximately 164 dive sites where divers can expect to watch sharks. It is, however, important to state that there are also other attractions at many shark dive sites in the Maldives. Distinguishing between dive sites where sharks are present and where sharks are the main attraction is therefore very difficult and depends on the importance that each individual tourist places on seeing sharks during dives. The common sharks that can be seen by divers throughout most atolls are grey reef (*Carcharhinus amblyrhynchos*), white-tip reef (*Triaenodon obesus*), and black-tip reef (*C. melanopterus*) sharks. Tawny nurse sharks (*Nebrius ferrugineus*) can be found throughout the Maldives but are mostly observed by divers in the Vaavu atoll. A main attraction for visitors is diving or swimming with whale sharks (*Rhincodon typus*) that occur in the South Ari Marine Protected Area but can also be found seasonally in the Baa atoll and the more southern Huvadhoo, Faafu and Dhaalu atolls. Pelagic sharks are another attraction, such as schooling hammerhead sharks (*Sphyrna lewini*), which can be occasionally observed around the Rasdhoo and Vaavu atolls. Silver-tip sharks (*Carcharhinus albimarginatus*) can be found along walls and channels that connect the inner and outer atolls, and in the southern Fuvamulah Island it is possible to dive with tiger sharks (*Galeocerdo cuvier*) and thresher sharks (*Alopias sp.*).

2.2 Surveys

2.2.1 Tourist survey

Questionnaires were developed to document the trip expenses of dive tourists. Prior to data collection, these questionnaires were tested with 12 divers in Western Australia, Australia. In the Maldives, the survey was conducted with 300 dive tourists between September–November 2016, with researchers visiting 19 different dive centers on 13 different islands. Surveys were administered digitally on a tablet or as an equivalent paper-based survey. The questionnaire was divided in four sections. First, dive tourists were asked about their trip purpose and trip characteristics such as length of their stay and the number of dives they made. The second section asked about respondents' satisfaction with the shark-diving experience, which was measured on a Likert scale from 1 (very unsatisfied) to 5 (very satisfied). This section also asked for respondents' plans to make more shark-dive trips to the Maldives in the future. The third section recorded the travel costs during the current trip including expenses on dive activities, accommodation, food and beverages, domestic travel, and souvenirs and gifts, as well as international air fares. Those respondents who had purchased a travel package were asked to detail expenditures for the package, all items included in the package, and expenditures on items not included in the package. All other respondents were asked for expenditures on each of the items above separately. For ease of response, interviewees were able to state their expenses in their preferred currency, which were later converted to US\$ based on the currency conversion rate in November 2016. The third section also asked respondents about the duration of their stay and the number of days they had been diving. In section four, respondents answered questions about their demographic characteristics.

2.2.2 Dive operator survey

The dive operator survey involved audio recorded interviews with managers of the 19 participating dive operators and contained two sections. Section one aimed at understanding the current characteristics of the (shark) dive operations and elicited information regarding the main attractions for dive tourists, shark-diving sites they visited, and shark species that could be seen at these sites. The second section enquired about the number of tourists taking dive trips, local and foreign employee numbers, as well as expenditures on operational costs, employee wages, and taxes. Full questionnaires are provided in the supplementary material.

2.3 Economic benefits from shark-diving

The direct economic benefits from diving and shark-diving tourism in the Maldives were estimated through (i) the direct business revenue; (ii) business tax revenues; and (iii) the revenues to the local community in

the form of salaries.¹ Benefits were calculated for all divers and for shark divers only. Shark divers were defined as those divers who stated that they would not return to the Maldives if they could not dive with sharks. Hence, all associated travel costs for these divers, and calculation of associated benefits, can be attributed directly to shark-diving tourism.

2.3.1 Direct business revenue

First, the revenues that divers generate for the dive business directly (DBR_D) were calculated as:

$$DBR_D = DTC \times D \times DD, \quad (1)$$

Where *dive travel cost* DTC captures expenditure purely on dive activities per day, D reflects the total number of divers visiting the Maldives per year, and DD is the average number of days that a dive tourist is diving during their trip. Only diving days were included in the estimation to account for the multi-purpose nature of holidays and to avoid the inclusion of any costs that were not directly associated with diving activities. D was estimated as the fraction of total tourist arrivals (sourced from Ministry of Tourism 2016) who stated that the main purpose of their visit was diving times the total number of tourist arrivals. The dive-business revenue from *shark divers* specifically (DBR_{SD}) is the DBR_D times the fraction of dive tourists who said that they would not come back to the Maldives if there were no sharks (labelled SDF):

$$DBR_{SD} = DBR_D \times SDF \quad (2)$$

Second, the local business revenue from divers (LDB_D) was calculated by multiplying local trip costs per day (LTC) by the number of divers D and dive days DD . LTC included only locally spent costs (diving plus domestic transportation, accommodation, living costs, and gifts and souvenirs) but not international flight costs. Thus, LDB_D captures the revenues that accrue to local businesses more generally and includes the diving industry. Local business revenue from shark divers (LBR_{SD}) was then calculated as:

$$LBR_{SD} = LBR_D \times SDF = LTC \times D \times DD \times SDF \quad (3)$$

Third, total direct business revenue from divers (TBR_D) were estimated through the total trip costs TTC of dive tourists. TTC include all locally spent costs LTC (as above) plus international air fares. The total business revenues from shark divers (TBR_{SD}) is the TBR_D times the fraction of shark divers (SDF). These total business revenues will accrue to local and overseas businesses and was calculated as:

$$TBR_{SD} = TBR_D \times SDF = TTC \times D \times DD \times SDF, \quad (4)$$

¹ All variables and formulas are summarised in Appendix A.

2.3.2 Business tax revenues

The tax revenues (TR_{SD}) from the dive operators and associated businesses that provide services for shark divers were estimated by multiplying the business tax rate (BT) with the local business revenue from shark divers (LBR_{SD}). Additionally, a green tax of US\$6/day that is paid by all tourists who stay in the Maldives (MIRA - Maldives Inland Revenue Authority n.d.) was considered. The green tax obtained from shark divers was based on the number of shark divers visiting the Maldives per year and the average days they were diving. Accordingly, TR_{SD} was calculated as:

$$TR_{SD} = DBR_s \times BT + (6 \times D \times SDF \times DD) \quad (5)$$

2.3.3 Salaries

Diving also has flow-on revenues to the local community in the form of employee wages (called here ‘direct community income from diving’; DCI_D). This was measured by the estimated number of local and foreign employees that are associated with diving (E) and their average annual wages (\bar{W}). The numbers were obtained from the dive operator surveys and extrapolated to all registered dive operators in the Maldives (DO) using:

$$DCI_D = (E_{foreign} \times DO \times \bar{W}_{foreign}) + (E_{local} \times DO \times \bar{W}_{local}) \quad (6)$$

It was assumed that the proportion of jobs that can be associated with shark-diving (\bar{W}_s) relative to all jobs in the dive tourism industry is directly proportional to the fraction of shark divers visiting the region because shark dive operations do not differ in staffing from other types of dive operations. According to this assumption, the direct community income from shark-diving (DCI_s) is the DCI_D times the fraction of shark divers (SDF).

Our indicators of the economic benefits of shark-diving are based on financial flows, similar to the Gross Domestic Product measure used for whole economies. However, they do not equate to the total economic benefits from the shark-diving industry, for which the consumer surplus for the full range of use and non-use values (Hanley, Barbier, and Barbier 2009) and producer surplus (profits) would need to be estimated, not just revenues. Also, sharks play an important role in marine ecosystems and most probably contribute to a number of ecosystem services that are not assessed here.

3 RESULTS

3.1 Sample characteristics

We collected 300 complete dive tourist surveys for data analysis (Table 1). About 40% of respondents were female. The majority (84%) of respondents originated from Europe and the majority (74%) had come to the Maldives mainly for diving purposes. About a third of all participants (87) were classified as shark divers on the basis that they stated that they would not return to the Maldives if there were no sharks to be seen. Respondents were, on average, satisfied with their shark-diving experience in the Maldives (rating of 3.62 out of 5). We further collected information about average daily expenditure on diving activities; expenditure on local business goods and services such as hotels, restaurants, domestic transport and souvenir shops; and on total trip costs (including all expenditures on local businesses and international air fares).

Table 1: Characteristics of survey sample ($n=300$)

Respondents' characteristics	Value
Gender (% female)	40
Age (mean years \pm SD ^a)	42 (\pm 11)
Annual net household income (mean US\$ \pm SD)	87,617 (\pm 44,838)
Origin of respondents (% of respondents)	
<i>Europe</i>	84
<i>Asia</i>	10
<i>Others</i>	6
Average trip days (<i>TD</i>) (mean # of days)	11.9
Average days of diving (<i>DD</i>) (mean # of days)	6.6
Average dive experience (mean # of dives \pm SD)	172 (\pm 34)
Diving was the main purpose of the trip (% of respondents)	74
Shark diver fraction (<i>SDF</i>) (%)	33.2
Average satisfaction with shark-diving experience ^b	3.62 (\pm 0.94)
Dive trip costs (<i>DTC</i>) (mean US\$/person day and 95% CI ^c)	85 (75 – 95)
Local travel costs (<i>LTC</i>) (mean US\$/person day and 95% CI)	304 (268 – 340)
Total travel costs (<i>TTC</i>) (mean US\$/person day and 95% CI)	396 (347 – 445)

^aSD = Standard Deviation; ^b based on a Likert scale from 1 = very unsatisfied to 5 = very satisfied; ^c CI = Confidence Interval

3.2 Economic benefits from shark-diving

Using the results from our survey, the dive business revenue (DBR_{SD}) generated by shark divers was over US\$14 million per year (Table 2). Benefits from shark-diving also flow on to other businesses. Shark divers spent more than US\$51 million per year on local businesses that include diving, accommodation, food and beverages, domestic transportation, and gifts and souvenirs. The total business revenue from shark divers who visited the Maldives (TBR_S) was estimated to be almost US\$60 million per year. The dive operator survey revealed a tax rate of 12%. Together with the payment of the daily green tax by divers, shark-diving was estimated to generate a tax revenue of US\$7.18 million per year.

Table 2: Estimation results of the economic benefits generated from divers and shark divers per year. Benefits are shown for dive businesses only as well as for associated local businesses and all businesses used by dive tourists during their holidays.

Business revenues		Value (US\$/year)	95% CI
DBR_D	Dive business revenues from divers	43,291,304	(38,198,210 – 48,384,399)
DBR_S	Dive business revenues from shark divers	14,372,713	(12,681,710 – 16,063,702)
LBR_D	Local business revenues from divers	154,830,076	(129,873,912 – 179,276,930)
LBR_S	Local business revenues from shark divers	51,403,585	(43,118,098 – 59,519,986)
TBR_D	Total business revenues from divers	180,295,315	(165,339,385 – 193,351,406)
TBR_S	Total business revenues from shark divers	59,858,045	(54,872,595 – 65,272,721)
Tax revenues			
TR_D	Tax revenues from diving	21,635,466	(20,605,631 – 22,475,096)
TR_S	Tax revenues from shark-diving	7,182,975	(6,676,995 – 7,297,749)

Benefits from shark-diving further flow on to the community through the provision of salaries to employees of the diving industry. The dive operator survey revealed that the dive industry in the Maldives generated approximately 1,304 jobs including 720 local and 584 foreign workers (Table 3). Local and foreign workers had mean annual salaries of US\$8,544 and US\$10,464, respectively. Therefore, local annual salaries lie just below foreign annual salaries. The total direct income from diving received by Maldives locals and foreigners was approximately US\$12.4 million. Accordingly, the direct income of all employees who work with shark-diving operations was US\$4.1 million (about US\$2 million each for local and foreign employees) (Table 3).

Table 3: Number of employees in dive operations and their annual salaries for Maldivian local and foreign workers.

Salaries		Locals	Foreigners	Total
E	Number of employees in dive operations (#)	720	584	1,304
\bar{W}	Average annual salary (US\$/year)	8,544	10,464	9,504
DCI_D	Direct income from diving (US\$/year)	6,152,268	6,110,256	12,393,216
DCI_S	Direct income from shark-diving (US\$/year)	2,042,553	2,028,605	4,114,548

4 DISCUSSION AND CONCLUSIONS

This study found that shark divers in the Maldives contributed about US\$14.4 million to the local economy in 2016. In 1992, Anderson and Ahmed (1993) estimated the annual economic value of shark-diving in this location to be US\$2.4 million, a value corresponding to US\$7.9 million in 2016 (when taking into account inflation according to the Consumer Price Index). Although differences in methodologies mean that our estimate was not precisely comparable to the 1992 value, this does indicate that the annual direct revenues from shark-diving have almost doubled between the early 1990s and 2016. This major increase can be partly explained by tourist arrivals that have increased five-fold since 1992 (Ministry of Tourism 2016). The average price of dive trips, however, stayed within a similar range at US\$30 (US\$99 when inflation adjusted) per day in the early 1990s (Anderson and Ahmed 1993) to an average of US\$85 per day in 2016. However, there was a large discrepancy between the growth rate of the business revenues of shark diving and tourist arrivals, which might be explained by a change in focus of the tourism industry in the Maldives towards luxury resorts rather a niche market of diving and snorkeling as key holiday activities.

In addition to the growth of the shark dive tourism sector, there also has been a shift in the importance of target species. The principal example in this context is whale shark diving, an activity that was nearly non-existent in the early 1990s, but was estimated to generate business revenues of up to \$9.4 million in the Maldives in 2013 (Cagua et al. 2014). Although mindful of methodological differences between the present study and earlier work, this confirms that whale shark diving makes up a significant part of the overall business revenues from shark-diving in the Maldives. Other species that have been targeted by the dive tourism industry since 1992 include tiger and thresher sharks, which can be observed in the southern-most atolls. These species may have been included as a target species as a result of a spread of the tourism industry in the south of the Maldives over recent decades, coupled with the designation of an additional 56 “resort islands” since 1992 (Ministry of Tourism 2016). However, it should be noted that although the number of resorts has increased substantially, many divers in the Maldives choose live-aboard vessels rather than resort-based diving. Due to logistics, these divers only constituted about 10% of our sample size, but were more likely to be more focused on shark diving. If this is the case, then this bias in the sample towards resort-based diving may have resulted in an underestimate of the value of shark diving in the Maldives.

Shark-diving also contributed about US\$51.4 million to a variety of national business sectors, including dive tourism, hotels, restaurants, transport, and souvenir shops. This represents about two per cent of the total expenditures on local businesses by international tourists in the Maldives and 1.4% of national GDP (The World Bank 2017). It could be argued that not all travel costs of these dive tourists are used solely for shark-diving, because they also spend money on other goods and services during their trip. However, shark divers were classified as those tourists who would not return to the Maldives if there were no sharks to be seen. In this situation, any estimated revenues would be lost to the Maldives if there were no sharks or shark-diving industry.

The contribution of shark-diving activities to the Maldivian economy exceeds estimates from studies in other locations that used similar survey designs and analyses. In Fiji, shark-diving inputs approximately US\$42 million annually to the economy (Vianna et al. 2011), whereas in the Bahamas, local dive expenditures totaled US\$49 million (Haas, Fedler, and Brooks 2017). In Palau, the shark-diving industry generates around US\$17 million per year (Vianna et al. 2012). The greater business revenues from shark-diving in the Maldives relative to these other locations can be explained by the high numbers of shark-dive tourists that visit the Maldives annually (approximately 25,600 shark divers), which exceeded visitor numbers in Fiji, the Bahamas, and Palau (between 8,600 and 19,200 shark dive tourists per year). However, it is important to bear in mind that shark-diving industries worldwide are expected to have increased substantially in tourist participation in recent years (Cisneros-Montemayor et al. 2013), so these differences in relative values might also reflect the time lags among studies.

Shark-diving in the Maldives maintains approximately 239 jobs that generate a direct annual income of US\$2 million to the local community. Jobs include dive guides as well as staff for boat operations, office work, and equipment maintenance. However, Maldivian locals only represent about 55% of all employees who work for the dive-tourism sector and often involve lower-tier jobs such as equipment maintenance and boat operations (Shakeela and Cooper 2009). As a result, the average annual salary of locals was lower than that of foreign employees as well as of the national average of US\$ 9,518 per year. To close this gap between local and foreign employees, the government or the tourism sector could invest in education and training programs to upskill and attract more qualified locals to working in the industry. However, the community benefits from shark-diving are diverse, with divers using a range of other goods and services such as hotels, restaurants, and souvenir shops during their trip, thus also generating jobs across other business sectors. Employees in tourism-related businesses also purchase goods and services with their salaries and therefore contribute to a wider range of business sectors. These multiplier effects were not considered by our study.

The generation of employment also has important implications for former shark fishermen who lost their livelihood when shark fishing was banned. After the implementation of the shark sanctuary, about one third of the former shark fishers changed their fishing gear and now supply the tourism market with reef fish, and about two per cent began working directly for the tourism sector (Ali K., unpublished data), although this was a shift in employment that had already begun prior to this date (Anderson and Waheed 2001). This suggests that the tourism industry provided alternative to support the livelihoods of at least some former shark fishers. However, in order to provide a comprehensive picture, further studies are required that focus on the impact of the shark sanctuary on the livelihoods of shark fishers (particularly in those communities where there are few alternative livelihoods available).

The growth of the shark-diving tourism industry in the Maldives in the last 24 years underlines the value of sharks to the national economy and may be attributed to past efforts to protect sharks in national waters. At the same time, this highlights the need for ongoing efforts to sustainably manage the sector. For example,

there have been concerns that visitors exceed the carrying capacity of tourism operations that focus on whale sharks, with negative impacts on both whale sharks and tourist satisfaction with the shark-diving experience (Cagua et al. 2014).

The success of long-term management and conservation efforts in shark sanctuaries, especially in developing countries, depends largely on the availability of funds. The diverse economic and community benefits of shark-diving in the Maldives provides a means by which these goals might be funded. Nevertheless, Bhat et al. (2013) found a strong discrepancy between the revenues that are generated by nature-based tourism and the government's expenditures on nature conservation in the Maldives. It is advisable for national authorities to recognise the economic benefits of effective management of the shark sanctuary in the Maldives, and to ensure sufficient revenues generated from shark-diving tourism are re-invested into maintaining shark populations. This will require an emphasis on enforcement of the sanctuary, a well-regulated shark-diving industry and ongoing fisher-community involvement.

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APPENDIX A

Table A.1: Variables used for the estimation of the socio-economic value of shark-diving

Variables	Description	Data source	
D	Number of divers per year	Number of dive tourists visiting the Maldives per year	Ministry of Tourism, 2016 (a), (b)
TA	Tourist arrivals	Total number of tourists visiting the Maldives per year	Ministry of Tourism, 2016 (b)
SDF	Shark diver fraction	Fraction of dive tourist arrivals that would not return to the Maldives if there were no sharks	Tourist survey
TD	Trip days	Average number of trip days	Tourist survey
DD	Diving days	Average number of diving days	Tourist survey
DTC	Dive trip costs	Expenses from tourists on diving	Tourist survey
LTC	Local travel costs	Expenses from tourists on domestic transportation, accommodation, diving, food and beverages, and extras	Tourist survey
TTC	Total travel costs	Total travel expenses (include local travel costs plus international air fares)	Tourist survey
BT	Business tax rate	Business tax rate	Dive operator survey
E	Number of employees	Number of employees that work in the dive industry	Dive operator survey
W	Wages	Average salary of employees that work in the diving industry	Dive operator survey
DO	Dive operators	Number of registered dive operators	Ministry of Tourism, 2016 (c)

Table A.2: Formulas used for the estimation of the socio-economic value of shark-diving

Code	Description	Formula
DBR_D	Dive business revenues from divers	$DTC \times D \times DD$
DBR_{SD}	Dive business revenues from shark divers	$DBR_D \times SDF$
LBR_D	Local business revenues from divers	$LTC \times D \times DD$
LBR_{SD}	Local business revenues from shark divers	$LBR_D \times SDF$
TBR_D	Total business revenues from divers	$TTC \times D \times DD$
TBR_{SD}	Total business revenues from shark divers	$TBR_D \times SDF$
TR_{SD}	Business tax revenues from shark-diving	$DBR_{SD} \times BT + (6 \times D \times SDF \times DD)$
DCI_D	Direct community income as salaries from diving	$DCI_D = (E_{foreign} \times DO \times \bar{W}_{foreign}) + (E_{local} \times DO \times \bar{W}_{local})$
DCI_{SD}	Direct community income as salaries from shark-diving	$DCI_D \times SDF$

Dive Operator Survey

Date (dd/mm/yy) ____/____/____ Company _____ Foreign / Local

Atoll _____ Island _____ Interviewer Initials _____

A) Activities of the dive boat operation

Before we start, I just want to assure you that all information collected is strictly confidential and no names of people or companies will be published or shared with others. You are free to withdraw from this survey and ask questions at any time during this interview. First of all, I would like to ask you some questions about your work place and the dive boat operations of this company.

1. What is your position in this company?

General Manager

Dive guide/ Master/ Instructor

Administration

Others _____

2. For how long has this company been operating dive boat tours in the Maldives in total?
 _____ years _____ months

3. Are you or is this company a member of any tourism association in the Maldives?

Yes / No

Live-aboard Association Maldives (LAM)

Tourism Employee Association Maldives (TEAM)

Maldives Association of Tourism Industry (MATI)

Divers Association Maldives (DAM)

Others _____

4. How many people are employed by this company (including all facilities e.g. dive boat operations, souvenir shops, bar/ restaurants, resorts/ guesthouses) and what is their average salary?

Facility	Type of employees	Number of people	Average salary (USD/MVR) per week / month / year
Total OR	a. Maldives locals and resident		
	b. Non-residents		
Dive boat operation	a. Maldives locals and resident		
	b. Non-residents		
Bar/ Restaurant	a. Maldives locals and resident		
	b. Non-residents		
Resort/ Guesthouse	a. Maldives locals and resident		
	b. Non-residents		
Others	a. Maldives locals and resident		
	b. Non-residents		

5. What is the maximum number of people that this company can hold in dive operations per day – over all boats? _____ People/day

6. What was the **average** working capacity of the company during the previous season (in percent of the maximum number of people it can hold)? _____ %

7. Does this company advertise dives or dive trips (e.g. on the internet or with flyers) specifically to see sharks? Yes / No

8. In your opinion, which diving activities attract most tourists to the Maldives? Please rank the following attractions from 1 (attracts the most) to 5 (attracts the least).

Possible activities	Ranking	Possible activities	Ranking
a. Coral reef dives		f. Manta rays	
c. Wreck dives		g. Cave dives	
e. Shark watching		h. Others	

9. What dive sites does this company visit most often to specifically dive with sharks?

Site 1	Site 3
Site 2	Site 4

10. In your opinion, which shark species are most likely to attract tourists to the Maldives?

B) Dive tourism and the Shark sanctuary

Thank you that was the first part. Now, I would like to ask you about your companies' attitude towards shark fishing and the shark sanctuary of the Maldives.

11. Did you know that the Maldives have been declared a shark sanctuary? Yes / No

Explanation: In 2010, the Ministry of Fisheries and Agriculture (MoFA) announced an indefinite total ban on all types of shark fishing in the whole Maldivian waters (MoFA Iu'laan: 30-D2/29/2010 /32). Additionally in 2011, the Ministry of Housing and Environment (MoHE) announced a ban on capture, keeping, trade and harming of sharks under the Environment Protection and Preservation Act (EPPA).

12. Have you ever observed shark fishing activities during your dive operations, or around the resort? Yes / No

[Only ask if 'yes'] Are they usually foreign vessels or local fishing vessels who you have seen fishing for sharks? Local / Foreign / Both equally

[Only ask if 'yes'] How often do you see shark fishing activities during your dive operations, or around the resort?

- I used to see it but not anymore
- I didn't use to see that but now I do
- I observed it approximately _____ times during my entire career (_____ years of career)
- Frequency _____ times a _____ month / _____ year

13. Do you take any action after you observe shark fishing activities or the trade with shark products? This can be anything at all. I am interested in how you react.

- I ignore it
- I tell my colleagues about it
- I complain to the fishermen/ salesman about it
- I report it to the police or authorities in charge
- I create evidence of the incident (e.g. pictures, videos or notes of details)
- Others _____

14. If you have you ever reported any illegal (shark) fishing activity or illegal trade in shark products to the authorities? What were your reasons for doing so?

- I reported it to the police or authorities in charge because _____
- _____
- I used to report these incidences but gave up on it because _____
- _____
- Others _____

15. If you have you never reported any illegal (shark) fishing activity or illegal trade in shark products to the authorities? What were your reasons for not doing so?

- I wanted to report it but didn't know how to do it
- I don't think that reporting illegal fishing would make a difference
- Others _____

16. Is this company involved in any social initiatives that are associated with shark conservation (e.g. organize or participate in educational programmes or invest in communal infrastructure)?

Training of local people from the Maldives:

Activity	Yes/No	Comments
Dive guide/ Master/ Instructor		
Boating		
Administration		

Seller		
Others		

- Other educational programmes
- Investment in communal infrastructure
- Others _____

17. Does this company support any research project or scientific programs (other than the present one)? Yes / No

- Sharks count
- Whale shark project
- Coral reef restoration
- Manta ray project
- Marine turtle project
- Others _____

18. Have you heard of the shark trust fund of the Maldives? Yes / No

Explanation: In 2010, MoFA opened a Shark Trust Fund and asked the tourism industry to contribute for the fund to compensate and facilitate alternative income generating ways for shark fishermen.

19. Has this company participated in a compensation scheme (such as the shark trust fund) of shark fishermen after the establishment of the shark sanctuary? Yes / No

Name of the programme _____

20. What are your reasons for engaging in any of the initiatives that improve shark conservation (e.g. participation in research projects, social programmes, compensation scheme, reporting illegal fishing activities)?

- Financial reasons _____
- Moral reasons _____
- Ecological reasons _____
- Political reasons _____
- Others _____

21. What hinders you in engaging in any of the initiatives that improve shark conservation (e.g. participation in research projects, social programmes, compensation scheme, reporting illegal fishing activities)?

- Financial reasons _____
- Moral reasons _____
- Ecological reasons _____
- Political reasons _____
- Others _____

22. What reasons would motivate you to engage in more activities that support shark conservation in the Maldives? Please rank the following 7 reasons in their importance for your motivation from 1 (most important) to 7 (least important).

Incentives	Rank	Comments
If that would bring me more revenues		
If the relationship to authorities and the community improved		
If that would make the marine environment/ shark populations healthier		
If more dive operators were doing the same/ if I was part of a collaboration between dive operators		
If there was more illegal fishing present		
If shark populations were reducing		
If that would create more jobs		

C) Diving Expenses

In this last part of the survey, I would like to ask you some questions about the service and running costs of this company. This information will be used to estimate the socio-economic value of sharks for the dive tourist industry in the Maldives.

23. How many dives does this company make on a usual day trip? _____ dives

24. What is the price for a day trip that your company charges per day?

Flat rate: (USD/MVR) _____ per day

Additional charges (e.g. equipment, nitrox, night dives):

(USD/MVR) _____ per day

(USD/MVR) _____ per day

25. Does your business offer dives as part of package tours/dive packages? Yes / No

26. What percentage of the tourists diving with your company purchase dive packages?
_____ %

27. Could you give me the following details of the dive package(s) you offer?

Package	Cost (USD/MVR)	Days	Dives/ day	Accom.(single/twin /triple room)	Meals included	Number of people or %
1.						
2.						
3.						

28. Could you estimate the percentage of the companies' revenue from dive operations that is spent on (1) operating costs, (2) wages, (3) licenses and other running costs?

Running costs	Percent of total revenue
(1) Operating costs (e.g. fuel, boat, equipment and rent)	
(2) Wages/salaries of hired labour	
(3) Governmental licenses/fees	
Others:	

D) Follow-up and Comments

That's it! Thank you very much for participating in this survey. Your answers are really helpful and your time is much appreciated.

29. Would you be interested in staying informed about this project, and/or would you be willing to participate in future follow-ups of this research?

Yes, I would like to be updated on the progress of the research project

Yes, I am available for possible future questions of this research project

No thanks

If yes, please indicate your name and e-mail address

Name _____ E-mail _____

30. Do you have any other concerns or comments about the shark diving tourism in the Maldives that we have not yet discussed?

Do you have any other comments on this survey that I didn't ask you about?

Dive Tourist survey

A) In this section, we would like to know something about your purpose to visit the Maldives.

Question 1

Is this the first time that you have dived in the Maldives? If not, please indicate how many times you have visited the Maldives for diving. **Tick one box**

- Yes, this is the first time
- No, I have been here _____ times (including this trip)

Question 2

Did you come to the Maldives because someone recommended it to you (e.g. friends, family or reviews on the internet)? **Tick one box**

- Yes, mostly because of a recommendation
- Yes, but also because of other reasons
- No, a recommendation was not the reason

Question 3

For what main activity did you come on this trip? **Tick one box**

- Beach holidays
- Diving
- Snorkeling
- Sightseeing
- Other (please specify) _____

Question 4

How important was seeing sharks to you to come on this trip? **Tick one box**

- Not important at all
- A little bit important
- Important
- Very important
- The most important

Question 5

How interested were you in seeing any of the following attractions during your current dive trip?

	Very uninterested	Uninterested	Neutral	Interested	Very interested
Manta rays	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
High fish abundance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sharks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Caves	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coral reefs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Others (please specify)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 6

Before you came on this trip, did you know that the Maldives have banned shark fishing by creating a shark sanctuary? **Tick one box**

- Yes
- No → **Go to section B (page 5)**
- Not sure

Question 7

How did knowing that the Maldives are closed to shark fishing influence your decision of the Maldives as a holiday destination? **Tick one box**

- It did not influence my decision at all
- It influenced my decision a little bit
- It was important for my decision
- It was the most important reason for my decision

B) In this section, we would like to know how satisfied you are with your visit to the Maldives.

Question 8

If you have dived with sharks in the Maldives, how satisfied were you with the diving experience, with regard to the four shark watching criteria below.

	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
1. Number of sharks seen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Number of shark species seen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Quality of the interaction with sharks (e.g. time watching sharks, proximity to sharks)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Overall satisfaction with the shark dive experience	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 9

Have you visited any other shark diving areas in the world?

Yes. Location(s):

No

Not sure → **Go to section C (page 6)**

Question 10

How did the shark diving experience in the Maldives compare on average with your experience(s) at other sites? **Tick one box**

- Dives in the Maldives were a better shark watching experience
- Dives in the Maldives were about the same shark watching experience
- Dives in the Maldives were a worse shark watching experience

C) The next questions are about your plans to visit the Maldives in the future.

Question 11

How many times do you plan to visit the Maldives in the next 10 years? (Remember that each visit is associated with certain travel costs.) **Tick one box**

- 0 times
- 1 to 5 times
- 6 to 10 times
- More than 10 times

Question 12

Within this margin of times that you stated you plan to visit the Maldives. What is your best guess of number of visits you plan to do? **Remember this number as you will need it in questions 14, 15 and 17**

_____ **Times**

Question 13

Would you recommend the Maldives as a shark diving destination (e.g. to friends, family or over the internet)?

- Yes
- No

Information

Sharks were fished traditionally in the Maldives for many decades. With the implementation of the shark sanctuary in 2010, shark fishing was banned and fishers gave up the rights to fish for sharks. We are interested in your plans to dive in the Maldives if there would be illegal shark fishing activities.

Question 14

You said earlier that you plan to visit the Maldives a certain number of times (question 12). Imagine that you observed shark fishing (e.g. a fisher catching sharks on a boat or on the beach) or trade in shark products (e.g. shark meat, fins or souvenir articles like teeth or jaws) during your current trip. How would that:

- Change the number of visits that you are planning to make to the Maldives in the next 10 years?
- Influence whether or not you recommend the Maldives as a shark diving destination (e.g. to friends, family or over the internet)?

	a) Number of visits you would plan in the next 10 years	b) Would you recommend the Maldives as shark diving destination	
		Yes	No
Example:	5	<input checked="" type="radio"/>	<input type="radio"/>
If you would not see any shark fishing or trade in shark products		<input type="radio"/>	<input type="radio"/>
If you would see shark fishing or trade in shark products		<input type="radio"/>	<input type="radio"/>

Question 15

You said earlier that you plan to visit the Maldives a certain number of times (question 12). Imagine that the number of sharks that you see would change in future visits to the Maldives. How would that:

- Change the number of visits that you are planning to make to the Maldives in the next 10 years?
- Influence whether or not you recommend the Maldives as a shark diving destination?

	a) Number of visits you would plan in the next 10 years	b) Would you recommend the Maldives as shark diving destination	
		Yes	No
If the number of sharks increased		<input type="radio"/>	<input type="radio"/>
If the number of sharks decreased		<input type="radio"/>	<input type="radio"/>
If there were no sharks at all		<input type="radio"/>	<input type="radio"/>

Question 16

Dive operators can engage in several social and ecological initiatives to reduce illegal shark fishing. How important do you consider the following actions of a dive operator?

	Very unimportant	Unimportant	Neutral	Important	Very important
Monitor and control protected areas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Help to improve the economic situation of fishers (e.g. by employing them or by paying compensation fees)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Help to improve the social situation of fishers (e.g. by investing in educational programs and infrastructure)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Integrate fishers in the management of protected areas (e.g. by mediating between fishers and other stakeholders)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 17

You said earlier that you would visit the Maldives a certain number of times (question 12). Imagine that the dive operator you chose take actions to reduce illegal fishing or not. How would that:

- a) Change the number of visits you would do with that specific dive operator in the next 10 years?
- b) Influence whether or not you would recommend that specific dive operator to others?

	a) Number of visits you would do with this dive operator in the next 10 years	b) Would you recommend this dive operator	
		Yes	No
If the dive operator would engage in actions against illegal fishing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If the dive operator would not engage in actions against illegal fishing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 18

Now thinking about your current trip or previous trips to the Maldives. Have you ever observed any shark fishing activities, trade in shark products or other occurrences related to shark fisheries in the Maldives? **Tick all that apply**

- Shark fishing activities (e.g. shark being landed on a boat or a beach)
- Trade in shark products (e.g. shark meat, fins, teeth or jaws)
- Other (please specify) _____
- No, I have never observed any shark fishing or trading in the Maldives. → **Go to section D (page 9)**

Question 19

If you observed any shark fisheries, trade in shark products or other occurrences related to shark fishing in the Maldives, please give details of your observation(s).

	What did you see?	Where did you see this?	When did you see this?
Observation 1:			
Observation 2:			
Observation 3:			
Observation 4:			

D) To estimate the benefit from shark tourism (and dive tourism) to the Maldives economy we would like to have an estimate of your expenditure for this trip to the Maldives.

Question 20

How long have you been in the Maldives so far on this visit?

_____ Days

Question 21

What will be the total duration of your stay in the Maldives on this visit?

- _____ Days
- Not decided, but my best guess is: _____ Days

Question 22

Did you purchase a dive trip package for this trip to the Maldives?

- Yes → **Answer Questions 23 to 26**
- No → **Go to Question 27 (page 11)**

Question 23

Can you estimate the total cost of the package?

Cost _____ Currency _____

Question 24

How many people are included in this package?

_____ People

Question 25

What was included in the package? (Please tick all options included in the package and add details if option is included in the package)

Included in package	Item		Details
<input type="radio"/>	Air flights		
<input type="radio"/>	Accommodation	Number of nights:	
		Number of rooms:	
<input type="radio"/>	Dive trips	Number of days:	
		Number of dives per day:	
<input type="radio"/>	Food and beverages		
<input type="radio"/>	Others (specify)		

Question 26

Could you please estimate how much more money in total (additional to the cost of the package) you have spent (or will spend) on this visit to the Maldives

Items outside your package	Cost for additional items outside your package	
	Cost	Currency
International air flights		
Ferries and inland flights		
Accommodation		
Food and beverages		
Entertainment		
Non-dive activities		
Additional dives		
Souvenirs		
Others (please specify) _____		

→ If you purchased a package trip, go to section E (page 13).

Question 27

What are you paying on average for accommodation while in the Maldives?

	Accommodation	
	Cost	Currency
In total or		
Per day		

Question 28

What are you paying on average for food, beverages and other living costs (not including accommodation) while in the Maldives?

	Food and beverages	
	Cost	Currency
In total or		
Per day		

Question 29

Please estimate what you paid (or will pay) in total for dive trips while in the Maldives

	Dive trips	
	Cost	Currency
In total		

Question 30

Please estimate what you paid in total for air flights to the Maldives

	Air flights	
	Cost	Currency
In total		

Question 31

Please estimate what you will pay in total for other tourist-related activities while you are in the Maldives (e.g. for souvenirs, non-dive activities and entertainment. Do not include accommodation)

	Cost for additional items outside your package	
	Cost	Currency
Total costs or		
Entertainment		
Non-dive activities		
Souvenirs		
Ferries and inland flights		
Others (please specify)		

E) Finally, we have a few questions about you to make sure we have a good sample of respondents.

Question 32

Please indicate your gender

- Male
- Female

Question 33

What is your age?

- Between 18 and 24 years old
- Between 25 and 34 years old
- Between 35 and 44 years old
- Between 45 and 54 years old
- More than 55 years old

Question 34

What is your nationality?

Question 35

In what income category does your annual combined income fall (please consider the income from all sources for the whole household before taxes)? (For currency conversions, see page 14) **Tick one box**

- Less than US\$ 20,000/year
- Between US\$ 20,000 and US\$ 49,999/year
- Between US\$ 50,000 and US\$ 79,999/year
- Between US\$ 80,000 and US\$ 119,999/year
- US\$ 120,000 or more

Question 36

What is your diving experience? **Tick one box**

- Less than 5 dives
- Between 5 and 49 dives
- Between 50 and 99 dives
- Between 100 and 499 dives
- 500 dives or more

That's it! Thank you very much for participating in this survey. Your answers are really helpful and your time is much appreciated.

Would you be interested in staying informed about this project, and/or would you be willing to participate in future follow-ups of this research?

- Yes, I would like to be updated on the progress of the research project
- Yes, I am available for possible future questions of this research project
- No thanks

If yes, please indicate your name and e-mail address

Name _____ E-mail _____

Do you have any other concerns or comments about the shark diving tourism in the Maldives that we have not yet discussed?

Do you have any comments on this survey?

Currency conversions
(September 2016)

1.00 Australian Dollar	=	USD	0.76
1.00 British Pound	=	USD	1.30
1.00 Chinese Yuan	=	USD	0.15
1.00 Euro	=	USD	1.12
1.00 Indian Rupee	=	USD	0.015
1.00 Japanese Yen	=	USD	0.01
1.00 Russian Ruble	=	USD	0.015

For any other currencies or help with the conversion, please ask one of our team members.