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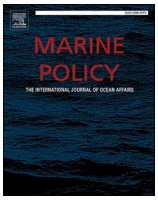

Economic impact and conservation potential of shark-diving tourism in the Azores Islands

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ABSTRACT

Shark-diving tourism is an emerging industry in the Azores Islands. However, this industry directly competes with fishing, as both exploiting the same highly migratory shark species. This study quantifies the commercial value of the Azorean shark-diving industry based on a survey of dive tourists and local dive operators and the potential of this industry to further generate funds for implementation of direct conservation actions. The economic contribution of the shark-diving industry to the regional economy of the Azores in 2019 was estimated to be just over USD $ 1 Million. The results of a spiked censored interval data model of contingent valuation indicated that implementation of an extra conservation fee per dive trip, to be paid by dive tourists, could potentially yield over USD $ 103,000 per year to be used for management and enforcement of a proposed MPA for sharks around the dive sites. Our analysis suggests that the emerging shark-diving industry in the Azores Islands has potential to grow throughout the Macaronesian archipelago, thereby increasing tax revenues and the number of jobs and income to Azorean local communities, potentially promoting conservation and sustainable use of the shark populations. However, expansion of this industry into a robust contributor to the archipelago's economy would require a concomitant strengthening of industry regulation, and support by the government, to protect businesses and investments. This could be partially obtained through improving in fisheries management, implementation of a functional MPA and adequate enforcement.

1. Introduction

The Azores is an increasingly popular destination for nature-based tourism, receiving more than 600,000 visitors each year [5]. Tourists are mainly attracted by the archipelago's landscapes and marine-related activities such as sailing, surfing, whale and dolphin watching and, more recently, scuba and shark diving [10]. In the Azores shark diving is a summer season activity that began in 2011 [7], growing in popularity among European tourists due to the reliability of encounters and quality of experience. The Azores has the only specialized shark-diving industry in the Macaronesian Region [30], targeting pelagic shark species such as shortfin mako sharks (*Isurinus oxyrinchus*) and, primarily, blue sharks (*Prionace glauca*, [7]). This industry was estimated to generate a total economic contribution of over USD $ 2 million in 2014 [63], and has shown signs of increasing demand over the last decade.

Observing sharks in their natural habitat using snorkel or scuba gear (from here on defined as shark diving) is an activity that is rapidly growing in popularity globally [26], with nearly 600,000 participants engaged in this industry each year [78]. This type of non-consumptive use of sharks generates substantial benefits to local and regional economies in several countries through direct business revenues, regional and national taxes, jobs creation and indirect revenues to accessory services such as accommodation, food and transport [31,36,44,61,66–68,77]. For tropical island economies, which often rely on marine tourism as a major source of revenues, the contribution of the shark-diving industry can be considerable, and may account for an important fraction of their Gross Domestic Product [67].

Contrastingly, many of the shark species on which shark-diving tourism industry relies on are exposed to unsustainable and unmanaged fisheries [73]. In the Azorean waters, blue shark and shortfin mako shark are historically caught by-catch by European industrial longlines fisheries targeting swordfish [20,57,62]. However, a recent global

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analysis found that industrial fishing activities in the North Atlantic have an 80% overlap with the space use of blue sharks and suggest that these species are now targeted [50]. Despite certain shark fishing regulations, which have been established by the European Union forbidding the catch and trade of some shark species (e.g. hammerhead, thresher sharks or deep water sharks), and an overall ban on shark finning since 2003, catches of blue and shortfin mako shark in the Azores are still largely unregulated, leading to regional population declines [11,62,73].

Shark-diving tourism has, in certain contexts, played a key role in demonstrating a new paradigm for viewing sharks as a renewable, socio-economically valuable, and non-consumptive resource when compared to fishing [26,28,65]. The economic benefits brought by shark diving may provide strong incentives for the implementation of management strategies that seek to maintain healthy populations of sharks [68]. Globally, there is an increase in the number of Marine Protected Areas (MPAs) designated for sharks, as well as national-level conservation measures to prohibit sharks being caught and killed (e.g. shark sanctuaries), many of which appear to occur within key shark-diving destinations [27]. These MPAs have been suggested as instruments for protecting or restoring shark populations worldwide [21,29,35,70]. However, the displacement of fishing activities and resulting social impact caused by the implementation of these MPAs is a complex issue, driven by challenges around access to adequate resources for financial compensation to local communities, as well as those related to monitoring and surveillance to ensure the effectiveness of MPAs [23,74].

To overcome some of the financial challenges of establishment and enforcement of shark-related MPAs, a sustainable financial option may include fee payments levied on tourists and operators engaging shark-diving trips. Previous studies have shown that dive tourists are often willing to pay to support the enforcement of MPAs for shark conservation in dive destinations where they have experienced shark-diving activities [31,63,68]. This mechanism has been suggested as a strategy to assist funding the effective implementation of conservation measures and to assist transition of local communities to sustainable activities integrated to the emerging shark-diving industry [68].

1.1. Economic valuation of shark-diving tourism

Economic valuations have played an increasingly important role in shaping policy decisions regarding the conservation and management of wildlife, including sharks [16,27]. Although there are no reliable global measures of the economic impact of wildlife tourism [33], a range of methods have been employed to estimate the total economic impact of this industry, from the consideration of the aggregated value of production through the volume of tour or access ticketing revenues, to the utilization of intersectoral macroeconomic impact modeling through Input Output Analysis [15].

In the case of shark-diving tourism, socio-economic studies have been conducted at many scales, providing an overview of the contribution of shark-diving industry to regional and national economies (e.g. [79], [78], [17,26,31,36,44,48,66,67,63,77]. Industry-wide valuations and economic assessments are well established within the scientific literature; however, inconsistencies in methods among studies and time lags among estimates may limit the ability to compare and combine studies to provide global estimates for the industry [27].

In more recent years, standardized valuation methods have been used in several countries around the world. These valuation studies have quantified the direct and indirect expenditures of participants engaged in shark-diving, quantifying similar metrics to assess the economic impact of shark-diving tourism and benefits for the locations where the activity is established (e.g. [31,36,45,66–68]).

1.2. Contingent valuation

The contingent valuation method (CVM) is a non-market valuation approach commonly utilized to determine the "willingness to pay" (WTP) of individuals for the provision of non-market environmental goods or services, or for public policies that have not yet been implemented [32,34,49]. Contingent valuation method studies have been successfully used in combination to shark-diving economic impact studies as a tool to investigate the potential established shark-diving operations may have to finance the implementation of shark conservation strategies in the absence of governmental financial support [68]. The CVM has also been used extensively to understand values associated with marine species conservation such as turtles [16,60,72], whales [42,53], manatees [59], penguins [41], and sharks [3,37,68].

Based on the utility maximization principle of welfare economics [9], the CVM reveals respondents' WTP for hypothetical quality or quantity changes of marine tourism resources. Data collection is based on a survey questionnaire that poses individuals with a tradeoff between market and non-market values [75]. The CVM is a widely used technique which offers flexibility as it is capable of capturing all components of Total Economic Value (TEV) including use and non-use values; allows the valuation of environmental changes that have not yet occurred; provides a full socio-demographic profile of the target population; allows contingent scenarios to be designed to directly elicit the value of the change under scrutiny and allows a better alignment of public expectations and political initiatives as the valuation process is submitted to public discussion [2].

However, CVM studies have been subject to some criticisms [64,71] due the potential emergence of some biases in the survey responses, such as hypothetical bias, information bias, protest response bias, elicitation format bias and scope effect [25,53]. For example, individual responses relying upon a hypothetical scenario, respondents may have less awareness of the proposed valuation and change of interests, and other biases associated with the selection of eliciting formats and the type of payment vehicles used [12]. However, the CVM is generally recognized as a technique that can lead to sufficiently reliable estimates if specific guidelines or protocols are followed [2]. In particular, scholars need to be cautious about potential biases and try to control by employing adequate survey design, maintaining the adequacy of samples, developing a well-narrated hypothetical scenario, and employing appropriate eliciting formats and payment vehicles (e.g. [4,16,68]). Thus, when adequately designed, CVM may offer useful insights of the potential of groups of respondents to provide financial support to specific conservation strategies, such as the creation and maintenance of MPAs [68].

This study aims to assess the regional economic contribution of the shark-diving industry in the Azores Islands based on dive tourists' expenditure and its potential to finance shark conservation strategies through dive tourists' willingness to pay. We combined these two approaches to provide a more comprehensive understanding of the potential of the Azorean shark-diving industry for conservation of two commercially important oceanic shark species: blue and shortfin mako shark. Thus, we present a standardized and robust analysis of the socio-economic impact of the shark-diving industry in the Azores using survey data and provide an analysis on the potential of shark-diving tourism to assist financial support for the establishment of a shark-related marine protected area.

2. Methods

2.1. Study site

The Azores Islands is considered the most remote oceanic archipelago in the North Atlantic and is located about 1600 kilometers from the west of mainland Portugal coast and 3900 kilometers from the east coast of North America. It is one of the two autonomous regions of Portugal, together with Madeira, and accounts for over 2% of the Portuguese population (above 247,000 inhabitants). This archipelago encompasses an area of 2333 km^2 and is formed by nine volcanic islands divided in 3 groups: The Eastern Group of São Miguel and Santa Maria, the Central Group of Terceira, Graciosa, São Jorge, Pico and Faial, and the Western

Group of Flores and Corvo (Fig. 1).

The Azores is one of the outermost regions of Europe and faces specific social and economic challenges such as the remoteness, insularity, small size, changeable climate, economic dependence on a few products [39] and the fragmentation and dispersion of its internal market [19]. The current drivers of the Azorean economy are agriculture, agro-industries, fisheries and tourism [22]. The latter has been seen by the Regional Government of the Azores as a strategic activity since the mid-1990s and public policies such as the expansion of accommodation capacity, international touristic promotion and airline liberalization have been adopted [69].

2.2. Shark-diving tourism in the Azores Islands

Diving with sharks in the Azorean archipelago started experimentally in 2009–2010 with expeditions around Pico and Faial Islands seeking to explore the potential of this activity in the region [54]. However, it was not until 2011 that it began as an industry [63]. Scuba-diving season lasts from June to October, during summer months, though shark-diving activities are mostly operated from July to September. According to Gonzáles-Mantilla et al. [30], eight diving centers were conducting dedicated shark-diving operations in 2019 (over 13% of the total Azorean diving industry); however, four Azorean diving centers receive between 80% and 90% of the total number of shark-diving tourists in the region. These diving centers are established equally on Faial and Pico Islands, with two centers on each island (Fig. 1). Despite being partially foreign-owned, local workers are also engaged in the business as skippers, dive guides and general staff.

The blue shark is the main specie targeted by shark-diving operations in the Azores; however, shortfin mako shark may occasionally be observed. According to dive operators, the number of sightings of the latter has reduced compared to few years ago when this specie was sighed in roughly 30% of the shark-dive trips. There are mainly two shark-diving sites: Pedra de Sousa, located at seven nautical miles northeast from port of Horta, and Condor Bank, at 20 nautical miles southwest from the same port. Due to the remoteness of Condor Bank from the ports of Horta and Madalena (roughly three hours on vessel), most of the operations occur in Pedra de Sousa (less than one hour on vessel). The frequency and abundance of blue sharks vary in each dive site during the season, therefore diving centers maintain regular communication with the Department of Oceanography and Fisheries (DOP) of the University of the Azores at Horta exchanging information about the location with highest probability for shark sightseeing.

Shark-diving operations in the Azores are conducted as half-day trips in offshore waters. Dive operators deploy a bait bucket containing a mixture of blood, tuna and cut sardines, to lure sharks to the vessel. The shark-diving trip may last between four and six hours, depending on how long it takes for the sharks to arrive (from 30 min to 3 h). A maximum of eight dive tourists and one dive guide may enter the water under at a given time. Dives are performed in pelagic waters (sea floor at 200 m) but to a maximum dive depth of 10 m. All the operations are performed under the code of conduct established by the Regional Government of the Azores. This code, developed in 2012 between two regional secretaries (Tourism and Ocean), four operators, and the University of the Azores, addresses activity preparation, human safety, animal wellbeing, diver attitude, and miscellaneous concerns [7].

The cost per shark-diving trip varies according to diver expertize and diving center ranging from € 175 (USD $ 194) to € 195 (USD $ 216). Whereas in Faial, the cost per dive ranges between € 165 (USD $ 183) and € 170 (USD $ 188). Faial diving centers also provided snorkeling with sharks with a cost between € 140 (USD $ 155) and € 150 (USD $ 166). Furthermore, all diving centers advertise dive packages, which may include accommodation, dive activities and, in some cases, international flights.

2.3. Tourist questionnaire

Dive tourist questionnaires were developed to document not only the diver's trip expenses but also their willingness to pay (WTP) for the enforcement and management of a MPA for sharks. Prior to data

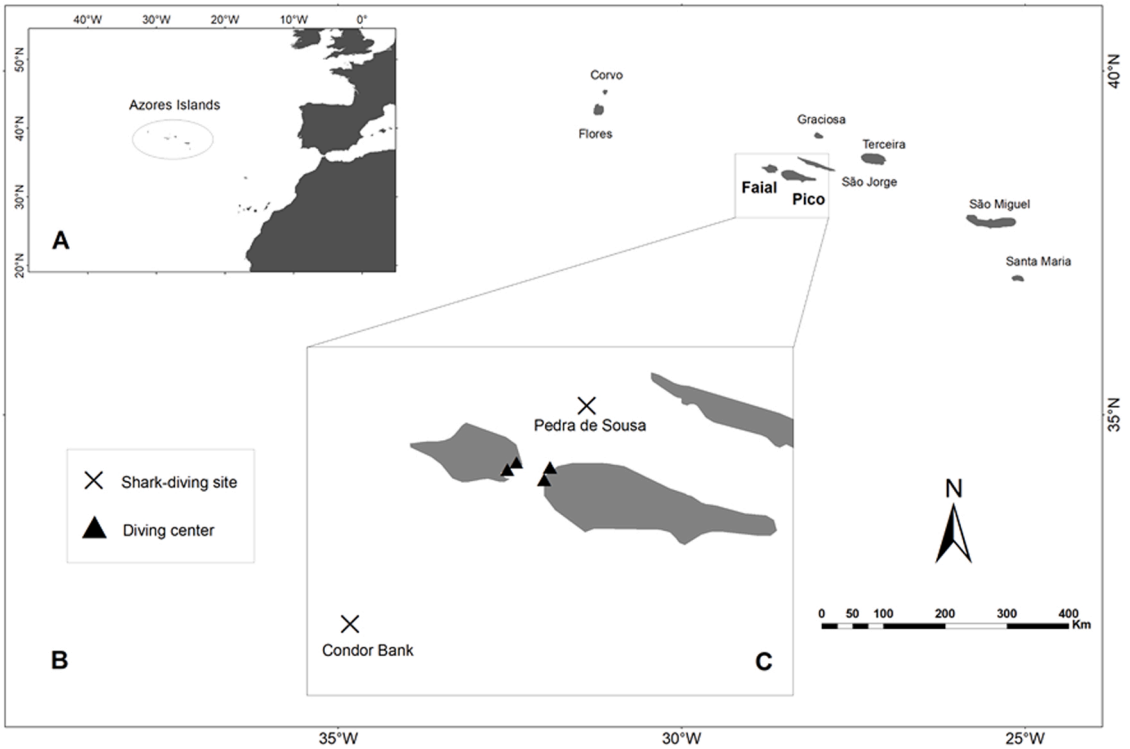

Fig. 1. (A) Geographic location of the Azores Islands, (B) Geographic location of Faial and Pico Islands in the Azores archipelago, (C) Location of shark-diving sites and the four main diving centers providing shark-diving operations in the Azores Islands.

collection, a pilot survey of 30 dive tourists at different shark-diving centers was conducted for testing the questionnaire. The survey (Supplementary material) was divided into 3 sections: a) motivation for visiting the Azores Islands; b) the expenditure while in the Azores; and c) satisfaction with the shark-diving experience. Each section constituted of five-10 objective questions.

The first section of the questionnaire collected information about the following aspects: number of times visiting the Azores; main reason for visiting this region; and number of days spending on shark-diving activities. The expenditures while in the region included: total expenses (excluding international flights); and expenses per item (food and drinks, accommodation, local transport, souvenirs and gifts, diving, shark diving, tourist activities, international flights, domestic flights and other expenses). The last section of the questionnaire was focused on: average number of sharks sighted; satisfaction with the operation on a scale from 1 (poor) to 5 (excellent) in terms of: number of sharks sighted, quality of interaction with sharks and total satisfaction; likeliness to recommend or repeat the activity, and a specific question if they would have come to the region if there were not sharks to be sighted. In this section we also included two contingent valuation questions, in which divers were asked for their maximum WTP by an extra daily fee to provide resources for enforcement and management of a MPA for sharks in the Azores, as well as an extra daily fee for the enjoyment of the shark-diving activity if the cost of the operation increased. Furthermore, we included a question regarding suggestions of where the extra amount should be invested (e.g. diver security, shark conservation, etc.).

2.4. Operator questionnaire

Questionnaires for the dive operators aimed to obtain information about the characteristics of the business and expenditures of the diving operation. The data gathered included: a) number of tourists involved in general dive trips and shark-diving trips; b) main dive attractions and activities; c) shark-diving sites; d) frequency of shark encounters; e) operational costs; f) employment; g) expectations regarding the dive industry in the region and enforcement of a MPA for sharks.

2.5. Survey implementation

The on-site surveys were conducted between August and October 2019 with the four main Azorean diving centers providing shark-diving trips, which accounted for 85% of the total shark-diving industry, based in Faial and Pico Islands. The surveys targeted separately both shark-diving tourists and dive operators. These self-administrated questionnaires were designed based on the standardized methodology described by Vianna et al. and largely applied for shark-diving economic impact valuation studies [31,36,45,66–68], including the Azorean industry assessment in 2014 [63]. Additionally, we also used the information gathered through personal inquiries to the main authors of these studies.

Questionnaires were distributed to dive tourists of the targeted dive centers in the ports of Horta (Faial Island) and Madalena (Pico Island). The tourist survey was performed under the supervision of the principal researcher with a brief introduction about the research. Most of the questionnaires were issued to the dive tourists once they returned from shark-diving trips. Some other respondents were personally contacted on the following days of the operation at the dive centers or the surroundings as they still remained on the island.

2.6. Estimates of regional economic impact from shark-diving tourism

The regional economic contribution yielded by the shark-diving industry in the Azores was estimated based on combined data from all individual divers' expenditures and characteristics of the dive operators' business. These estimates capture the business revenues brought to the region by the shark-diving industry in terms of: a) the direct and indirect business revenues; b) business tax revenues; and c) the revenues to the local community in the form of salaries [66]. Direct business revenues included the revenues of shark-diving operators and indirect business revenues included accessories services such as hotels, restaurants, car rentals, tourism operators, regional airlines, and souvenir shops. Dive tourists were classified into two categories: (1) dedicated shark divers and (2) opportunistic shark divers. The first category included those divers who stated that they would not have visited the Azores if they could not dive with sharks. Thus, all associated traveling expenditures for these divers, and calculation of associated benefits, can be attributed directly to shark-diving tourism. Opportunistic shark divers included those divers who would have visit the Azores regardless of the possibility to dive with sharks. Expenditures were calculated for opportunistic shark divers based on the average number of days diving with sharks and for dedicated shark divers based on the average number of days staying in the Azores. To further reduce the influence of leakage between sectors of the economy, the analysis of total revenues from shark diving did not include international flights. The total number of shark-diving tourists in the Azores Islands in 2019 was provided by the combined set of dive operators. The average expenditure of divers was calculated based on the data collected in the tourist survey. The average daily expenditure of dedicated and opportunistic shark divers was assumed as the same. The economic variables and formulas for data analyses are shown in Table 1 and Supplementary data.

We recognized that our estimates of business revenues are a supply side approximation of tourist expenditure and do not equate to the total economic benefits from the shark-diving industry since shark-diving

Table 1
Description of constants and parameters used to estimate revenues generated by the shark-diving industry in the Azores Islands.

Variable		Description (units)	Values	Source
D	# divers	Total number of dive tourists in the Azorean diving centers advertising shark-diving trips (#/yr)	20,140	Dive operator questionnaire
SD	# shark divers per year	Total number of dive tourists engaged in shark-diving operations in the Azores (#/yr)	1007	Dive operator questionnaire
DSD	# dedicated shark divers per year	Estimated number of dedicated shark divers visiting the Azores per year (#/yr)	306	Dive operator questionnaire
SDF	Shark divers' fraction	Proportion of dive tourists engaged in shark-diving operations (SD/D)	0.05	Dive operator questionnaire
DSDF	Dedicated shark divers' fraction	Proportion of dedicated shark divers (DSD/SD)	0.3	Tourist questionnaire
W	Wages	Average salary of employees of shark-diving industry in the Azores (€/yr)	8740	Dive operator questionnaire
BT	Business tax contribution	Minimum tax rate contribution from shark-diving businesses	0.04	Dive operator questionnaire
E	Number of employees	Estimated number of local employees in the shark-dive industry in the Azores	53	Dive operator questionnaire
A	Average days of diving	Average number of days diving with sharks in the Azores (days)	2.7	Tourist questionnaire
T	Average days of trip	Average number of days staying in the Azores	11.5	Tourist questionnaire

services contribute to a wider range of market and non-market values [38]. However, the revenue approximation provides a useful indicator of the economic importance of the industry, and is consistent with common economic metrics such as Gross Domestic Product and National Income Accounting [67].

2.7. Willingness to pay

We estimated the willingness to pay (WTP) of dive tourists for an extra daily fee used for management and enforcement of a hypothetical MPA for sharks [68] and for the enjoyment of the shark-diving activity if the cost of the operation increased. The contingent valuation questions were framed by using a payment card, that showed tourists five categories of user fees per trip in Euros (€) of 0, < 30 (USD $33), 30–60 (USD $ 33–67), 61–90 (USD $ 68–100), > 90 (USD $ 100). The bids were chosen based on local knowledge of dive operators about user fees from international marine reserves. Respondents were asked to select their maximum WTP from the offered bid amounts. The payment card approach allowed us to observe the lower and upper bound of respondent's WTP, with unbounded intervals for the extreme responses on the card, while also considering individuals with zero WTP values.

That is, from a modeling perspective, the individual is asked to choose between a set of intervals that comprising his/her willingness to pay, leading to monetary values within censored intervals. The bounds of the interval chosen would determine the largest and the minimum amount of money that the subject would be willing to pay for management and enforcement of a proposed MPA for sharks and the enjoyment of the shark-diving activity if the cost of the operation increased. For individual i, let L_i and U_i be the lower and the upper bounds of the chosen interval, respectively. $L_i = -\infty$ for those individuals choosing the lowest interval on the payment card, while for those choosing the highest interval on the payment card, $U_i = +\infty$. There can also be some individuals for whom WTP is not censored, since they state that they would not pay any amount of money, i.e. WTP is zero.

Thus, in this paper we propose the estimation of a spiked censored interval regression model, similarly to Kriström [40] for the single bounded dichotomous choice approach. This model allows for the consideration of individuals who answer a zero WTP value together with other individuals who choose some of the intervals in the payment card.

Therefore, the probability that the monetary value for individual i is located in the interval is

$$Pr\left(L_i \le WTP_i \le U_i\right) = \int_{L_i}^{U_i} f(WTP_i)dWTP_i = F(U_i) - F(L_i\Big) \quad (1)$$

where WTP_i is willingness to pay for individual i, F is the cumulative distribution function of willingness to pay, and f is the probability density function, with $F(-\infty) = 1$ and $F(+\infty) = 0$. The log likelihood function is derived by aggregation through the sample. That is,

$$\ell = \sum_{i=1}^{i=n} log(1 - I_i)[F(U_i) - F(L_i)] + logI_i[f(0)] \quad (2)$$

where I_i is an indicator function that takes the value of 1 if the individual states a zero WTP, and 0 if the respondent chooses some of the intervals on the payment card. The parameters that maximize the log-likelihood function can be obtained by iterative methods such as Newton-Raphson or simulation methods. WTP_i can be a function of explanatory variables, such as $WTP = \beta X_i + \varepsilon_i$, where X_i is a vector of characteristics of the individual, β is a vector of parameters, and ε_i is an error term which is normally distributed.

3. Results

3.1. Data collected and respondent profile

We collected 118 questionnaires, of which 115 were answered by dive tourists and 4 by dive operators (representing 85% of the Azorean shark-diving industry). Dive tourists were between 25 and 60 years old and came from eight countries: USA, Canada, Germany, Russia, Italy, Spain, France and Portugal. For most of respondents (~68%), this was the first trip to the Azores; however, about 21% had been in the region before. General diving activities was indicated as the main reason to visit the Azores (~37%), followed by general tourism (~22%). Approximately 15% of the respondents stated they traveled to the Azores specifically to dive with sharks. The average total length of the trip for all divers was 11.5 days, and 2.7 days for specifically diving with sharks (Table 2).

Approximately 30% of shark-diving tourists were classified as dedicated shark divers since they stated that would have not come to the Azores if it was not possible to dive with sharks. This figure included the respondents who stated having traveled to the archipelago specifically to dive with sharks, but also included divers who prioritized this destination because of shark diving (as a decision factor) but also to diversify their holidays with activities other than shark diving. Regarding shark-diving activities, the average number of sharks seen per dive was 2.6%, and 77% of tourists would definitely repeat this activity or recommend it to other people. Overall, the shark-diving trip was qualified as "excellent" by the majority of the tourist divers (69%) and as "good" for 24% (Fig. 2). Regarding the willingness to pay survey, 47% of respondents would pay less than € 30 (USD $ 33) as an extra fee per dive trip with the aim of enforcing a proposed MPA for sharks in the Azores (Fig. 3). If the cost of shark dive operation increased, over 40% of tourists would pay an extra fee higher than € 30. Most of respondents (~71%) reported they would like to see this extra revenue invested into shark conservation (Fig. 4).

3.2. Economic impact of shark-diving industry

Our study revealed that the total economic impact generated by shark-diving tourists in the regional economy of the Azores in 2019 was € 932,603 (USD $ 1,035,189), of which approximately 65% was attributed to dedicated shark divers. The expenditure of the dedicated shark divers that would not have visited the Azores if shark-diving activities were not advertised would have been lost to the region and therefore is entirely attributable to the main attractions, blue and shortfin mako sharks. Economic benefits from shark-diving reached the community in the form of salaries to local employees of the shark-diving industry. A total of 53 local employees were working directly for the Azorean diving centers providing shark-diving operations. Given that the total number of shark-diving tourists per year represents 5% of the total annual number of all divers in the Azores, this activity generates € 23,161 (USD $ 25,709) to the local community. Considering the

Table 2
Summary of divers' answers.

Divers' profile	Value
Average trip days (mean # of days ± SD)	11.5 (± 4)
Average days of shark diving (mean # of days ± SD)	2.7 (± 3)
Shark diving was the main purpose of the trip (%)	14.8
Dedicated shark diver fraction (%)	30.4
Average number of sharks watched (mean # of days ± SD)	2.6 (± 1.3)
§ Likeliness to repeat or recommend the shark-diving experience (%)	
Definitely	77.4
Likely	16.5
Maybe	4.4
Unlikely	0
No	0

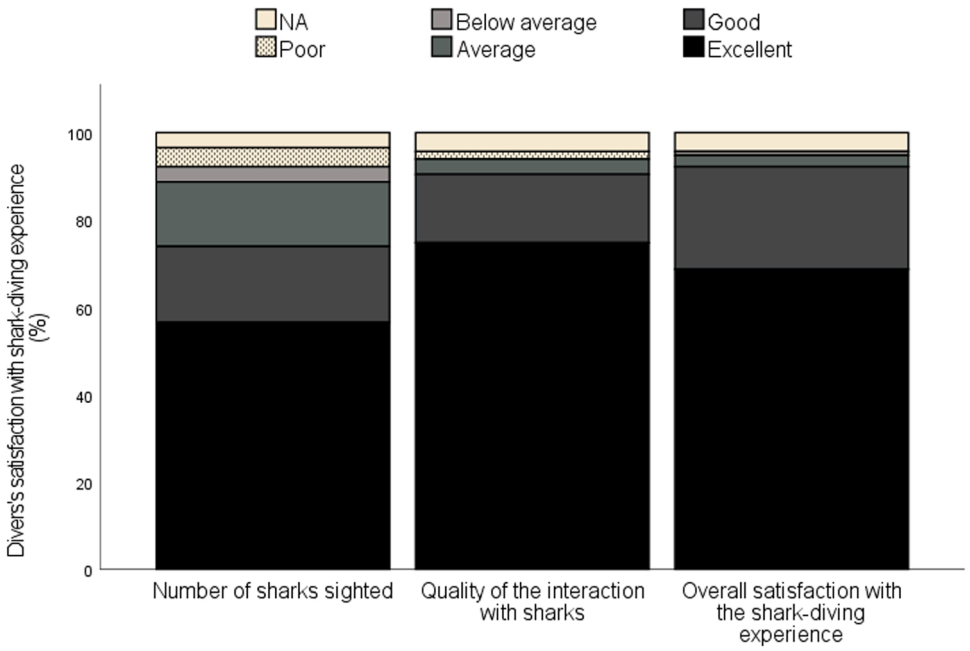

Fig. 2. Divers' satisfaction with shark-diving experience in terms of number of sharks sighted, quality of the interaction with sharks and overall satisfaction.

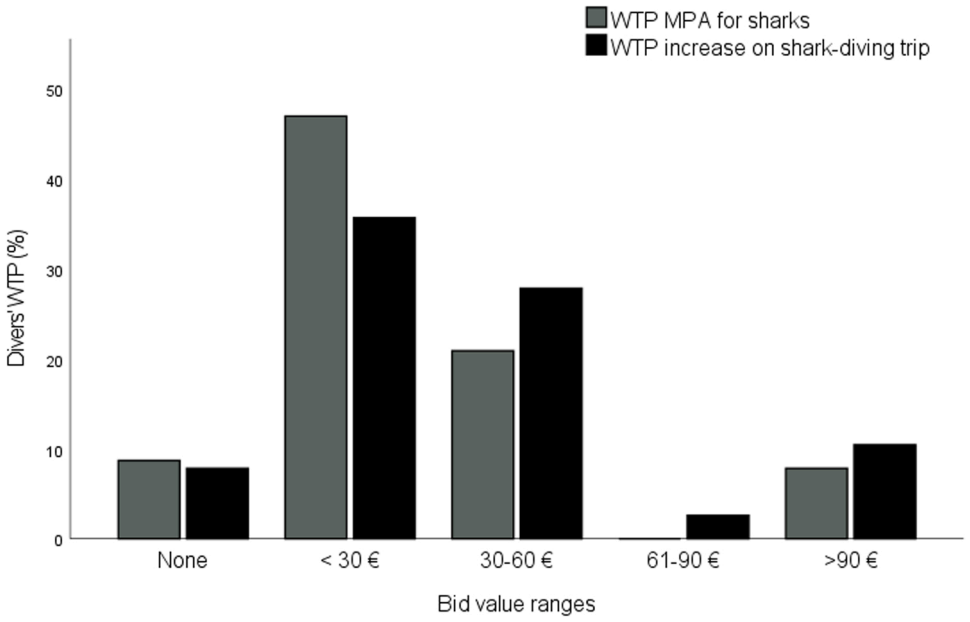

Fig. 3. Divers' willingness to pay (WTP) for management and enforcement of a MPA for sharks and for shark-diving trip if its cost increased.

minimum tax rate contribution of 4%, the total business tax revenues from shark-diving tourism in 2019 was € 37,304 (USD $ 41,408) (Table 3).

3.3. *Willingness to pay*

The willingness to pay (WTP) responses for the management and enforcement of an MPA for sharks and for the enjoyment of the shark-diving activity if the cost of the operation increased are modeled utilizing a censored regression approach that allows for the consideration of zero values and unbounded intervals. The variables that were significant explaining WTP values are described in Table 4, while Table 5 presents the model results.

It can be seen that WTP for a proposed MPA for sharks is higher for those dive tourists that have experienced an excellent quality with the shark-diving activity, have spent more on their vacation in the Azores, have been before in the islands, come to the islands for shark diving as a main reason and would like to strongly recommend the visit to Azores to other people. The mean WTP for the censored regression model is € 34.7 with a 95% confidence interval ranging from € 10.8 to € 51.7. For the enjoyment of the shark-diving activity if the cost of operation increased, WTP is significantly higher for those tourists who have perceived a higher quality of the experience, have spent more on their vacation and have been before in the islands. The mean of the maximum extra fee, or WTP, for the diving activity is € 38.93, with a confidence interval from € 15.6 to € 62.2.

The average individual WTP estimates were aggregated over the total number of shark-divers per year (*SDT*) and the average number of

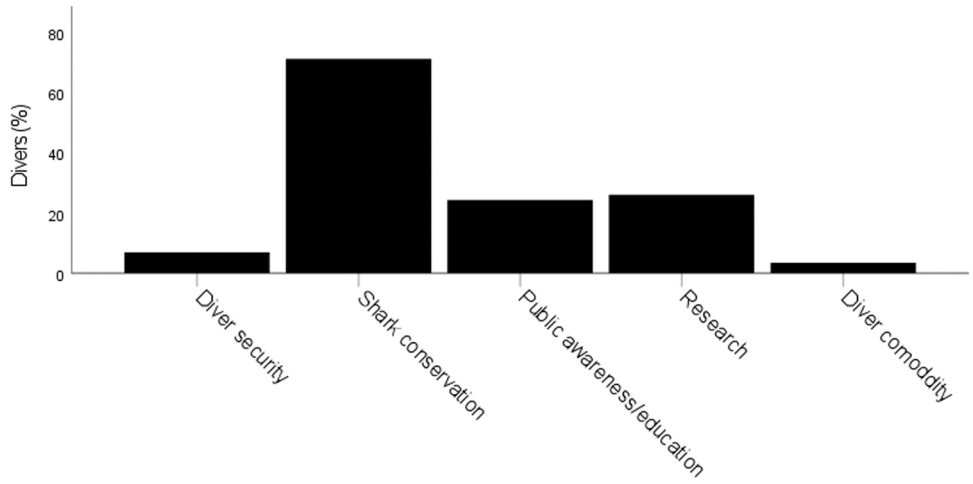

Fig. 4. Divers' choice of area of investment of extra-amount per dive trip.

Table 3
Estimated revenues and income generated by the shark-diving industry in the Azores Islands in 2019.

Code	Description	Value (€)	Value ($)
Annual business revenues			
BROSD	Business revenues from opportunist shark divers	340,245	377,672
BRDSD	Business revenues from dedicated shark divers	592,358	657,517
Total	Shark-divers	932,603	1,035,189
Annual community income			
DCID	Direct community income from diving	463,220	514,174
DCISD	Direct community income from shark-diving	23,161	25,709
Annual tax revenues			
BRTOSD	Business revenue tax from opportunist shark divers	13,610	15,108
BRTDSD	Business revenue tax from dedicated shark divers	23,694	26,300
Total	Business revenue tax from shark-divers	37,304	41,408

Table 4
Variables in the WTP model.

Variable	Description
Quality	Dummy variable that takes the value of 1 if the subject rates the quality of the tourist experience with sharks as excellent, 0 otherwise.
Expenditure	Total expenditure in the visit to Azores in Euros over 1000.
Main	Dummy variable that takes the value of 1 if the subjects' main reason for visiting the Azores was to dive with sharks, 0 otherwise.
Before	Dummy variable that takes the value of 1 if the subject had been in Azores before, 0 otherwise.
Recommend	Dummy variable that takes the value of 1 if the subject definitely recommends the visit to Azores to other people, 0 otherwise.

diving days (*A*) to obtain the potential annual revenues from an extra fee per shark-dive trip (*REV*) (Supplementary material). Based on the mean WTP for management and enforcement of a hypothetical MPA for sharks from respondents, the proposed MPA could generate an estimated annual revenue (REV) of € 94,346 (USD $ 103,780) (confidence interval: € 29,364–14,0567) (USD $ 32,301–154,624) from extra fee per shark-diving trip. Based on the mean WTP for the enjoyment of the shark-diving activity if the cost of operation increased, this situation could generate an estimated annual revenue of € 105,847 (USD $ 116,431) (confidence interval: € 42,415–169,116 (USD $ 46,656–186,027) from extra fee per shark-diving trip.

The cumulative distribution of WTP responses for a proposed MPA for sharks shows that nearly 30% of respondents were willing to pay more than € 30 and approximately 10% of respondents were not willing to pay an extra fee to enforce the proposed MPA for sharks (Fig. 5).

4. Discussion

4.1. Economic impact of the shark-diving industry in the Azores Islands

The total economic contribution generated by the shark-diving industry in the Azores was estimated as USD $ 1,035,189, which is significantly lower compared to other small-island industries in the world such as Fiji (USD $ 42 million), Palau (USD $ 18 million), French Polynesia (USD $ 5.4 million) or Fernando de Noronha in Brazil (USD $ 2.6 million) (Table 6, [17,48,66,67]). This could be mainly explained by the number of divers (1007) and the observed short shark-diving season, but most critically that the Azorean shark-diving industry has recently emerged (started in 2011), and that tourism is still burgeoning in the archipelago [5,69]. Unlike the other small-island destinations, the main shark-diving attractions in the Azores are oceanic shark species (blue shark and shortfin mako shark), which appear seasonally in the regional waters, therefore, shark-diving activities are only operated for three months per year, during the summer period, similar to what was reported by Gallagher and Hammerschlag [26] in places such as Rhode Island (USA) and Southern California (USA). However, if we standardized by number of years and operations, the Azorean shark-diving tourism would be among the highest and most profitable small-island industries considering its reliance in the European economy which is stronger than in the other diving destinations (Table 6).

In 2014, Torres et al. [63] estimated the revenues generated by the Azorean shark-diving industry in over USD $ 2 million per year (Table 4); the study included estimates of direct, indirect and induced revenues from shark-diving. As observed in our results, the total number of shark-diving tourists in 2019 has decreased compared to 2014 (273 fewer tourists), and this difference represents over 27% of the total number of dive tourists in 2019 (1007 shark-diving tourists). This could partially explain why the total business revenues in 2014 were higher than our estimation in 2019; however, the difference between the two studies is still substantial after accounting for the smaller number of tourist in 2019, which is likely a consequence of the inclusion of international flights in dive tourist expenditures estimated by Torres et al. [63]. In our study we did not include this category of expenditure in order to focus on the revenues that are retained in the Azorean economy, as opposed to revenues that may leak to foreigner countries. Another factor that could potentially explain the difference between these estimates is the proportion of dedicated shark divers. In Torres et al. [63],

Table 5
Censored interval regression results of divers' WTP for management and enforcement of a hypothetical Marine Protected Area (MPA) for sharks and for shark-diving trip if the cost of the operation increased.

	MPA for sharks			Increase on shark-diving trip		
Variable	**Coefficient**	**Std. err.**		**Coefficient**	**Std. err.**	
Constant	6.46	3.94	*	15.11	7.62	*
Quality	19.61	7.88	***	25.24	12.08	**
Expenditure	5.022	2.36	**	3.014	1.66	*
Main	7.88	3.17	**	9.23	6.17	
Before	13.87	3.87	***	12.63	7.69	*
Recommend	5.77	2.14	***	12.51	8.81	
ln (s)	2.67	0.12	***	3.51	0.10	***
N	97			97		
Log-likelihood	-102.24			-167.003		
McFadden's R2	0.411			0.181		
McFadden's Adj R2	0.370			0.102		
AIC	218.495			348.006		
BIC	-118.794			-178.44		
LR(5)	142.519			99.10		
Mean WTP (€)	34.7	10.8–51.7		38.93	15.6–66.2	

Notes: $*p < 0.1$, $**p < 0.05$, $***p < 0.001$

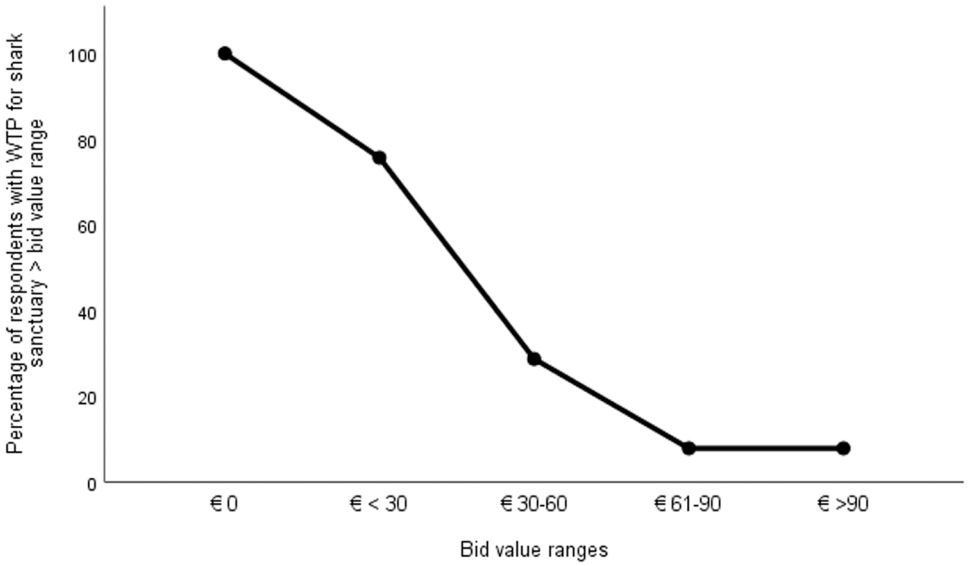

Fig. 5. Cumulative distribution of WTP for a proposed MPA for sharks responses showing the percentage of respondents who were willing to pay the amount specified by each bid range category.

Table 6
Comparing the commercial value of shark-diving industries in island destinations.

Shark-diving destination	Year	Number of divers	Season length	Average expenditure per trip (USD)	Average expenditure per day (USD)	Total business revenues (USD million)
Fiji	2011	49,000	Year-round	2300	212	42.2
Palau	2010	8600	Year-round	–	–	17.4
French Polynesia	2009	12,623	Year-round	–	325	5.4
Fernando de Noronha	2014	4400	Year-round	1483	269	2.6
The Azores	2014	1280	3 months	3672	322	2.2
The Azores	2019	1007	3 months	2189	203	1.0

dedicated shark divers represented nearly the half of the total number of tourists engaged in shark-diving activities (44%), while in 2019 our study found this to be 30%. This difference reduced the total revenue estimate in our study, as the expenditures of dedicated shark divers were calculated based on the average number of days staying in the Azores and not only for the average number of days diving with sharks (i.e. opportunist shark divers). This large difference in the number of tourists engaged in shark-diving activities may be related to differences in the survey sampling design. The survey performed by Torres et al. [63] mostly targeted divers utilizing one of the four major diving centers, while our survey targeted the entire shark-diving industry and was successful in sampling 85% of the dive operators. According to the dive operators, the diving center targeted by Torres et al. [63] historically hosts most of the shark-diving tourists in the region, which was also confirmed in our results (about 30% of the entire industry). We observed that the average expenditure of divers utilizing this diving center was 30% higher than those of dive tourists in the other diving centers (€ 163.7 per day), which could also partially explain the higher values

estimated by Torres et al. [63].

This comparison unequivocally demonstrates the need for analyses of shark-diving socioeconomics to be representative of the entire industry in order to obtain a more accurate estimate of the total economic impact in the region. As more standardized valuation studies become available, these data may assist the development of models that could predict the potential of diving tourism to finance the implementation of management and conservation strategies [68].

Despite the smaller size when compared to shark-diving industries in many other countries, this industry in the Azores has the potential to grow due to the optimal conditions for diving practices [54], high probability of shark sightseeing (i.e. blue sharks) and the current expansion of the nature-based tourism industry in the Azores [69]. According to the dive operators, other potential shark-diving sites can be found in the archipelago such as Azores and Joao de Castro Banks and this could lead to a higher number of diving centers engaged with shark-diving activities. Additionally, the average expenditure per day for diving with sharks in the Azores is lower compared to the other mentioned shark-diving destinations (i.e. Fiji, French Polynesia and Fernando de Noronha), which could encourage dedicated shark divers, particularly from Europe, to visit/return to the Azorean archipelago for this reason.

4.2. Local community income from shark-diving industry in the Azores Islands

The direct local community income generated by the Azorean shark-diving industry was also lower than other small-island industries; however, expenditure on shark-diving had flow-on effects for the local economy, benefitting businesses that might not be directly involved in the industry such as accommodation, transport, restaurants, etc. [68]. Also, considering that diving activities occur in the Azores for 5 months per year, local workers in diving centers receive a higher income per month during this period than the average monthly income in other sector of the economies [6]. Still, the annual average salary of the local community engaged in the diving industry may appear relatively small due to the short diving season. This suggests that the growth in the number of shark-diving operations and the development of a coastal shark diving year-round could further expand the Azorean shark-diving industry and increase community income.

Considering the potential interaction of fisheries and shark-diving tourism in the Azores, it is important to discuss the revenues produced by shark landings in the Azorean Economic Exclusive Zone (EEZ). Pelagic longlines land the largest majority of shark catches in this region [20], with blue and shortfin mako sharks accounting for most of the catches [50,57]. According to Torres et al. [62], the total landed value of these pelagic species in 2014 was less than € 20,000 (USD $ 22,000) in the Azorean market, which evidenced lower benefits of catches of blue shark and shortfin mako shark for the local fishers compared to other more valuable fish species (e.g. swordfish, tuna, etc.). The low local demand for pelagic sharks in the regional market has led to a high discarding of blue and shortfin mako sharks in domestic fleets [24,47]. Yet, local pelagic longlines in the Azores operate at a much smaller scale compared to European industrial pelagic fleets [18]. In contrast, the majority of shark catches from mainland and foreign fleets are landed in mainland European harbors, where shark meat and fins have a higher market value and management restrictions (quota or MLS) for these species are absent [24]. This suggests that there is a large underestimation of the pelagic shark catches in the Azorean waters and the value of this industry.

As pelagic shark catches have a minor socio-economic impact in the Azorean local community [13,47], the non-consumptive use of sharks through the shark-diving tourism industry may potentially represent a higher source of income and provide more job opportunities. Local fishers could also benefit from the increasing presence of shark-diving tourists through a higher demand for more sustainable fish products regionally, which could make local fishers encouraged to reduce bycatch and particularly discards of blue and shortfin mako sharks, and to support the shark-diving tourism industry [67].

4.3. The shark-diving experience in the Azores Islands

The overall shark-diving experience in the Azores was highly valued by dive tourists (rated “Good” or “Excellent” by 92% of respondents), which may explain why 77% of the divers interviewed would definitely return or recommend this activity. Our results in the assessment of the overall shark-diving experience and the average number of shark sightings per trip (2.6 sharks) had similar results to the survey performed in 2014. However, in our survey we included a specific question about the number of shark sightings per trip and 23% of respondents expressed a relatively low degree of satisfaction. This may reflect the dive tourist preference for consistent shark sightings and that observing fewer individuals of blue and shortfin mako shark in the future could negatively affect the motivation to perform this activity. According to the dive operators, shortfin mako sightings have largely diminished in the shark-diving operations in recent years, which is likely a consequence of increasing fishing pressure and overfishing [11,62,73]. As stated by Zimmerhackel et al. [76], evidence of shark population declines in shark-diving destinations may trigger a substantial decrease in demand for dive trips with economic losses not only to the dive industry, but also to the broader local tourism market. Conversely, increasing abundance of sharks may further increase demand and generate higher economic gains [76], which could be potentially achievable with the enforcement of MPAs for sharks.

4.4. Willingness to pay (WTP) for a proposed MPA for sharks in the Azores Islands

Willingness-to-pay studies have been widely used to investigate the acceptance and optimal value of hypothetical marine park fees, including MPAs for sharks, and inform decision makers of the financing potential of fee implementation [31,43,58,68]. Our results show that the shark diving-industry in 2019 could generate over € 94,300 (USD $ 103,700) for the management and enforcement of a proposed MPA for sharks. This represents an increase in the willingness to pay by divers utilizing this industry when compared to a similar survey from 2014 [63], which estimated that a total amount of € 62,720 (USD $ 68,992) could be generated for the same matter. This difference could be associated to a general trend of increasing of concern by divers with the protection of shark populations. However, it was also observed that if the cost of shark-diving operations would increase, tourist divers could pay a higher extra fee generating € 105,847 (USD $ 116,431), and for most of them (71%) this amount should be invested in shark conservation. This could be explained by the fact that tourist divers perceive that the Azorean government may be falling short to protect shark populations, as stated by some respondents, and would prefer to support independent shark conservation initiatives such as promoted by diving centers.

Our WTP model analysis shows that dive tourists who had a higher quality of experience, a higher average expenditure in the Azores and have returned to the region would be willing to pay more for the enforcement and management of an MPA for sharks and in case the cost of the shark-dive trip increased. It seems logical that dive tourists who have returned to the Azores and were highly satisfied with the shark-diving trip would like to repeat the experience with shark populations and their habitat well-conserved, even if the cost of the operation increased. It also seems logical that dive tourists who spent more in the region would be able to pay more for the activity and to financially assist shark conservation actions. We also observed that over 90% of the dive tourists were willing to contribute financially to the establishment of a MPA for sharks which could be related to the general high satisfaction with the activity. However, the implementation of any fee payment

scheme must consider potential effects on return rates of individual tourists through further market research or contingent behavior studies [68].

The Azores is a pioneer in the region in the implementation of a set of marine conservation instruments through MPAs, having started in the 1980's when few countries were actively engaged in marine spatial management for conservation [80]. With 110,000 km^2 of extension, the current established network of the Azorean MPAs has achieved a representative coverage of a full range of ecosystems habitats and vulnerable marine environments, along with the establishment of large offshore MPAs both within and beyond the Azorean EEZ [81]. However, Azorean MPAs cannot fully protect the populations of a large number of migratory species that visit the archipelago such as oceanic shark species because only part of their life cycle is spent within Azorean waters [80]. Moreover, underfunding for monitoring, enforcement, management, and public and stakeholder engagement is also challenging in the region, as in most MPAs worldwide [23,74]. Despite some MPAs around shark-diving sites in the Azores have been implemented banning certain fishing activities (e.g. demersal fisheries in Condor Bank), these reserves still lack effective protection [1].

Shark-diving tourism has demonstrated to be a financial mechanism for protection of sharks and their habitats through conservation strategies and management in many diving destinations around the world [8,67,68]. However, this engagement relies on how significant the economic contribution of the shark-diving industry for the regional economy is [27]. The total business revenues generated by the Azorean industry may not currently represent a strong contributor of economic outcomes for the local community and to support strong conservation strategies. However, prohibitions on shark fisheries through the implementation of MPAs for sharks would not be challenging for local fishers and the overall local community. The marine environment is deeply rooted in Azorean livelihoods and culture, and recent studies show that most Azorean people consider marine conservation a priority and are willing to engage to avoid loss of marine biodiversity [52,53]. The main stakeholder affected by a shark fisheries ban would be the European industrial fleets, which are the largest pelagic shark fisheries in the Azorean waters, and that potentially threaten the expansion of the shark-diving industry. Conversely, the establishment and adequate management of MPAs for sharks would only benefit the local economy and investing in shark conservation can increase this potential.

Finally, considering that enforcement of an MPA for protecting pelagic sharks is challenging due to their migratory patterns, this MPA would require a large-scale conservation planning with regional connectivity. Blue sharks and shortfin mako sharks move through the entire biogeographical region of Macaronesia, which also include the archipelagos of Madeira, Canary Islands and Cape Verde. This area is also a hotspot of large-distant industrial fisheries targeting pelagic sharks [50] with signs of significant overfishing [82]. In light of these facts, supra-regional control measures could be implemented to reduce shark-fishing mortality through the implementation of a network of pelagic MPAs in Macaronesia. This region has also shown a high potential for the development of shark-diving tourism [30], which could potentially generate funds to assist the enforcement and adequate management of these marine reserves. Hence, good practices in the Azorean shark-diving industry would not only serve as an example for the other Macaronesian archipelagos, but for other small-islands sharing similarities in terms of overlapping of pelagic industrial fisheries and oceanic shark populations.

5. Conclusion

Our study investigated the economic value of the shark-diving tourism industry targeting pelagic or oceanic sharks in the Azores Islands and the potential of generation revenues for conservation. Despite being one of the most widespread group of sharks in the world, the species focused on here (blue and shortfin mako) have been modestly represented among global shark-diving tourism operations (over 10%, [26]), and our findings contribute to a better understanding of the potential economic dimensions of this emergent market in the Mid-Atlantic. The contingent valuation analysis based on the willingness to pay survey shows that the Azorean shark-diving tourism could assist financial resourcing for the implementation of a MPA for sharks. However, this industry needs to expand in order to represent a strong contributor of economic outcomes for the local community and to support strong conservation strategies.

The growth possibilities of the Azorean shark-diving industry depend mainly on attracting a greater number of tourists to the region, particularly dedicated shark divers. A wider awareness among local authorities about the economic benefits of this potentially sustainable industry is needed, with the aim to improve marketing strategies, increasing support for local dive centers to explore this market, and to integrate more local workers from the Azorean community into the shark-diving industry.

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CRediT authorship contribution statement

Pedro G. Gonzáles-Mantilla: Conceptualization, Formal analysis, Investigation, Project administration, Funding acquisition, Visualization, Writing - original draft. **Austin J. Gallagher:** Formal analysis, Writing - review & editing, Supervision. **Carmelo J. León:** Formal analysis, Writing - review & editing, Project administration, Supervision, Validation. **Gabriel M.S. Vianna:** Conceptualization, Formal analysis, Methodology, Writing - review & editing, Supervision.

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Conflict of interest

No potential conflict of interest was reported by the authors.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2021.104869.

References

[1] P. Afonso, M. Schmiing, J. Fontes, F. Tempera, T. Morato, R.S. Santos, Effects of marine protected areas on coastal fishes across the Azores archipelago, mid-North Atlantic, J. Sea Res. 138 (2018) 34–47.
[2] K. Arrow, R. Solow, P.R. Portney, E.E. Leamer, R. Radner, H. Schuman, Report of the NOAA panel on contingent valuation, Fed. Regist. 58 (10) (1993) 4601–4614.
[3] L. Arthur, A case study of divers' willingness to pay tourist fees towards shark conservation in The Maldives. Masters, University of Newcastle, Newcastle, 2011.

[4] S.A. Aseres, R.K. Sira, Estimating visitors' willingness to pay for a conservation fund: sustainable financing approach in protected areas in Ethiopia, Heliyon 6 (8) (2020), e04500, 6.

[5] Azorean Statistical Office (2017). Séries Longas – Turismo. Angra do Heroísmo, SREA.

[6] Azorean Statistical Office (2019). Statistical Yearbook of the Azorean Region 2018.

[7] J. Bentz, P. Dearden, E. Ritter, H. Calado, Shark-diving in the Azores: challenge and opportunity, Tour. Mar. Environ. 10 (1–2) (2014) 71–83.

[8] J.M. Brunnschweiler, The Shark Reef Marine Reserve: a marine tourism project in Fiji involving local communities, J. Sustain. Tour. 18 (1) (2010) 29–42.

[9] K. Boyle, Contingent valuation in practice. In 'A Primer on Non-Market Valuation'. (Eds P Champ, K Boyle, T Brown) pp. 111–170, 2003.

[10] H. Calado, K. Ng, C. Lopes, L. Paramio, Introducing a legal management instrument for offshore marine protected areas in the Azores—The Azores Marine Park, Environ. Sci. Policy 14 (8) (2011) 1175–1187.

[11] S.E. Campana, Transboundary movements, unmonitored fishing mortality, and ineffective international fisheries management pose risks for pelagic sharks in the Northwest Atlantic, Can. J. Fish. Aquat. Sci. 73 (10) (2016) 1599–1607.

[12] R.T. Carson, Contingent valuation: a user's guide, 2000.

[13] N. Carvalho, G. Edwards-Jones, E. Isidro, Defining scale in fisheries: small versus large-scale fishing operations in the Azores, Fish. Res. 109 (2011) 360–369, https://doi.org/10.1016/j.fishres.2011.03.006.

[15] J. Catlin, M. Hughes, T. Jones, R. Jones, R. Campbell, Valuing individual animals through tourism: science or speculation? Biol. Conserv. 157 (2013) 93–98.

[16] M. Cazabon-Mannette, P.W. Schuhmann, A. Hailey, J. Horrocks, Estimates of the non-market value of sea turtles in Tobago using stated preference techniques, J. Environ. Manag. 192 (2017) 281–291.

[17] E. Clua, N. Buray, P. Legendre, J. Mourier, S. Planes, Business partner or simple catch? The economic value of the sicklefin lemon shark in French Polynesia, Mar. Freshw. Res. 62 (6) (2011) 764–770.

[18] J.P. Correia, F. Morgado, K. Erzini, A.M.V.M. Soares, Elasmobranch landings in the portuguese commercial fishery from 1986 to 2009, Arquipel. Life Mar. Sci. 33 (2016) 81–109 (Available online at), ⟨http://hdl.handle.net/10400.3/3983⟩.

[19] G. Couto, P. Pimentel, J.C.B.D. Ponte, Tourism development potential in an insular territory: the case of Ribeira Grande in the Azores, in: CEEAplA-A-Working Paper Series, 2017, pp. 1–23.

[20] D. Das, P. Afonso, Review of the diversity, ecology, and conservation of elasmobranchs in the Azores region, mid-north Atlantic, Front. Mar. Sci. 4 (2017) 354.

[21] L.N. Davidson, N.K. Dulvy, Global marine protected areas to prevent extinctions, Nat. Ecol. Evol. 1 (2) (2017) 1–6.

[22] T.P. Dentinho, M.A. Fortuna, How Regional Governance Constrains Regional Develop-ment. Evidences From an Econometric Base Model For the Azores, Rev. Port. Estud. Reg. 52 (2019) 25–35.

[23] G.J. Edgar, R.D. Stuart-Smith, T.J. Willis, S. Kininmonth, S.C. Baker, S. Banks, C. D. Buxton, Global conservation outcomes depend on marine protected areas with five key features, Nature 506 (7487) (2014) 216–220.

[24] L. Fauconnet, C.K. Pham, A. Canha, P. Afonso, H. Diogo, M. Machete, H.M. Silva, F. Vandeperre, T. Morato, An overview of fisheries discards in the Azores, Fish. Res. 209 (2019) 230–241, https://doi.org/10.1016/j.fishres.2018.10.001.

[25] V. Frontuto, S. Dalmazzone, E. Vallino, S. Giaccaria, Earmarking conservation: Further inquiry on scope effects in stated preference methods applied to nature-based tourism, Tour. Manag. 60 (2017) 130–139.

[26] A.J. Gallagher, N. Hammerschlag, Global shark currency: the distribution, frequency, and economic value of shark ecotourism, Curr. Issues Tour. 14 (8) (2011) 797–812.

[27] A.J. Gallagher, G.M. Vianna, Y.P. Papastamatiou, C. Macdonald, T.L. Guttridge, N. Hammerschlag, Biological effects, conservation potential, and research priorities of shark-diving tourism, Biol. Conserv. 184 (2015) 365–379.

[28] A.J. Gallagher, C.P. Huveneers, Emerging challenges to shark-diving tourism, Mar. Policy 96 (2018) 9–12.

[29] A.J. Gallagher, D. Amon, T. Bervoets, O.N. Shipley, N. Hammerschlag, D.W. Sims, The Caribbean needs big marine protected areas, 2020.

[30] P.G. Gonzáles-Mantilla, A.J. Gallagher, C.J. León, G.M. Vianna, Challenges and conservation potential of shark-diving tourism in the Macaronesian archipelagos, Mar. Policy 131 (2021), 104632.

[31] A.R. Haas, T. Fedler, E.J. Brooks, The contemporary economic value of elasmobranchs in The Bahamas: reaping the rewards of 25 years of stewardship and conservation, Biol. Conserv. 207 (2017) 55–63.

[32] N. Hanley, E.B. Barbier, E. Barbier, Pricing Nature: Cost-benefit Analysis and Environmental Policy, Edward Elgar Publishing, 2009.

[33] K. Higginbottom (Ed.), Wildlife Tourism: Impacts, Management and Planning, Common Ground Publishing, 2004.

[34] D. Hoyos, P. Mariel, Contingent valuation: past, present and future, Prague Econ. Pap. 4 (2010) (2010) 329–343.

[35] E. Hoyt, The role of marine protected areas and sanctuaries, in: E.J. Techera, N. Klein (Eds.), Sharks: Conservation, Governance and Management, Routledge, 2014, pp. 236–261.

[36] C. Huveneers, M.G. Meekan, K. Apps, L.C. Ferreira, D. Pannell, G.M. Vianna, The economic value of shark-diving tourism in Australia, Rev. Fish Biol. Fish. 27 (3) (2017) 665–680.

[37] A.L. Indab, Willingness to pay for whale shark conservation in Sorsogon, Philippines. Marine and Coastal Ecosystem Valuation, Institutions, and Policy in Southeast Asia, Springer,, Singapore, 2016, pp. 93–128.

[38] R.E. Just, D.L. Hueth, A. Schmitz, The Welfare Economics of Public Policy: A Practical Approach to Project and Policy Evaluation, Edward Elgar Publishing, 2005.

[39] M. Kaim, Green Entrepreneurship Management in Portugal: the case of Azores Islands. Competitivitatea şi Inovarea în Economia Cunoaşterii Vol. 2, 2018, pp. 368–372.

[40] B. Kriström, Spike models in contingent valuation, Am. J. Agric. Econ. 79 (3) (1997) 1013–1023.

[41] S.E.F. Lewis, J.K. Turpie, P.G. Ryan, Are African penguins worth saving? The ecotourism value of the Boulders Beach colony, Afr. J. Mar. Sci. 34 (4) (2012) 497–504.

[42] J.B. Loomis, D.M. Larson, Total economic values of increasing gray whale populations: results from a contingent valuation survey of visitors and households, Mar. Resour. Econ. 9 (3) (1994) 275–286.

[43] G. McDonald, T. Mangin, L.R. Thomas, C. Costello, Designing and financing optimal enforcement for small-scale fisheries and dive tourism industries, Mar. Policy 67 (2016) 105–117.

[44] P.A. Mieras, C. Harvey-Clark, M. Bear, G. Hodgin, B. Hodgin, The economy of shark conservation in the Northeast Pacific: the role of ecotourism and citizen science, in: Advances in Marine Biology, Vol. 78, Academic Press, 2017, pp. 121–153.

[45] P.L.K. Mustika, M. Ichsan, H. Booth, The economic value of shark and ray tourism in Indonesia and its role in delivering conservation outcomes, Front. Mar. Sci. 7 (2020) 261.

[47] C. Pham, A. Canha, H. Diogo, J.G. Pereira, R. Prieto, T. Morato, Total marine fisheries catch for the Azores (1950-2010), ICES J. Mar. Sci. 70 (2013) 564–577, https://doi.org/10.1093/icesjms/fst024.

[48] N.M. Pires, R.C. Garla, A.R. Carvalho, The economic role of sharks in a major ecotourism archipelago in the western South Atlantic, Mar. Policy 72 (2016) 31–39.

[49] P.R. Portney, The contingent valuation debate: why economists should care, J. Econ. Perspect. 8 (4) (1994) 3–17.

[50] N. Queiroz, N.E. Humphries, A. Couto, M. Vedor, I. da Costa, A.M.M. Sequeira, G. Mucientes, A.M. Santos, F.J. Abascal, D.L. Abercrombie, K. Abrantes, D. Acuña-Marrero, A.S. Afonso, P. Afonso, D. Anders, G. Araujo, R. Arauz, P. Bach, A. Barnett, D. Bernal, M.L. Berumen, S. Bessudo Lion, N.P.A. Bezerra, A.V. Blaison, B.A. Block, M.E. Bond, R. Bonfil, R.W. Bradford, C.D. Braun, E.J. Brooks, A. Brooks, J. Brown, B.D. Bruce, M.E. Byrne, S.E. Campana, A.B. Carlisle, D.D. Chapman, T. K. Chapple, J. Chisholm, C.R. Clarke, E.G. Clua, J.E.M. Cochran, E.C. Crochelet, L. Dagorn, R. Daly, D. Devia Cortés, T.K. Doyle, M. Drew, C.A.J. Duffy, T. Erikson, E. Espinoza, L.C. Ferreira, F. Ferretti, J.D. Filmalter, C.G. Fischer, R. Fitzpatrick, J. Fontes, F. Forget, M. Fowler, M.P. Francis, A.J. Gallagher, E. Gennari, S. D. Goldsworthy, M.J. Gollock, J.R. Green, J.A. Gustafson, T.L. Guttridge, H. M. Guzman, N. Hammerschlag, L. Harman, F.H.V. Hazin, M. Heard, A.R. Hearn, J. C. Holdsworth, B.J. Holmes, L.A. Howey, M. Hoyos, R.E. Hueter, N.E. Hussey, C. Huveneers, D.T. Irion, D.M.P. Jacoby, O.J.D. Jewell, R. Johnson, L.K.B. Jordan, S.J. Jorgensen, W. Joyce, C.A. Keating Daly, J.T. Ketchum, A.P. Klimley, A.A. Kock, P. Koen, F. Ladino, F.O. Lana, J.S.E. Lea, F. Llewellyn, W.S. Lyon, A. MacDonnell, B.C.L. Macena, H. Marshall, J.D. McAllister, R. McAuley, M.A. Meÿer, J.J. Morris, E.R. Nelson, Y.P. Papastamatiou, T.A. Patterson, C. Peñaherrera-Palma, J. G. Pepperell, S.J. Pierce, F. Poisson, L.M. Quintero, A. Richardson, P.J. Rogers, C. A. Rohner, D.R.L. Rowat, M. Samoilys, J.M. Semmens, M. Sheaves, G. Shillinger, M. Shivji, S. Singh, G.B. Skomal, M.J. Smale, L.B. Snyders, G. Soler, M. Soria, K. M. Stehfest, J.D. Stevens, S.R. Thorrold, M.T. Tolotti, A. Towner, P. Travassos, J. P. Tyminski, F. Vandeperre, J.J. Vaudo, Y.Y. Watanabe, S.B. Weber, B. M. Wetherbee, T.D. White, S. Williams, P.M. Zárate, R. Harcourt, G.C. Hays, M. G. Meekan, M. Thums, X. Irigoien, V.M. Eguiluz, C.M. Duarte, L.L. Sousa, S. J. Simpson, E.J. Southall, D.W. Sims, Global spatial risk assessment of sharks under the footprint of fisheries, Nature (2019), https://doi.org/10.1038/s41586-019-1444-4.

[52] A. Ressurreição, J. Gibbons, T.P. Dentinho, M. Kaiser, R.S. Santos, G. Edwards-Jones, Economic valuation of species loss in the open sea, Ecol. Econ. 70 (2011) 729–739, https://doi.org/10.1016/j.ecolecon.2010.11.009.

[53] A. Ressurreição, J. Gibbons, M. Kaiser, T.P. Dentinho, T. Zarzycki, C. Bentley, M. Austen, D. Burdon, J. Atkins, R.S. Santos, G. Edwards-Jones, Different cultures, different values: the role of cultural variation in public's WTP for marine species conservation, Biol. Conserv. 145 (2012) 148–159, https://doi.org/10.1016/j.biocon.2011.10.026.

[54] A. Ressurreição, E. Giacomello, Quantifying the direct use value of Condor seamount, Deep Sea Res. Part II: Top. Stud. Oceanogr. 98 (2013) 209–217.

[57] R. Santos, A. Novoa-Pabon, H. Silva, M. Pinho, Elasmobranch species richness, fisheries, abundance and size composition in the Azores archipelago (NE Atlantic), Mar. Biol. Res. 16 (2) (2020) 103–116.

[58] P.W. Schuhmann, R. Skeete, R. Waite, T. Lorde, P. Bangwayo-Skeete, H. A. Oxenford, D. Gill, W. Moore, F. Spencer, Visitors' willingness to pay marine conservation fees in Barbados, Tour. Manag. 71 (2019) 315–326.

[59] B.D. Solomon, C.M. Corey-Luse, K.E. Halvorsen, The Florida manatee and eco-tourism: toward a safe minimum standard, Ecol. Econ. 50 (1–2) (2004) 101–115.

[60] M. Stithou, R. Scarpa, Collective versus voluntary payment in contingent valuation for the conservation of marine biodiversity: an exploratory study from Zakynthos, Greece, Ocean Coast. Manag. 56 (2012) 1–9.

[61] K.N. Topelko, P. Dearden, The shark watching industry and its potential contribution to shark conservation, J. Ecotourism 4 (2) (2005) 108–128.

[62] P. Torres, R.T. da Cunha, A. dos Santos Rodrigues, The elasmobranch fisheries of the Azores, Mar. Policy 73 (2016) 108–118.

[63] P. Torres, N. Bolhão, R.T. da Cunha, J.A.C. Vieira, A. dos Santos Rodrigues, Dead or alive: The growing importance of shark-diving in the Mid-Atlantic region, J. Nat. Conserv. 36 (2017) 20–28.
[64] L. Venkatachalam, The contingent valuation method: a review, Environ. Impact Assess. Rev. 24 (1) (2004) 89–124.
[65] G.M.S. Vianna, M.G. Meekan, D. Pannell, S. Marsh, J.J. Meeuwig, Wanted Dead or Alive? The Relative Value of Reef Sharks as a Fishery and An Ecotourism Asset in Palau, Australian Institute of Marine Science, Perth, 2010.
[66] G.M.S. Vianna, J.J. Meeuwig, D. Pannell, H. Sykes, M.G. Meekan, The Socioeconomic Value of the Shark-diving Industry in Fiji, University of Western Australia, Perth, 2011, p. 26.
[67] G.M.S. Vianna, M.G. Meekan, D.J. Pannell, S.P. Marsh, J.J. Meeuwig, Socio-economic value and community benefits from shark-diving tourism in Palau: a sustainable use of reef shark populations, Biol. Conserv. 145 (1) (2012) 267–277.
[68] G.M. Vianna, M.G. Meekan, A.A. Rogers, M.E. Kragt, J.M. Alin, J.S. Zimmerhackel, Shark-diving tourism as a financing mechanism for shark conservation strategies in Malaysia, Mar. Policy 94 (2018) 220–226.
[69] J. Vieira, G. Câmara, F. Silva, C. Santos, Airline choice and tourism growth in the Azores, J. Air Transp. Manag. 77 (2019) 1–6.
[70] C.A. Ward-Paige, A global overview of shark sanctuary regulations and their impact on shark fisheries, Mar. Policy 82 (2017) 87–97.
[71] P.C. White, A.C. Bennett, E.J. Hayes, The use of willingness-to-pay approaches in mammal conservation, Mammal. Rev. 31 (2) (2001) 151–167.
[72] J.C. Whitehead, Ex ante willingness to pay with supply and demand uncertainty: implications for valuing a sea turtle protection programme, Appl. Econ. 24 (9) (1992) 981–988.
[73] B. Worm, B. Davis, L. Kettermer, C.A. Ward-Paige, D. Chapman, M.R. Heithaus, S. T. Kessel, S.H. Gruber, Global catches, exploitation rates, and rebuilding options for sharks, Mar. Policy 40 (2013) 194–204.
[74] B. Worm, Marine conservation: how to heal an ocean, Nature 543 (7647) (2017) 630–631.
[75] J. Xiao, M. Wang, X. Gao, Valuing tourists' willingness to pay for conserving the non-use values of marine tourism resources: a comparison of three archipelagic tourism destinations in China, J. Sustain. Tour. (2020) 1–33.
[76] J.S. Zimmerhackel, A.A. Rogers, M.G. Meekan, K. Ali, D.J. Pannell, M.E. Kragt, How shark conservation in the Maldives affects demand for dive tourism, Tour. Manag. 69 (2018) 263–271.
[77] J.S. Zimmerhackel, M.E. Kragt, A.A. Rogers, K. Ali, M.G. Meekan, Evidence of increased economic benefits from shark-diving tourism in the Maldives, Mar. Policy 100 (2019) 21–26.
[78] A.M. Cisneros-Montemayor, M. Barnes-Mauthe, D. Al-Abdulrazzak, E. Navarro-Holm, U.R. Sumaila, Global economic value of shark ecotourism: implications for conservation, Oryx 47 (3) (2013) 381–388.
[79] M.L. Dicken, S.G. Hosking, Socio-economic aspects of the tiger shark diving industry within the Aliwal Shoal Marine Protected Area, South Africa, African Journal of Marine Science 31 (2) (2009) 227–232.
[80] R.C. Abecasis, P. Afonso, A. Colaço, N. Longnecker, J. Clifton, L. Schmidt, R. S. Santos, Marine conservation in the Azores: evaluating marine protected area development in a remote island context, Frontiers in Marine Science 2 (2015) 104.
[81] B.C. O'Leary, R.L. Brown, D.E. Johnson, H. von Nordheim, J. Ardron, T. Packeiser, C.M. Roberts, The first network of marine protected areas (MPAs) in the high seas: the process, the challenges and where next, Marine Policy 36 (3) (2012) 598–605.
[82] J.S. Link, R.A. Watson, F. Pranovi, S. Libralato, Comparative production of fisheries yields and ecosystem overfishing in African Large Marine Ecosystems, Environmental Development 36 (2020) 100529.