Shark-diving tourism in the Macaronesian archipelagos: challenges and opportunities

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Abstract
The Macaronesian region is typically heavily exploited by fisheries; however, in recent years, marine wildlife tourism has become popular and a shark-diving industry has emerged, potentially presenting an alternative for the sustainable use of sharks. Combining a literature review with interviews with dive operators conducting shark encounters in the Macaronesian archipelagos, we provide an overview of the challenges and conservation potential of shark-diving tourism for these territories. Owing to the regular presence of important shark species for tourism and the growth of the scuba-diving industry, shark-diving has potential to expand over the region. Yet, the overlap between European industrial fishing pressure and shark populations, coupled with the unregulated recreational and artisanal fishing sector in the Canary Islands and Cape Verde, may jeopardize the sustainability of the shark-diving industry. However, the economic benefits for local communities directly and indirectly produced by shark-diving tourism suggest local benefits, fostering stronger shark conservation in Macaronesia.

INTRODUCTION
The poor regulation of shark fisheries, including the common practice of shark-finning in the High Seas [1], [4], [5], has triggered a precipitous worldwide decline of many shark populations [3], [6]. Due to overfishing, sharks are currently accepted worldwide as a group for priority conservation [6], with 25% of the nearly 500 known shark species in the Red List of the International Union for Conservation of Nature – IUCN threatened with extinction [7]. In light of this situation, new economic perspectives, which may allow a more sustainable use of sharks are now being considered, such as shark-diving touristic industry. This type of non-consumptive use of sharks, first developed in the late 20th century [10], has been growing in popularity and today is a global phenomenon [11]. In recent years, sharks have become important attractions in many dive sites around the world, contributing to local, regional and national economies [10], [11], [12], [13], [14], [15], [16]. Observing these animals in their natural habitat either from boats or underwater with snorkel or scuba gear is a niche sector in the rapidly developing marine tourism market [17]. Aside from producing positive changes in tourist knowledge, attitudes, and conservation behaviors [18], [32] and making significant
contributions to national economies, the revenues from this industry may support the livelihood of local communities, and support conservation strategies and management [19], [20].

Shark-diving tourism has also seen an increase in academic attention. A review by Gallagher et al. [18] found that, until 2014, 47 original research articles focusing on some aspect of the shark-diving tourism industry were published, with 47% of these studies consisting of socio-economic analyses conducted at many scales. These studies generally concluded that, where shark-diving tourism is viable, the economic benefits from shark conservation are potentially larger than what can be achieved by fisheries exploiting the same resources [12], [19], [21], [33]. Therefore, identifying and assessing new potential sites for shark-diving tourism development is strongly encouraged in the greater literature [10], [21], particularly in those regions experiencing significant shark populations declines due to overfishing, such as in the Northeast Atlantic [23]. However, despite these declines, only around 10% of the scientific studies published on shark-diving tourism have focused on the Atlantic Ocean [18], despite the high number of shark-diving operations in this region [11] and to date no study has focused on the NE Atlantic in particular.

In the present study, we address this gap by mapping and contextualizing the opportunities, both current and potential, for shark-diving tourism within the Macaronesian archipelagos (the Azores, Madeira, Canary Islands and Cape Verde). This biogeographic region contains some of the highest rates of marine biodiversity in the North-East Atlantic Ocean [24], whereby species from diverse geographic areas meet [25]. It is particularly characterized by the presence of highly migratory pelagic shark species with moderate to high risk of extinction such as blue shark (Prionace glauca) [26] and shortfin mako shark (Isurus oxyrinchus) [27], together with other highly threatened demersal species such as angel shark (Squatina spp.) [28]. This region is also a hotspot for commercial fishing activities from small to large scale fleets, which pose significant risks to these species [29], [30], [31]. Here we summarize the challenges of the shark-diving industry in the Macaronesian archipelagos based on the analysis of the shark-related activities in the regional context, namely fisheries and tourism, and present the perspectives and opportunities for potential expansion of this market.
METHODS
We collected qualitative and quantitative data about shark-related activities in Macaronesia from a broad bibliographic review and documental analysis on the following subjects: shark-based tourism, shark fisheries and shark conservation. For this purpose, we used peer-reviewed publications, published PhD theses, government, NGO and newspaper reports, internet websites, UN databases and personal enquiries. Peer-reviewed publications were selected from the Science Citation Index Database (Web of Science) and Google Scholar.

From September to December 2019, we conducted interviews with diving operators in each archipelago of Macaronesia in order to understand the scale and potential about the shark-diving activity they provide. Prior to this, we identified and quantified all the official diving centers in the region through online search on the websites of national and regional authorities from Macaronesia and also performed an online search to identify non-official diving centers.

Then, we identified diving centers specifically advertising shark encounters as an associated service. The criteria used to select these companies included: (a) a banner on the website homepage featuring a shark image and/or text advertising a shark encounter and (b) operations directly promoting and pricing a specific shark encounter. Moreover, we also include in our analysis those companies mentioning sharks on their websites as part of the attractions of a given diving or snorkeling activity.

After we identified and quantified all the diving centers providing shark encounters in the Macaronesian archipelagos, we attempted to contact all of them and were successful in obtaining reply from 30% to 40% in each archipelago. The criteria used to identify those companies to be interviewed included: (a) conduct specific shark-diving operations; (b) be official diving centers and (c) include diversity in terms of geographic distribution, seniority and size of the operations. Thought the interviews, we quantified the scope of their operation through the following parameters: (a) number of years providing scuba-diving activities; (b) number of operations per year; (c) % of shark encounters operations; (d) price of shark-diving or shark encounters operations; (e) shark species observed; (f) frequency of shark observation and (g) seasonality. We also included an open-ended question about the potential of shark-diving tourism in each archipelago.
Since there are limited data available from the official sources, we used the Sea Around Us – research initiative database (http://www.seaaroundus.org) to elicit the volume of shark catches in the Exclusive Economic Zones (EEZ) of the Macaronesian archipelagos. We also collected the total landed values of sharks in order to compare the revenues generated from shark fisheries and shark-diving tourism.

MAIN FINDINGS
- We identified 228 diving centers in the Macaronesian archipelagos of which 129 companies advertised shark encounters. General shark encounters, defined as those encounters where sharks are not the main attraction of diving activities, were advertised by 120 diving centers. Meanwhile, specific shark encounters were advertised by 8 companies.
- The Azores is the only archipelago where it is possible to undertake specific shark-diving activities, mainly in Faial and Pico Island. Blue sharks are the main attraction of shark-diving operations, which occurs only during summer season (from July to September). Casual shark encounters in general recreational diving operations are common in the Canary Islands and Cape Verde. Madeira was the sole archipelago where shark encounters were not advertised.
- The total volume of commercial elasmobranchs catches between 2004 and 2014 in the Macaronesian archipelagos EEZ was 28,620 t with a total landed value estimated to be over USD $ 808.6 million. The Azores EEZ had the highest quantity with a total 22,360 t and landed value in order of USD $ 763 million.
- The primary shark species targeted by the diving industry are threatened by commercial and recreational fisheries. In particular, pelagic and migratory species overlap with Spanish and Portuguese industrial fisheries across all Macaronesian waters, while coastal species are being exploited by recreational and artisanal fisheries in the Canary Islands and Cape Verde.

CONCLUSIONS
Shark-diving tourism could be further developed in the Macaronesian archipelagos. However, although there may be some small operations that can persist on a local level, developing a robust industry that can provide incentives to local fishers for supporting diving activities requires to establish a regional policy to safeguard sharks. Increasing public awareness of the importance of sharks for ocean health, and, most critically - disseminating the ecological and
economic benefits of shark-diving operations to local authorities of each archipelago is the first stage in this process. It is also necessary to strengthen management and effective monitoring of shark (and fisheries in general) catches by local and foreign fleets operating in the Macaronesian waters, coupled with the creation of large-scale protected areas over the region.

References


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