The socio-economic value of the shark-diving industry in Fiji

Authors:

GMS Vianna[1,2], JJ Meeuwig[2], D Pannell[3], H Sykes[4] and MG Meekan[1,*]

1. Australian Institute of Marine Science, UWA Oceans Institute (M096) 35 Stirling Hwy, Crawley WA 6009. Australia
2. Centre for Marine Futures (M090), The University of Western Australia 35 Stirling Hwy, Crawley WA 6009. Australia
3. School of Agricultural and Resource Economics (M089), The University of Western Australia,
35 Stirling Hwy, Crawley WA 6009. Australia **4.** Marine Ecology Consulting, Fiji

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* Author for correspondence: MG Meekan, Australian Institute of Marine Science, The UWA Oceans Institute (M096),
35 Stirling Hwy, Crawley WA 6009. Australia. Email: m.meekan@aims.gov.au

Australian Institute of Marine Science
PMB No 3
Townsville MC Qld 4810

PO Box 41775
Casuarina NT 0811

AIMS (M096) Botany Building
University of Western Australia
Crawley WA 6009

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DISCLAIMER

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1. Executive Summary

We quantified the economic revenues generated by shark diving and the distribution of these revenues to the principal local stakeholders involved with the industry, including businesses, government and local community.

Shark-diving contributed US $42.2 million to the economy of Fiji, a sum composed of revenues generated by the industry combined with the taxes paid by shark-divers to the government.

This estimate was based on self-administered questionnaires designed to collect information on the costs and benefit of the shark-diving industry. We conducted the study in August/September 2011 and distributed questionnaires on the islands of Viti Levu (including the islands of Nananu-i-Ra and Beqa), Vanua Levu, Taveuni and Kadavu, the Yasawa and Mamanuca groups. Questionnaires were answered by 289 divers, 18 dive operators, six resort managers (surveyed at Pacific Harbour and Coral Coast only), 14 dive guides and nine local subsistence fishers from villages that regularly received payment from shark-diving operators for the use of the reef of which they are the traditional owners.

We took a conservative approach to all calculations in order to reduce the risk of over-estimating the value of shark-diving to the Fijian economy

We calculated the economic revenue of shark-diving to Fiji based on three key pieces of information:

(1) Total number of divers visiting the country and the proportion of tourists engaged in dive activities from the Fiji International Visitor Survey 2009
(2) All expenditures of the divers visiting Fiji primarily to engage in shark-diving activities ("dedicated shark-divers") as revealed by our surveys;
(3) The expenditures of divers who visited Fiji for reasons other than diving with sharks, but chose to engage in shark-diving while in the country ("casual shark-divers") as revealed by our surveys. Expenditures of these divers were allocated as the proportion of their trip spent shark diving, rather than for their entire visit.

In 2010 we estimated that approximately 49,000 divers were engaged in shark-diving activities in Fiji accounting for 78% of the 63,000 divers visiting the country. Dedicated and casual shark-divers accounted for 24% and 54% of all divers we interviewed respectively.

The shark-diving industry contributed US $17.5 million in taxes to the government, a sum composed of corporate taxes from shark-diving (US $11.6 million) and the direct taxes from shark-divers (US $5.9 million)

A minimum of US $4 million was generated annually by shark-diving for local communities. This revenue consisted of salaries paid by the industry to employees (US $3.9 million annually) and community levies paid by dive operators to traditional owners in villages for access to reefs (US $124,200 annually). Employees of the dive industry were predominantly Fijian (13 of 14 dive guides who responded to surveys).

Community levies from shark-diving have played a significant role in promoting the conservation of reefs through systems of traditional ownership.

Viti Levu hosted the largest number of dedicated and casual shark-divers (17,000) with Pacific Harbour accounting for around 50% of the shark-divers, or approximately 8,600 tourists. The Mamanuca/Yasawa group also hosted a large number of shark-divers (11,000) while Vanua Levu/Taveuni hosted approximately 3,600. Kadavu had only 17% of divers identified as casual shark-divers and no dedicated shark-divers interviewed during our survey.

Shark-diving generated approximately US $10.2 million on Viti Levu (63% of business revenues from diving) and US $3.2 million (40% of the business revenues) in the Mamanuca/Yasawa groups.

2. Background

An increasing global market for shark fins has driven a shift in exploitation of sharks from one of largely by-catch to a target fishery around the world. Typically, such fisheries are poorly managed and regulated and fail to consider the consequences of shark life-history traits of slow growth, late maturity and low fecundity (Field et al., 2009; Stevens et al., 2000). This has led to the rapid collapse of fisheries (Ferretti et al., 2008; Myers and Worm, 2003) so that today, there are many examples of severe overfishing of populations of coastal and pelagic sharks from both developed and developing countries, as well as in international waters (Baum et al., 2003; Dulvy et al., 2008; Ferretti et al., 2008; Luiz and Edwards, 2011; Myers and Worm, 2003; Stevens et al., 2000; Ward-Paige et al., 2010).

This global over-exploitation of sharks highlights the need for convincing economic arguments that can halt or reduce declines and assist the implementation of more effective conservation strategies (Vianna et al. 2010, Clua et al. 2011). Worldwide concern over the ecological and economic impacts of the loss of sharks as apex predators in marine ecosystems has led a number of small island nations to grant greater protection to shark populations. Since the Republic of Palau created a nationwide shark sanctuary in 2009, other Pacific island states such as the Republic of the Marshall Islands and the territories of Tokelau, Guam and the Northern Marianas have followed suit by banning commercial shark fishing and the trade of shark parts, including fins, within their waters. These bans are not restricted to the Pacific Ocean: the Republic of the Maldives recently implemented the first nationwide shark sanctuary in the Indian Ocean and the Honduras and the Bahamas have also created sanctuaries extending bans on commercial shark fishing to Atlantic waters. Protection measures have also been adopted by the American states of Hawaii, Oregon, Washington and the more recently California, which effectively ban commercial shark fishing and the shark fin trade off the west coast of the United States. In 2011, the Canadian cities of Toronto, Oakville and Mississauga also adopted shark conservation measures and passed bans on the sale of shark fins, thus targeting the marketing of shark products.

The trend towards conservation by tropical island states has been assisted by the increasing recognition of the value of sharks as a non-consumptive resource for a shark-diving tourism industry that is growing very rapidly (Gallagher and Hammerschlag, 2011). As of 2011, established shark-diving operations are found in at least 83 locations in 29 countries, including tropical and temperate waters around the world (Gallagher and Hammerschlag, 2011). Destinations with well-established shark-diving include countries such as South Africa, the United States and Australia. However, in 2010, island nations of Oceania and the Greater Caribbean together were responsible for approximately 38% of the locations offering dedicated shark encounters for divers (Gallagher and Hammerschlag, 2011).

The analysis of the economic revenues generated by the shark-diving industries across the Indo-Pacific has highlighted the high economic value of sharks as a non-consumptive resource for nations where tourism represents a major part of the economy. In French Polynesia, the dive industry based on interactions with lemon sharks in the lagoon of Moorea Island was estimated to generate approximately US $5.4 million annually (Clua et al. 2011). Similarly, the shark-diving industry in Palau, Micronesia, was estimated to generate US $18 million per year, accounting for approximately 8% of the gross domestic product (GDP) of the country (Vianna et. al. 2010). These studies demonstrate substantial benefits to several sectors of the local economy and the high economic value associated with the conservation of sharks.

The Republic of Fiji is one of the most developed island nations in the Indo-Pacific, with tourism occupying a central role in the economy of the country (Central Inteligence Agency, 2011). Similar to other destinations across the region, nature tourism represents one of the main products of the tourism industry in Fiji (Anon., 2009). The diving industry in Fiji is well-established, with dive centres spread across all the main tourist destinations as well as relatively remote areas. Shark-diving activities have been identified in at least three destinations where they rely on the observation of different species ranging

from reef to large coastal sharks (Gallagher and Hammerschlag, 2011). The shark-diving industry in Fiji has been described as having an important socio-economic role, generating jobs and revenues to local community (Brunnschweiler, 2009), but the amount of this contribution to the economy as a whole in Fiji remains unknown. Here, we address this issue using socio-economic surveys of the main tourism operators of the shark-diving industry and diving tourists visiting Fiji. We quantify the economic value of the shark-diving industry in the country, including the economic revenues generated by divers and the distribution of these revenues to the principal local stakeholders involved with the industry including businesses, government and local community.

Photo: Bull shark (*Carcharhinus leucas*) and shark feeder during shark-feeding dive in Beqa lagoon. Photo by Gabriel Vianna

3. Methods

3.1 Shark-diving in Fiji

Fiji has a well-established diving industry with resorts and independent businesses offering diving operations on the main islands and island groups across the country. Many dive operations in Fiji advertise in-water interactions with sharks. While many of these activities rely on opportunistic sightings, dedicated shark-diving operations exist in specific areas (Table 1). For the purpose of this study, we defined "shark-diving" as a SCUBA dive in which a planned underwater interaction with sharks was the primary attraction of the dive.

3.1.1 Viti Levu

Pacific Harbour and the Coral Coast

Pacific Harbour is the most famous shark-diving destination in Fiji as it offers the opportunity of reliable sightings of a number of species of large sharks. Bull (*Carcharhinus leucas*) and tiger sharks (*Galeocerdo curvier*) represent the main attraction for tourists diving in the area, with 120 and 5 individuals of these species identified at one of the principal dive sites respectively (Neumann pers. comm.). Besides these large coastal sharks, six smaller species are typically sighted, including grey reef (*Carcharhinus amblyrhynchos*), whitetip reef (*Triaenodon obesus*), blacktip reef (*C. melanopterus*), silvertip (*C. albimarginatus*), sicklefin lemon (*Negaprion acutidens*) and tawny nurse (*Nebrius ferrugineus*) sharks.

Two operators specialise in shark-feeding dives, offering dive trips four to five days per week at two dive sites next to Pacific Harbour in Beqa Lagoon (Figure 1). Five resorts and one liveaboard boat operation based in areas nearby have established agreements with one of the shark-diving operators and also bring their divers to observe the shark-feeding operation.

Pacific Harbour in Beqa Lagoon has gained increasing attention of the international diving community as a world-class destination for shark-diving, due to the size, diversity and abundance of sharks and the reliability with which they can be observed. This place is the main attraction for shark-divers visiting Fiji and is located on the southern coast of the main island of Viti Levu close to international airports (Figure 1). This ease of access makes Pacific Harbour a popular destination for both divers that travel to Fiji specifically to see sharks (hereafter termed "dedicated shark-divers") and divers that choose shark-focused dives as just part of a wider experience of diving in Fiji (hereafter termed "casual shark-divers").

In addition to Pacific Harbour, a smaller shark-feeding dive is also operated three times a week from a resort situated at the Coral Coast (southern coast of Viti Levu). This operation relies on attracting divers to engage with approximately 15 whitetip and blacktip reef sharks.

Bligh waters

Dive operators based on the northern coast of Viti Levu (Rakiraki area and Nananu-I-Ra island) (Figure 1) and liveaboard vessels based on Viti Levu offer dive trips to the area of Bligh Waters. This area is advertised mainly as a destination to see soft coral. However, the opportunity to view sharks is the focus of at least one dive (Table 1). Shark-diving operations rely on opportunistic sightings of grey and whitetip reef sharks that occur at a site during specific current conditions, with approximately 10 sharks typically sighted per dive at such times.

3.1.2 Vanua Levu and Taveuni

The area of Vanua Levu and Taveuni includes dive sites at the Koro Sea and Somosomo Strait. Abundant soft corals constitute the main draw card for divers to the area. However operators also advertise shark-diving based on opportunistic sightings at two dive sites (Table 1). On Vanua Levu, a dedicated shark dive focuses on scalloped hammerhead sharks (*Sphyrna lewini*) is offered by at least three dive operators. This dive consists of opportunistic sighting at locations where hammerhead sharks are known to regularly occur. The occurrence of hammerhead sharks is believed to be tide-dependent. Therefore, the dive operators coordinate the trips to optimise the chances of shark sightings that can vary from single individuals to schools of tens of hammerhead sharks.

3.1.3 Mamanuca and Yasawa Islands

At least 16 resorts at the Mamanuca and Yasawa Islands conduct dive operations in the northwest part of Fiji. However, two areas offer shark-diving (Figure 1). Close to Mana Island in the Mamanuca group (Table 1), a site where sharks were formerly fed by dive guides known as The Supermarket, is now visited for opportunistic sightings of reef sharks. Although shark-feeding is no longer a regular activity, relatively high abundances of grey, whitetip and blacktip reef sharks are reputed to remain in the area.

A dedicated shark-feeding dive is offered in the central part of the Yasawa Islands group. Three dive operators from the islands of Tavewa, Nauya-Lailai and Nacula participate in the shark-diving at this site (Figure 1, Table 1), with dives offered twice a week with boats from the three operators bringing divers to the site simultaneously. This operation relies on the presence of grey, whitetip and blacktip reef sharks and occasionally lemon sharks.

3.1.4 Kadavu

The main attraction for divers visiting Kadavu (Figure 1) is the abundance and quality of hard corals of the Great Astrolabe Reef. Shark-diving in this area relies on opportunistic sightings of reef sharks including grey, whitetip and blacktip reef sharks in at least one dive site (Table 1). Besides the opportunistic sightings of sharks, an important draw card for divers visiting Kadavu is the regular and predictable sightings of manta rays (*Manta birostris*).

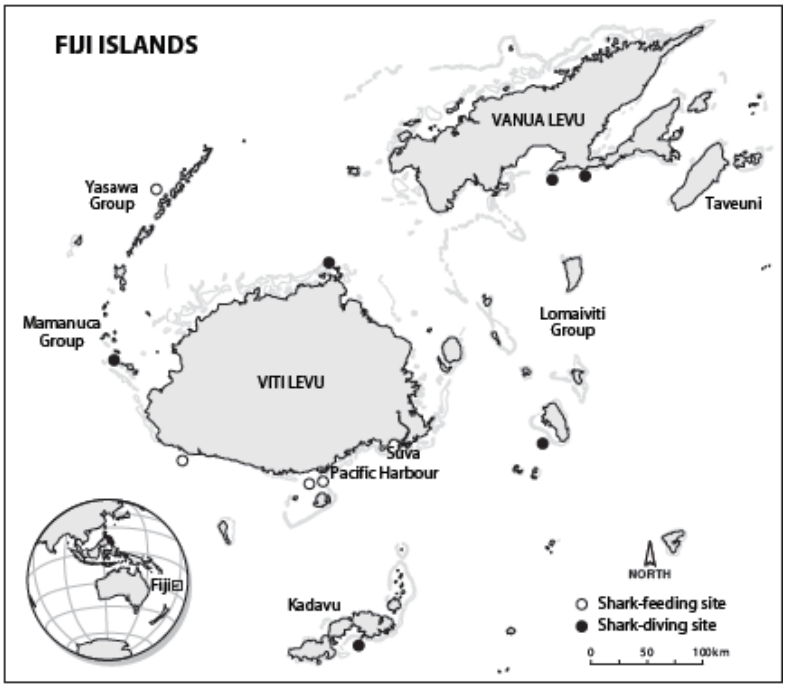

Figure 1. Main shark-diving sites of Fiji identified during survey in 2011.

Table 1. Main shark-diving sites and location in Fiji in 2011.

Dive site	Area	Type of dive	Number of operators	Frequency (days/week)	Most common species
Shark Reef Marine Reserve	Pacific Harbour-Viti Levu	Feeding	1	5	Bull, Tiger, Grey reef, whitetip and blacktip reef sharks
The Bistro	Pacific Harbour-Viti Levu	Feeding	1 (6)*	4	Bull, Tiger, lemon, tawny nurse and silvertip sharks
Breath Taker	Rakiraki-Viti Levu	Opportunistic	4	2	Grey reef, whitetip and blacktip reef sharks
Sand Patch	Coral Coast- Viti Levu	Feeding	1	3	Whitetip and blacktip reef sharks
Dream House	Savusavu-Vanua Levu	Opportunistic	4	1	Hammerhead sharks
Grand Central Station	Savusavu-Vanua Levu	Opportunistic	2	-	Grey reef, tawny nurse, whitetip and blacktip reef sharks
The Cathedral	Yasawa group	Feeding	3	2	Grey reef, lemon, whitetip, blacktip reef sharks
The Supermarket	Mamanuca group	Opportunistic **	-	-	Grey reef, tawny nurse, whitetip and blacktip reef sharks
Eagle Rock	Kadavu	Opportunistic	2	2	Grey reef and whitetip reef sharks
Nigali Pass	Gau Island-Lomai Viti	Opportunistic***	2	2	Grey reef and whitetip reef sharks

* The shark-feeding is operated by a single operator however six other operators are permitted to attend the feeding operation.

**Former shark-feeding site

*** Occasionally used for shark-feeding

3.2 Tourism in Fiji

Similarly to other Pacific Island nations, the Fijian economy relies mainly on primary production and on a tourism industry focused on the natural environment. In 2010, Fiji hosted 631,868 visitors mainly from Australia and New Zealand (66%), Asia (16%), Europe (9%) and North America (10%), who on average stayed in the country for 9.5 days (http://www.statsfiji.gov.fj). In the same year, tourism generated approximately US $558 million in revenues (Anon., 2011) and was responsible for approximately 18% of the gross domestic product (GDP) of the country (US $3,100 million) (International Monetary Fund, 2010). The per capita GDP in Fiji was estimated as US $3,524 per year in 2010.

3.2.1 Survey techniques

The socio-economic survey targeted the main stakeholders involved in the shark-diving industry in Fiji, including tourist divers, dive operators, resort managers, dive guides and members of local communities that retain traditional ownership of the reefs utilized as shark-diving sites (qoliqoli). The survey was based on self-administered questionnaires designed to target each of these groups and collect information regarding the costs and benefit of the shark-diving industry, and builds on the survey used in a similar study in Palau (Vianna et al., 2010). We conducted the onsite survey in August/September 2011, collecting a total of 336 answered questionnaires, primarily focused on divers (Table 2). We distributed questionnaires on the islands of Viti Levu (including the islands of Nananu-i-Ra and Beqa), Vanua Levu, Taveuni and Kadavu, the Yasawa and Mamanuca group.

Questionnaires were answered by 289 divers, 18 dive operators, six resort managers (surveyed at Pacific Harbour and Coral Coast only), 14 dive guides and nine local subsistence fishers (Table 2). This last group consisted of members of a local village that regularly receives payment from shark-diving operators for the usage of the reef of which they are the traditional owners. The tourist questionnaire was structured to obtain information about the demographic characteristics of the divers, their motivations in visiting Fiji, satisfaction with diving experience, and expenditures while in the country. Expenditures were divided among the categories of accommodation, living costs, diving (and shark-diving, when applicable), domestic transfers and other activities while in Fiji (e.g. land tours). Self-administered questionnaires and a printed explanation of the purpose of the research were handed to the divers at the end of the dive trips at dive operators or resorts.

The questionnaire for dive operators obtained information about the characteristics of the business, including number of tourists taking dive trips and their preferences, main dive attractions and activities, information about employees and operators' expectations regarding the dive industry. We also collected detailed information regarding the expenditures related to the diving operation, most notably the expenditures related to the cost of running a shark-diving operation and the expenditures on salaries and contributions to the local communities for usage of traditionally-owned reef. This questionnaire was answered by the main operators engaged in dedicated shark-diving in Fiji, including all the shark-diving operators at Pacific Harbour, the principal destination for shark-diving in the country.

We interviewed 13 Fijian and one English dive guide working for eight different dive operators distributed across the country (Table 2). This sample reflects the high proportion of Fijian citizens employed by the diving industry in the country. The dive-guide questionnaire provided information about the salaries paid by the diving industry, popular shark-diving sites and their characteristics and number of tourists visiting these sites annually.

Since conservation regulations were likely to affect fishing activities, fishers were also surveyed using a standard questionnaire. This provided information about their fishing activities, techniques, level of interaction with sharks, perception of shark conservation and income from fishing. The interviews were conducted at Galoa, which is one of the main villages benefiting from the community levy paid by the shark-diving operators at Pacific Harbour.

All interviews were conducted in accordance with the requirements of the National Statement on Ethical Conduct in Human Research (Australia) and the policies and procedures of The University of Western Australia.

Table 2. Number of questionnaires collected during the survey in Fiji in August/September 2011.

Area	Questionnaires					Estimated no. of dive operators in the area
	Divers	Dive guides	Fishers	Resorts	Dive operators	
Fiji	289	14	9	6	18	-
Viti Levu	196	6	8	6	10	14
Pacific Harbour*	180	4	8	6	2	2 (6)**
Mamanuca/Yasawa group	34	0	1	0	4	16
Vanua Levu/ Taveuni	34	6	0	0	4	10
Kadavu	25	2	0	0	0	5

*Data from Pacific Harbour are a sub-sample of data from Viti Levu.
** These six dive operators are based either at resorts along the Coral Coast or on islands in the area. These operators also attend shark-feeding dives operated from the Pacific Harbour.

3.2.2 Economic variables and data analysis

We took a conservative approach to all calculations in order to reduce the risk of over-estimating the value of shark-diving to the Fijian economy. Our calculations were based on the parameters and estimates calculated from our surveys, combined with official estimates of the number of visitors from the Fiji Bureau of Statistics: (http://www.statsfiji.gov.fj/Tourism/Visitor_Arrivals.htm).

Our key calculations were as follows:

(1) Total number of divers visiting the country (D) was based on the proportion of tourists engaged in dive activities from the Fiji International Visitor Survey 2009 Report, published by the Ministry of Public Enterprises, Communications, Civil Aviation & Tourism (Anon. 2009).
(2) Total revenues from dedicated shark-divers (SD) were calculated as all expenditures of the proportion of surveyed divers visiting Fiji primarily to engage in shark-diving activities. The contribution of this group to the shark-diving industry was termed the shark-diving parameter (SDP).
(3) Total revenues derived from casual shark-divers (CSD) were calculated as a proportion of the expenditures of divers who visited Fiji for reasons other than diving with sharks, but chose to engage in shark-diving while in the country; for this reason expenditures for casual shark divers were allocated as the proportion of their trip spent shark diving, rather than for their entire visit. The contribution of this group to the shark-diving industry was termed the casual shark-diving parameter (CSDP).

A detailed list of variables, parameters, formulas and data sources is presented in Table 3.

Table 3. Description of constants and parameters used to estimate revenues generated by the shark-diving industry in Fiji.

Abbreviation	Constants and estimates	Description	Values	Units	Source	Comments
Fiji						
T	Visitors in Fiji in 2010	Average number of visitors in the area	631,868	No./Year	Bureau of statistics, 2011	
D	Number of divers in 2010	T x 0.1	63,187	No./Year	Anon., 2009	Based on the estimate that 10% of tourists engage on diving activities while in Fiji.
TSD	Total number of shark-divers	SD + CSD	49,286	No./Year	Based on interviews with shark-diving operator managers	Estimate based on the number of shark-divers hosted by each shark-diving operator
SD	Number of dedicated shark-divers	SDP x D	15,165	No./Year		Dedicated shark-diver is defined as a diver who visits Fiji primarily to dive with sharks
CSD	Number of casual shark-divers	CSDP x D	34,121	No./Year	Operators questionnaire	Casual shark-diver is defined as a tourist who visited Fiji for a reason other than shark-diving but was engaged in shark-diving actives while in the country.
SDP	Shark-diving parameter	Proportion of shark-divers	0.24	-	Tourist questionnaire	Calculated as the proportion of divers who answered the questionnaire who were dedicated shark-divers
CSDP	Casual shark-diving parameter	Proportion of casual shark-divers	0.54	-	Tourist questionnaire	Calculated as the proportion of divers who answered the questionnaire who were casual shark-divers
Pacific Harbour						
T harb	Tourists visiting the area in 2010	T Coral Coast/ No of accom. at Coral Coast x no. of accom. at P. Harbour	24,879	No./Year	Estimated based on Anon., 2009, Bureau of statistics, 2010 and 2011	Estimates based on the percentage of tourist spending most of the time in Fiji in this area (Anon., 2009)
D harb	Number of divers per year	Sum of number of divers hosted by each operator	9,205	No./Year	Based on the interviews with dive-operator managers	
TSD harb	Total number of shark-divers	SD + CSD	8,616	No./Year	Based on interviews with shark-diving operator managers	
SD harb	Number of dedicated shark-divers	SDP harb x TD harb	2,836	No./Year		
CSD harb	Number of casual shark-divers	CSDP harb x TD harb	5,780	No./Year		
SDP harb	Shark-diving parameter	Proportion dedicated of shark-divers harb	0.31	-	Tourist questionnaire	
CSDP harb	Casual shark-diving parameter	Proportion of casual shark-divers hard	0.63	-	Tourist questionnaire	

Viti Levu						
T viti	Tourists visiting the area per year	T x 0.62	384,439	No./Year	Based on Anon., 2009, Bureau of statistics, 2011	Calculated based on estimates of the percentage of tourist spending most of the time at this area (Anon., 2009)
D viti	Number of divers per year	Ave. no. divers per operator x no. of operators	19,033	No./Year	Operators questionnaire	
TSD	Total number of shark-divers	SD + CSD	17,320	No./Year	Based on interviews with shark-diving operator managers	
SD viti	Number of shark-divers	D viti x SDP viti	5,329	No./Year	Operators questionnaire	
CSD viti	Number of casual shark-divers	CSDP viti x D viti	11,991	No./Year	Operators questionnaire	
SDP viti	Shark-diving parameter	Proportion of dedicated shark-divers viti	0.28	-	Tourist questionnaire	
CSDP viti	Casual shark-diving parameter	Proportion of casual shark-divers viti	0.63	-	Tourist questionnaire	
Vanua Levu/Taveuni						
T vanu	Tourists visiting the area per year	T x 0.02	12,637	No./Year	Based on Anon., 2009, Bureau of statistics, 2011	
D vanu	Number of divers per year	Ave. no. divers per operator x no. of operators	6,170	No./Year	Operators questionnaire	
TSD	Total number of shark-divers	SD + CSD	3,582	No./Year	Based on interviews with shark-diving operator managers	
SD vanu	Number of shark-divers	D vanu x SDP vanu	796	No./Year	Operators questionnaire	
CSD vanu	Number of casual shark-divers	CSDP vanu x D vanu	2,786	No./Year	Operators questionnaire	
SDP vanu	Shark-diving parameter	Proportion of dedicated shark-divers vanu	0.13	-	Tourist questionnaire	
CSDP vanu	Casual shark-diving parameter	Proportion of casual shark-divers vanu	0.45	-	Tourist questionnaire	
Mamanuca/Yasawa Group						
T maya	Tourists visiting the area per year	T x 0.21	132,692	No./Year	Based on Anon., 2009, Bureau of statistics, 2011	
D maya	Number of divers per year	Ave. no. divers per operator x no. of operators	20,544	No./Year	Operators questionnaire	
TSD	Total number of shark-divers	SD + CSD	10,876	No./Year	Based on interviews with shark-diving operator managers	
SD maya	Number of shark-divers	D maya x SDP maya	2,417	No./Year	Operators questionnaire	
CSD maya	Number of casual shark-divers	CSDP maya x D maya	8,459	No./Year	Operators questionnaire	
SDP maya	Shark-diving parameter	Proportion of dedicated shark-divers maya	0.12	-	Tourist questionnaire	
CSDP maya	Casual shark-diving parameter	Proportion of casual shark-divers maya	0.41	-	Tourist questionnaire	

Our study estimated the total economic revenue generated by the shark-diving industry and the magnitude of the key components of that revenue. We recognize that economic revenue does not equate to net economic benefits from the industry; calculation of this would have required estimates of both the supply and demand curves for shark-diving services, in order to calculate producer and consumer surpluses (Just et al., 2005). This calculation was beyond the scope of this study, given the lack of market data available for statistical analysis of supply or demand. However, revenue provides a useful indicator of the economic importance of the industry, and is consistent with common economic metrics such as GDP. This approach also allows us to focus on economic benefits that are retained within Fiji, whereas much of the producer and consumer surpluses generated by the industry may be captured by foreign businesses and consumers. To further reduce the influence of leakage between sectors of the economy, the analysis of the direct, indirect and induced benefits from shark-diving was restricted to quantifying the revenues obtained by businesses that benefited directly by the presence of shark-divers (i.e. dive operators, hotels, resorts, restaurants and souvenir shops). The calculation of the flow of economic revenues from shark-diving to the local community was restricted to wages provided by the dive operators to their employees and the community levy paid by the dive operators to the villages to use shark-diving sites located at their traditional fishing grounds.

Photo: Bull sharks (*Carcharhinus leucas*) photographed during shark dive at Beqa Lagoon (Pacific Harbour).
Photo by: Gabriel Vianna

Table 4. Description of formulas used to estimate economic revenues generated by the shark-diving industry in Fiji.

Abbreviation	Variables	Formula	Units	Source	Comments
Expenditures					
DET	Diver expenditure per trip	Living costs + Diving expenses + Extra expenses + Transfer expenses	US$/Trip	Tourist questionnaires	Average of the total expenditures in the specified categories by divers. "Extra" includes extras expenses during the trip not specified in the other categories (i.e. souvenirs, land-based tours, etc). Transfer expenses includes domestic transfers only.
DDE	Daily diver expenditure	DET/Length of stay	US$/Day	Tourist questionnaires	
DED	Diver expenditure on dives	Average diving expenses	US$/Trip	Tourist questionnaires	Average expenditure of a diver on dives per trip
DESD	Diver expenditure on shark-diving	Average expense on shark-diving trips	US$/Trip	Tourist questionnaires	
CSDEST	Casual shark-diver expenditure on shark-diving trips	DED x Percentage spent on shark-diving	US$/Trip	Tourist questionnaires	1 day of living costs covers the costs of meals and transfers while in the area.
TDET	Total diver expenditure per trip	DET + DT	US$/Trip		
Business revenues from tourism					
BRSD	Business revenues from dedicated shark-divers	SD x DET	US$/Year		
BRCSD	Business revenues from casual shark-divers	CSD x CSDEST	US$/Year		For this calculation CSD was divided into the sub-classes of divers who visit Fiji primarily for diving and divers who visit Fiji for other activities but were engaged in diving activities while in the country.
BRS	Business revenues from shark-diving	BRSD + BRCSD	US$/Year		
Economic benefits from shark-diving to community					
SSDI	Salaries from shark-diving industry	W x (SD x DED + CSD x DESD)	US$/Year	Operators questionnaire	Expenditure of the shark-diving industry on salaries
CLSD	Community levy from shark-diving	L x TSD	US$/Year		The estimate of CLSD Fiji takes into account solely L harb,L maya and L coral
Tax revenues from shark-diving					
DTSD	Direct taxes from shark-divers	SD x (DET x VAT + DT + HTT/2) + (BRCSD x VAT)	US$/Year		
CTSD	Corporate tax from shark-diving	CT x BRS	US$/Year		CTSD is the sum of revenue taxes from shark-divers from diving, accommodation and other expenses
Costs of shark-diving					
CSDO	Cost of shark-diving operation	C x TSD x DESD	US$/Year	Operators questionnaire	Represents the expenditure of shark-diving operations on: fuel, maintenance, licenses, wages and extra costs of dive operation
Total revenues					
TRS	Total economic revenues from shark-diving	BRCSD + (SD x TDET)	US$/Year		
TTRSD	Total tax revenues from shark-diving	DTSD + CTSD	US$/Year		
DCISD	Direct community income from shark-diving	SSDI + CLSD	US$/Year		

3.2.3 Business revenues from shark-diving

The economic importance of shark-diving varies among areas in Fiji. For this reason, in addition to national estimates of economic revenues of the shark-diving industry we present the local economic revenues from shark-diving for popular diving areas in Fiji (i.e. Viti Levu, Vanua Levu/Taveuni and Mamanuca/Yasawa groups). The economic value of shark-diving in Pacific Harbour is presented both separately and as part of Viti Levu. The lack of official statistics and data from the dive industry prevented calculation of the economic value of shark-diving on Kadavu. However, we present the parameters estimated for the area based on other data collected during the survey.

The annual business revenue from sharks (BRS) in the shark-diving industry and associated businesses was estimated as

$$BRS = BRSD + BRCSD \quad (1)$$

BRSD was the business revenue generated by dedicated shark-divers:

$$BRSD = SD \times DET \quad (1.1)$$

where DET was the average expenditure per dive tourist, per trip (Table 5), and SD was the number of dedicated shark-divers visiting Fiji in a year. BRCSD represented the business revenues from casual shark-divers for the portion of their trip spent shark-diving calculated as

$$BRCSD = CSD \times CSDEST \quad (1.2)$$

where CSD was the number of casual shark-divers (from official statistics and survey data combined – see Table 4) and CSDEST was the expenditure of casual shark-divers on shark-diving trips (Table 4). DET consisted of diving expenses, living costs, (food and accommodation), domestic transfers and other expenditure such as souvenirs (data from surveys), over the duration of the visit to Fiji.

Table 5. Estimates of individual expenditures of divers and shark-divers. All figures are US$.

Area	Diver expenditure on dives (DED)	Diver expenditure on shark-diving (DESD)	Diver expenditure Per trip (DET)	Daily diver expenditure (DDE)	Casual shark-diver expenditure on shark-diving trip (CSDEST)	Total diver expenditure Per trip (TDET)	Living cost	Extra	Transfer
Fiji	555	269	2,300	212	196	2,343	1,168	577	123
Viti Levu	396	254	1,383	329	240	1,426	707	171	110
Pacific Harbour*	406	253	1,368	334	242	1,411	699	158	105
Vanua Levu/Taveuni	554	427	2,899	659	420	2,942	1,386	657	302
Mamanuca/ Yasawa	294	101	789	263	150	832	247	68	180

* Pacific Harbour is a subgroup of Viti Levu.

The total number of divers visiting Fiji annually was estimated as 10% of the number of visitors to Fiji in 2010 (Bureau of Statistics 2011, Anon. 2009). This value was used to estimate the numbers of shark-divers, casual shark-divers and divers not participating in shark diving visiting Fiji annually and thus the annual business revenue from diving tourism as a whole.

3.2.3 Economic benefits to the community

A component of business revenue from shark-diving is dispersed through the Fijian economy by payment of salaries to employees of dive businesses and by regular payments of the community levy by the dive operators. The latter is the fee paid by dive operators to the traditional owners for use of the reef. Together, these two components constituted the direct community income from shark-diving (DCISD), calculated as follows:

$$DCISD = SSDI + CLSD \quad (2)$$

where SSDI represented the salaries paid by the shark-diving industry and defined as

$$SSDI = W (SD \times DED + CSD \times DESD) \quad (2.1)$$

and W was the proportion of dive industry income that was allocated to paying wages and salaries (estimated from the operator questionnaire), DED was diver expenditure on dives, and DESD was the diver expenditure on shark-diving (estimated from tourist questionnaires), (Tables 4 & 6).
The community levy from shark-diving paid to the community annually (CLSD) was calculated as

$$CLSD = L \times TSD \quad (2.2)$$

where L represented the levy paid by each shark-diver to the communities who were the traditional owners of the shark-diving site, and TSD was the total number of shark-divers visiting the site (Tables 4 and 6).

Table 6. Description of tax constants and community levy used to estimate contribution generated by the shark-diving industry in Fiji.

Abbreviation	Constants and parameters	Description	Values	Units	Source	Comments
CT	Corporate income tax		0.28	-		
DT	Departure tax		43	US$/Trip		The airport departure tax is usually prepaid with the air ticket. This tax was increased to US$ 57 in 2011
VAT	Value added tax	Tax on spendings paid by final consumer in all goods and services	0.125	-		Value added tax was increased to 15% in Jan 2011
HTT	Hotel turnover tax	Accommodation cost x 0.05	0.05	-		
W	Wages parameter	Percentage of revenues of dive industry addressed to pay wages	0.22	-	Operators questionnaire	
C	Diving costs parameter	Percentage of revenues of the dive industry used to pay costs of diving operation	0.64	-	Operators questionnaire	Represents the percentage of total revenues spent by dive operators on: fuel, maintenance, licenses, wages and extra costs of dive operation
L harb	Pacific Harbour community levy	Levy to the community paid by divers when engaged in shark-diving	8	US$/Diver	-	This levy is paid directly to the community that retains the traditional ownership of the reef where the shark-diving is operated
L maya	Yasawa community levy		5	US$/Diver	-	
L coral	Coral coast community levy		1.1	US$/Diver	-	

3.2.4 Tax revenue

The tax revenue from the shark-diving industry was composed of two elements. Firstly, the corporate tax from shark-diving (CTSD) included the taxes paid by dive operators and accessory services that could be attributed to the economic revenues generated by shark-divers. This tax was defined as:

$$CTSD = CT \times BRS \quad (3)$$

where CT represented the corporate tax parameter (Table 5).

The second component was the direct tax from shark-divers (DTSD). This included the contributions charged directly to shark-divers (dedicated and casual shark-divers) in all goods and services related to shark-diving while in Fiji and includes the departure taxes paid by shark-divers who visited Fiji primarily to engage in shark-diving activities. This contribution was defined as:

$$DTSD = SD \times (DET \times VAT \times DT + HTT/2) + (BRCSD \times VAT) \quad (4)$$

where VAT represented the Values Added Tax paid by the final consumer for all goods and services in Fiji (Table 5). The departure tax (DT) is usually charged during the purchasing of air ticket and remitted directly to the Fiji Revenue and Customs Authority. The hotel turnover tax (HTT) is the tax contribution on the cost of accommodation, and was divided by two to account for the fact that the majority of tourists visiting Fiji share accommodation between two people (Anon. 2009). The calculation of direct taxes from shark-divers only considered the departure taxes and the hotel turnover taxes paid by dedicated shark-divers as diving with sharks was the primary reason for this group to visit Fiji.

3.2.5 Operational costs of shark-diving

A complete analysis of the operational costs involved in shark-diving tourism would need to include all sectors of the economy of Fiji that provide services to shark-divers. Such an analysis was beyond the scope of the present study. However, we suggest that an analysis of the direct economic cost of shark-diving to diving operators is indicative of the linkages between the shark-diving industry and the general economy of Fiji. Data from the questionnaires supplied to the dive operators provided an estimate of general costs of fuel, equipment maintenance, governmental licenses, wages and extra costs involved in the dive operation in Fiji. The operational cost of shark-diving (CSDO) was then calculated as follows:

$$CSDO = C \times TSD \times DESD \quad (5)$$

where C was the percentage of the business revenues of the dive operators used to cover costs of operation on fuel, maintenance, licenses, wages and extra costs (Table 5).

3.2.6 Total economic revenues from shark-diving

The total economic revenue (TRS) generated by shark-diving in Fiji was defined as business revenue and the departure tax contribution of shark-divers:

$$TRS = BRCSD + (SD \times TDET) \quad (6)$$

where TDET was the diver expenditure per trip combined with departure tax (Tables 4 and 5).

4. Results

4.1 Demographics and profile of respondents

Dedicated shark-divers, those who visited Fiji primarily to dive with sharks, accounted for 24% of all divers we interviewed, with casual shark-divers representing 54% of the divers interviewed. Assuming that these figures are representative, we estimate that in 2010 approximately 49,000 divers were engaged in shark-diving activities in Fiji. This group consisted of both dedicated and casual shark-divers who represented 78% of the 63,000 divers visiting the country (Table 3).

Respondents to our questionnaire were almost exclusively composed of adult divers (98%), with 59% of our sample males and 41% females. These divers originated primarily from Europe (31%), North America (23%) and Australia (23%) (Figures 2 and 3).

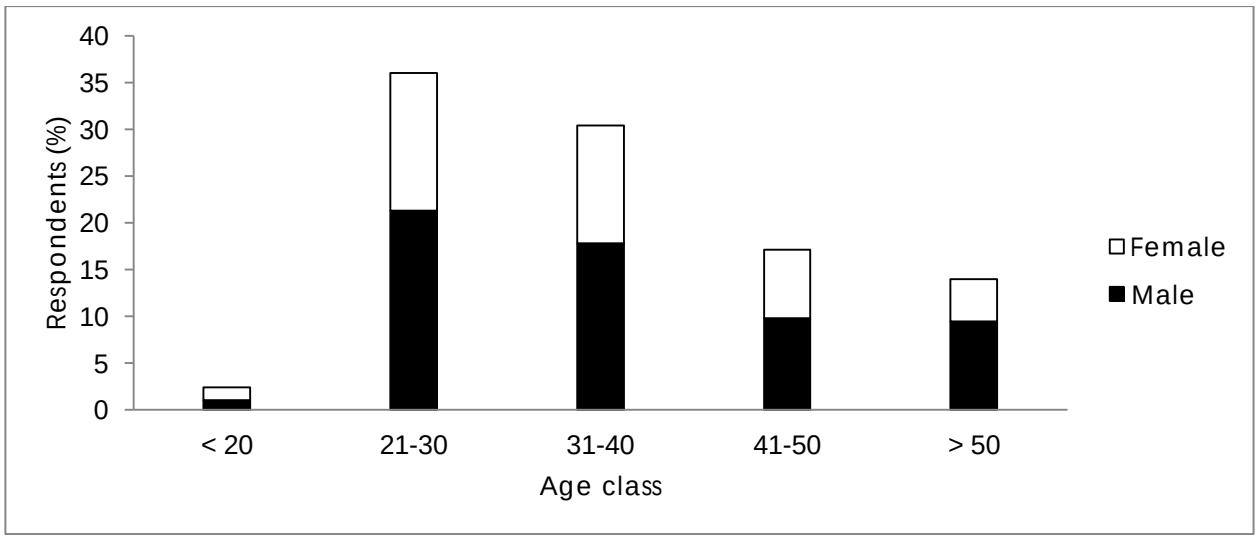

Figure 2. Distribution of divers by age and gender in sample collected during survey in Fiji in August/September 2011.

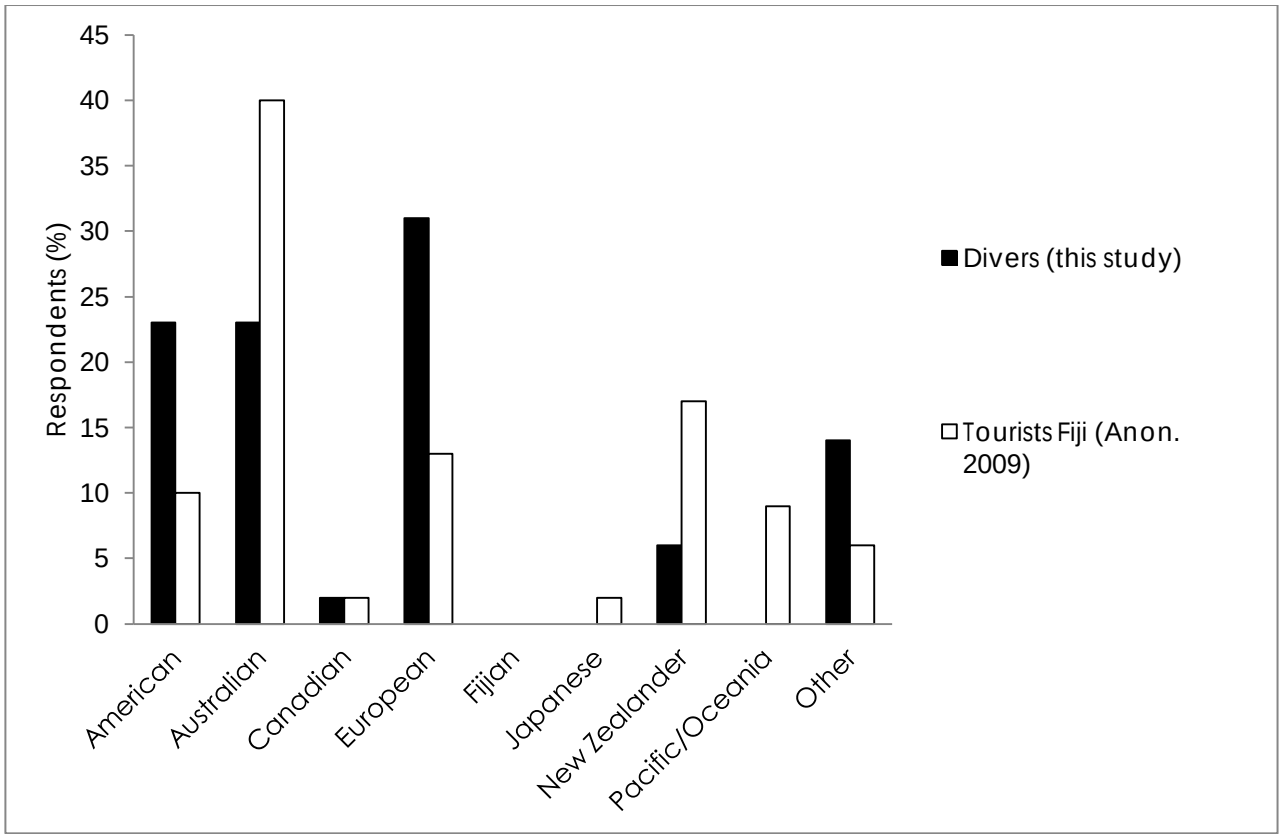

Figure 3. Distribution of divers by area of origin in sample collected during survey in Fiji in August/September 2011, compared with distribution of all tourists (Anon. 2009).

The general level of experience of divers was low, with approximately 30% of divers having completed more than 100 dives. However, dedicated shark-divers tended to be more experienced, with 64% of this group having logged more than 100 dives (Figure 4). Approximately 40% of divers reported an annual income higher than US $80,000 (Figure 5).

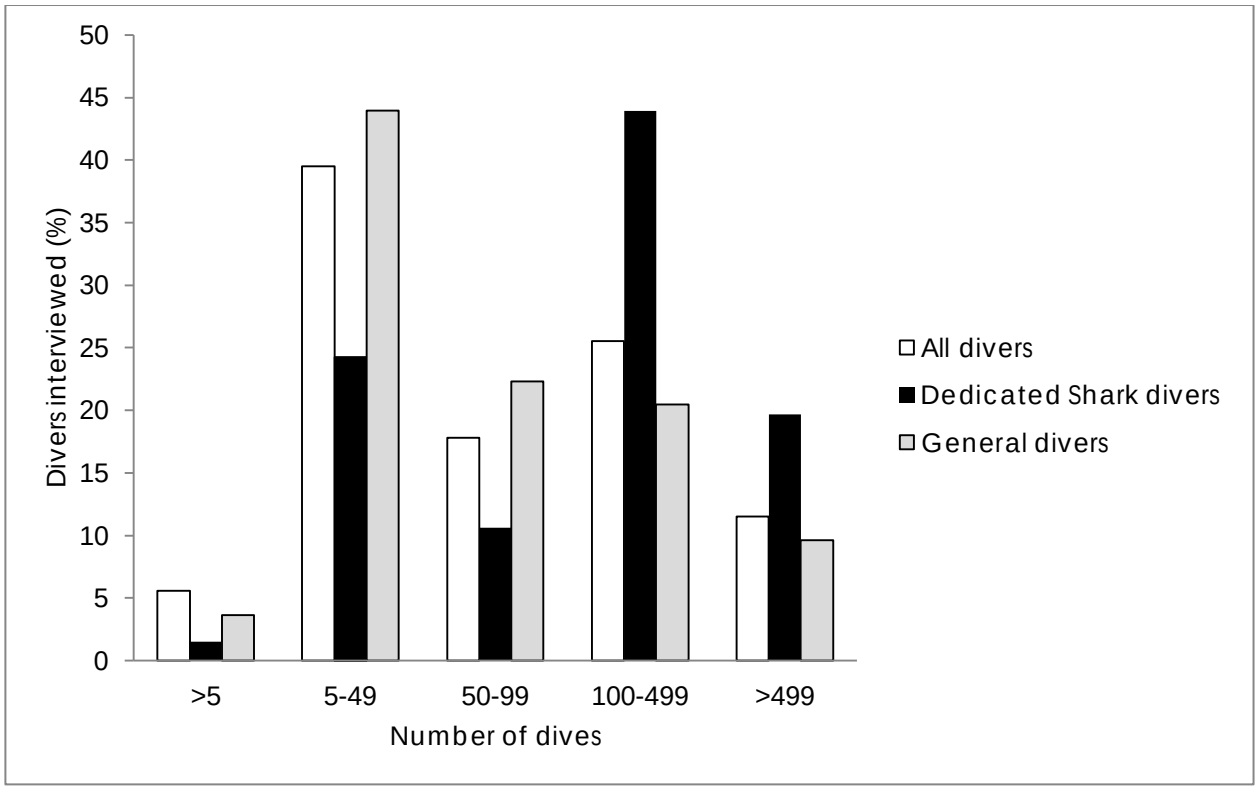

Figure 4. Distribution of divers by diving experience in sample collected during survey in Fiji in August/September 2011.

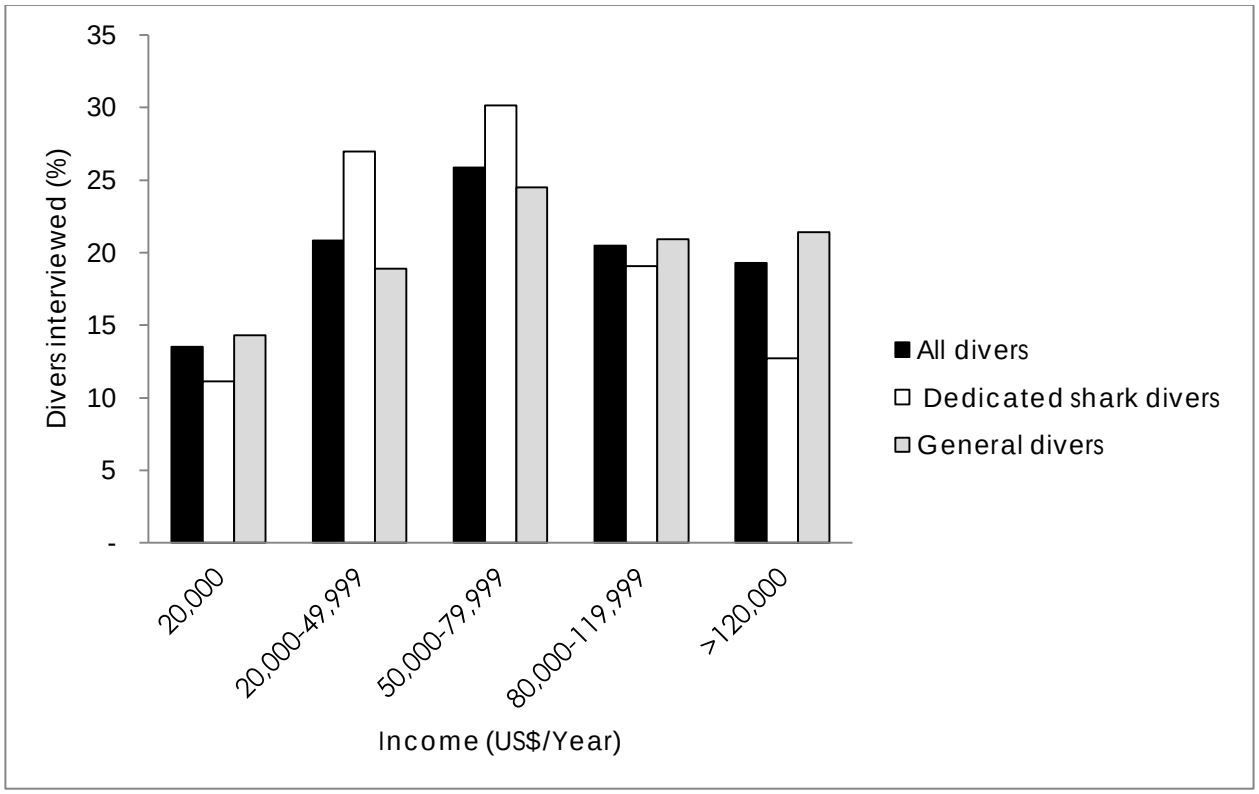

Figure 5. Distribution of divers by income in sample collected during survey in Fiji in August/September 2011.

4.1.1 Shark-diving regions

Viti Levu hosted the largest number (approximately 17,000) of dedicated and casual shark-divers. In this area, Pacific Harbour hosted around 50% of the shark-divers, or approximately 8,600 tourists (Table 3). Of all the divers interviewed in other areas of Fiji, 42% reported they visited Pacific Harbour to dive with sharks while in the country.

The Mamanuca/Yasawa group also hosted a large number of shark-divers, with approximately 11,000 divers engaged in shark-diving activities (Table 3). The area of Vanua Levu/Taveuni hosted approximately 3,600 shark-divers, which represented 58% of the divers visiting the area. Kadavu had the lowest proportion of shark-divers of all regions, with 17% of divers identified as casual shark-divers and no dedicated shark-divers interviewed during our survey.

4.2.2 Business revenues of shark-diving

Based on our estimates of expenditures by divers (Tables 4 and 5) and on the numbers of divers visiting the country provided by official statistics (Bureau of Statistics 2011, Anon. 2009), the diving industry in Fiji generates approximately US $79.5 million in business revenues per year. Shark-diving represents an important sector of this industry accounting for 52% of the business revenues, or approximately US $41.6 million.

Regionally, the shark-diving industry was responsible for generation of US $10.2 million on Viti Levu, accounting for 63% of the business revenues from diving in this area (Table 7). The Mamanuca/Yasawa group hosted the second largest number of shark-divers in Fiji, and generated approximately US $3.2 million in business revenues. The shark-diving industry was less important in the Mamanuca/Yasawa group than in other areas of Fiji, however it was still responsible for 40% of the business revenues from the diving industry in the region.

Table 7. Business revenues from the shark-diving industry in Fiji in 2010. All figures are millions of US$.

Area	Shark-divers (BRSD)	Casual shark-divers (BRCSD)	Total shark-diving (BRS)	Total diving	Relative importance of shark-diving (%)
Viti Levu	7.3	2.9	10.2	16.1	63
Pacific Harbour*	3.9	1.4	5.3	7.9	67
Mamanuca/Yasawa	1.9	1.3	3.2	7.8	40
Vanua Levu/Taveuni	2.3	1.2	3.5	8.1	43

*Data of Pacific Harbour is a sub-sample of data from Viti Levu

4.2.3 Economic benefits to the community from shark-diving

The shark-diving industry in Fiji generated a minimum of US $4 million to local communities annually. These economic benefits could be divided into two components: the first and largest consisted of the salaries paid by the industry to employees and was estimated as US $3.9 million (Table 8). The second was a community levy paid by dive operators (and ultimately by shark-divers) to the villages for the usage of the reef (Table 6) and was estimated to be US $124,200 annually. The distribution of these revenues was restricted to five villages located close to the Pacific Harbour (US $69,900) and at the Mamanuca/Yasawa group (US $54,300). In these two areas, the shark-diving industry payments of salaries in the same period were estimated to be US $575,000 and US $344,000 respectively (Table 8).

Table 8. Salaries generated by the shark-diving industry in Fiji in 2010. All figures are US$.

Area	Salaries from shark-diving industry			Salaries from the diving industry	Relative importance of shark-diving (%)
	Total shark-diving industry (SSDI)	Dedicated shark-divers	Casual shark-divers		
Fiji	3,871,000	1,852,000	2,019,000	7,444,000	52
Viti Levu	1,134,000	464,000	670,000	1,800,000	63
Pacific Harbour*	575,000	253,000	322,000	858,000	67
Mamanuca/Yasawa	344,000	156,000	188,000	861,000	40
Vanua Levu/Taveuni	359,000	97,000	262,000	834,000	43

*Data of Pacific Harbour is a sub-sample of data from Viti Levu

4.2.4 Tax revenues from shark-diving

The total tax contribution of the shark-diving industry in Fiji was estimated as US $17.5 million. This contribution can be divided in two components: the corporate taxes from shark-diving, estimated to be US $11.6 million and the direct taxes from shark-divers estimated as US $5.9 million (Table 9).

Table 9. Tax contribution generated by the shark-diving industry in Fiji in 2010. All figures are millions of US $.

Area	Direct taxes from diving industry				Corporate taxes from diving industry				Total tax revenues from shark-diving (TTRSD)
	Shark-diving total (DTSD)	Dedicated shark-divers	Casual shark-divers	Diving total	Shark-diving total (CTSD)	Dedicated shark-divers	Casual shark-divers	Diving total	
Fiji	5.9	5.0	0.8	11.3	11.6	9.8	1.9	22.4	17.5
Viti Levu	1.5	1.1	0.4	2.4	2.9	2.0	0.8	4.5	4.4
Pacific Harbour	0.8	0.6	0.2	1.2	1.5	1.1	0.4	2.2	2.3
Mamanuca/Yasawa	0.5	0.3	0.2	1.3	0.9	0.5	0.4	2.2	1.4
Vanua Levu/Taveuni	0.5	0.3	0.1	1.1	1.0	0.6	0.3	2.3	1.5

4.2.5 Total revenues from shark-diving

The total contribution of shark-diving to the economy of Fiji was estimated to be US $42.2 million ($35.5 million and $6.7 million from dedicated and casual shark-divers respectively) and was composed of the revenues generated by the industry combined with the departure taxes paid by shark-divers to the government.

5. Discussion

We estimated that the shark-diving industry contributed US $42 million to the Fijian economy in 2010. This revenue came from 49,000 divers or 78% of the total of 63,000 tourists who visited Fiji to dive in that year. These large inputs to the economy highlight the growing awareness among international divers of Fiji as a locality for shark tourism and are consistent with the attitudes of divers towards these animals. Surveys by Brown and Sykes (2011) found that 96% of divers rated sharks as one of the three principal animals they wanted to see on a dive in Fiji and 42% considered sharks as the most important diving attraction.

Our estimates of the total economic value of shark-diving in Fiji were based on the assumption that 10% of the visitors to Fiji were engaged in diving activities (Anon., 2009), the proportion of this group that included dedicated shark-divers (24%) and casual shark-divers (54%) as estimated from our surveys, and from our estimates of expenditures of these two groups on diving (Tables 4 and 5). It was more difficult to assess the value of shark-diving on a regional basis, due to the lack of reliable information about the distribution, numbers and turnover of divers across areas and the location and numbers of dive operators in the country. To estimate the number of divers (and therefore the number of shark-divers) visiting each area, we calculated the average number of divers that used the services of each operator in the area from our questionnaires and multiplied these totals by an estimate of the number of operators in the area. Although there was uncertainty associated with these estimates, our calculation of approximately 46,000 divers visiting three of the four main diving areas in Fiji (Viti Levu, Vanua Levu/Taveuni, Mamanuca/Yasawa group) was in general accordance with the government statistics of 63,000 divers visiting the whole of Fiji (Anon., 2009). These problems with estimating the number of divers on a regional basis (which also did not include the clients of liveaboard operators, seasonal changes in diver numbers and the many small dive businesses in other areas of the country) meant that the total number of divers and the revenues they generated, when summed on a regional basis, were less than the total numbers and revenues calculated from government statistics for Fiji as a whole.

On a regional basis, the most robust estimates for economic value of shark-diving were obtained from Pacific Harbour. Shark-diving at this location focuses on very limited numbers of dive sites and is offered by relatively few operators. The cooperation of these businesses with the survey team allowed a very comprehensive picture of the economic flows from this activity to be constructed. Tourism operations at Pacific Harbour are one of the principal draw cards for shark-diving tourism in Fiji. Shark-diving here has received considerable media attention and promotion (see for example, http://www.fijisharkdive.com/shark-media) and Pacific Harbour is conveniently situated near to the international airports, the major entry and exit points for tourists to the country. Thus, the shark-diving at Pacific Harbour can be easily accessed even if it is not a primary objective of a diving holiday. Indeed, many of the casual shark-divers we interviewed considered a dive with sharks at Pacific Harbour as an important part of their holiday that was pursued while in transit to other diving and resort destinations in Fiji.

Overall, the dive operations at Pacific Harbour were a major contributor to the revenues from shark-diving to Fiji. A total of 8,600 visitors were involved in shark-diving at this locality in 2010 providing approximately US $5.3 million in revenue. This economic contribution is likely to increase in the future given the rapid increase in tourism to this locality and the growing international reputation of the experience among divers. The increasing popularity is shown by a time series of diver participation statistics from a single operator who in 2004 attracted 700 divers. Participation doubled to 1,400 divers only two years later (Brunnschweiler 2009) and more than doubled again in 2010 to 3,000 divers (data from our study). Our interviews of the divers from these operations revealed that the opportunity to dive (safely) in close proximity with bull and tiger sharks that have a reputation as potentially very dangerous was the principal factor that drew divers to participate in this form of tourism. The diversity

(up to eight species), abundance (more than 120 individual bull sharks identified at one site with typically more than 10 sighted in a single dive), and size of the animals (many individuals over 2 metres in length) were also important factors on the decision of divers to engage in this shark-feeding dive . Most of the divers were aware of the shark dives at Pacific Harbour in their home countries prior to making the trip to Fiji and for 31% of the divers visiting the area, diving at this location was a principal reason for visiting the country, even if they then continued on to other islands in Fiji.

Shark-diving at Pacific Harbour generated revenues similar to those of Moorea Island in French Polynesia where provisioning of lemon sharks is also a feature of the experience offered to diving tourists. Clua et al. (2011) estimated that a total of 12,623 shark-divers visited Moorea per year, of which 7017 were dedicated shark-divers (i.e. tourists and locals whose main purpose of their visit was to dive with sharks, as defined by our study). Of the total number of shark-divers, 3968 were international tourists and of these, 27% visited Moorea primarily to go shark-diving, a proportion very similar the number of tourists visiting Fiji for the same purpose. Additionally, the estimate of annual revenue generated by Clua et al. (2011) for shark-diving in Moorea (US $5.4 m) was very close to our calculation for Pacific Harbour (US $5.3 m). Clua et al. (2011) suggested that revenues provided by international visitors were by far the largest portion (at US $5.2 m) of the total from shark-diving, although these data must be treated with caution since their estimates were based on assumed expenditure on food, flights and accommodation rather than information provided by divers.

Aliwal Shoal in South Africa also offers a shark-diving experience comparable to Pacific Harbour. At this shoal, operators use food provisioning to attract mainly large tiger sharks for viewing by divers. Dicken and Hosking (2009) estimated that in 2007, this industry was worth US $1.8 million per year in revenue to the region. The lower income at this locality relative to Moorea and Fiji reflects the smaller number of participants (only 1,065 divers). However if shark-diving tourism has been growing at a similar rate in South Africa as the Pacific, then the calculations by Dicken and Hosking (2009) are now almost certainly underestimates. Overall, differences in revenue from shark-diving in Fiji, French Polynesia and South Africa are likely due to the much larger market for diving tourism in Fiji compared to the other localities.

The provisioning of food for sharks is a feature common to businesses at Pacific Harbour, Moorea and Aliwal Shoal. Operators argue that this allows the experience offered to tourists to be of a high quality in terms of predictability, abundance and size of sharks. In turn, this means that they are able to promote these dives very widely with confidence that tourist expectations will generally be satisfied (e.g. Dicken and Hosking 2009). This is very important given the high running costs in terms of logistics (boats, fuel etc) and staff. However, shark-diving in other areas of Fiji generated revenue that was almost eight times that of Pacific Harbour and relatively few of these operators offered provisioning as part of the diving experience. This shows that opportunities for shark interactions for divers that do not involve provisioning are just as important (if not more so) than those where food is supplied to sharks. Evidence that provisioning is not necessarily a prerequisite for development of a shark-diving industry is shown in Palau, where none of the dive operators provide food for sharks. In 2010, approximately 8,600 tourists (21% of total tourist numbers) were categorised by Vianna et al. (2010) as shark-divers. These tourists generated revenues of US $18 million (or 8% of the GDP of Palau), including tax income for the Palauan Government of US $1.5 million and salaries to locals employed by the industry of US $1.2 million (Vianna et al. 2010). Similarly, our study shows that revenues of US $3.5 million per year for shark-diving can be generated by an industry based on opportunistic sightings of hammerhead sharks in Vanua Levu in Fiji.

In contrast to Pacific Harbour, shark-diving at other localities in Fiji was not necessarily seen as the principal goal of the diving trip. Rather, these dives were seen as an important addition to a holiday that had objectives other than just diving with sharks (e.g. viewing a variety of colourful marine life, fish and corals). However, it is interesting to note that most dive operators promoted some form of shark-diving experience irrespective of their location. In part, this may have been due to a perceived need to compete for tourism with the opportunities available at Pacific Harbour, but few operations in other areas of Fiji offered provisioning of sharks as a part of the shark-diving experience.

Our study sampled most of the principal areas in Fiji that host shark-divers and is thus likely to be representative of the tourists visiting the country for this pastime. However, in outlying regions, lower numbers of diving tourists reduced sample sizes and this increased uncertainty in estimates. Our estimate of the number of diving tourists visiting Fiji each year (10% of the total) was provided by government sources (Anon., 2009). Although we made an effort to cover a large range of dive operations, unequal distribution of divers across the areas, variations in the size of operations and restricted access to operator's information are probable sources of uncertainty in our estimates of numbers of divers on a regional basis. Furthermore, we conducted the survey during the months of August and September and could not examine seasonal changes in visitor numbers. Thus, our calculations are based on annual figures for numbers of divers using the services of dive operators. The estimates of salaries provided by the shark-diving industry to the local community were based solely on the salaries generated by operators (Table 4). This approach was likely to underestimate the total contribution, since the input of businesses providing services to shark-divers was not included. We adopted this conservative approach due to the lack of an appropriate wage parameter (Tables 4 and 6).

In addition to economic benefits, recognition of the importance of sharks as a draw card for tourists has had some important conservation outcomes in Fiji. The economic value of the shark-diving industry was responsible for the creation of the Shark Reef Marine Reserve in Beqa Lagoon that elevated the status of the shark-feeding site and the surroundings to no-take marine protected areas (MPAs) supported by the local communities. A levy charged on divers is distributed to the villages of traditional owners of the reef in compensation for the loss of income due to the cessation of fishing and MPA boundaries are patrolled to ensure compliance (Brunnschweiler, 2009). Similarly, unofficial and official bans on shark fishing have been imposed on a number of other dive sites throughout the region such as in parts of the Yasawa group, Vanua Levu and Taveuni. Conservation is also aided by awareness-raising by operators of long-term (monthly, yearly) trends in shark numbers. When businesses have a vested interest in healthy populations of sharks, monitoring trends in numbers over time (formally or informally) can become a part of dive operations. In some cases, this information has been made available to researchers for detailed analysis, which provides useful scientific insights into the status and the ecology of these animals (Brunnschweiler and Baensch, 2011).

In summary, we have shown that shark-diving provides very significant economic revenue to Fiji that is likely to grow in the future if current trends in diving tourism continue and shark populations remain in place. Diving at Beqa Lagoon provides the centrepiece of this industry, but is by no means the major revenue earner; shark-diving occurs throughout Fiji and is a feature of the diving experience offered in all localities we visited during this study. The revenues from shark-diving flow through to local Fijians through the provision of salaries and service to the industry and have played a significant role in the conservation of reefs through systems of traditional ownership. For these reasons, shark-diving provides a model for the non-extractive use of reef resources for the benefit of both local people and the reef ecosystem itself.

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