



Dead or alive: The growing importance of shark diving in the Mid-Atlantic region



Paulo Torres^{a,*}, Nuno Bolhão^a, Regina Tristão da Cunha^a, José António Cabral Vieira^b, Armindo dos Santos Rodrigues^c

^a CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, InBIO Laboratório Associado, Pólo dos Açores, Departamento de Biologia, Universidade dos Açores, Rua Mãe de Deus, 58, 9500-801 Ponta Delgada, Açores, Portugal

^b CEEAplA, Centro de Estudos de Economia Aplicada do Atlântico, Departamento de Economia e Gestão, Universidade dos Açores, Rua Mãe de Deus, 58, 9500-801 Ponta Delgada, Açores, Portugal

^c IVAR, Instituto de Investigação em Vulcanologia e Avaliação de Riscos, Universidade dos Açores, Apartado 1422, 9501-801 Ponta Delgada, Açores, Portugal

ARTICLE INFO

Article history:

Received 23 July 2016

Received in revised form 19 January 2017

Accepted 20 January 2017

Keywords:

Prionace glauca

Isurus oxyrinchus

Ecotourism

Shark conservation

Azores

ABSTRACT

In the Mid-Atlantic Azores, the emergence of a seasonal ecotourism shark diving industry strongly contrasts with a North Atlantic shark fishery for regional, national and foreign fleets. Shark diving may provide an economic alternative to fishing, promoting an ecological and economical sustainable use of these animals, favouring their conservation. Understanding socio-economic aspects of this new Mid-Atlantic industry is the first step towards its sustainability and ultimately shark conservation. Data were collected by means of questionnaire designed to solicit information on shark divers' knowledge, socio-economic status, expenditures and expectations, conducted between July and August 2014 on Pico and Faial Islands, to 144 divers. The majority of respondents were male (71%), between 25 and 40 years (41%), mainly from Germany, Holland and Austria, and 44% visited the Azores purposely to dive with sharks. On average, 2.6 sharks were seen per dive and 97% of respondents did not perceive any form of shark aggression or threat. The estimated generated income of shark diving in 2014 for the Azores amounts to 1,983.347€ (around US\$2,244.890). Such an amount may easily increase following the current rates of expansion for (eco)tourism in the Azores and the infancy of the local shark diving activity. Finally, it is worth saying that nearly 70% of participants were willing to pay an extra amount until 60€ to ensure that shark diving remains an option and more than half (53%) would like to see that amount invested in conservation.

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1. Introduction

Shark fisheries are the most severe threats to these charismatic species, exploited for their fins, meat, liver-oil, skin, teeth and cartilage (Rose, 1998), especially considering their general life-history characteristics (slow growth, late attainment of sexual maturity, long life spans, low fecundity and natural mortality). As target species or as bycatch, several shark populations have been severely reduced (Dulvy et al., 2014; Field, Meekan, Buckworth, & Bradshaw, 2009). Recently, although catches and landed value are declining, global commodity trading of shark products has increased, largely as a result of increased demand from emerging Asian economies, as luxury goods (FAO, 2011). Hence, today

elasmobranchs are accepted worldwide as a group for priority conservation due to their vulnerability to fishing pressure (Bonfil, 1994; Fowler & Cavanagh, 2005) and importance for ecosystem health (Friedlander & DeMartini, 2002).

Given the high exploitation level over these species, new economic perspectives are required to allow a more conservative approach in their use, such as shark watching touristic industry. At the same time the utilization of sharks by the tourism industry offers the potential to contribute towards their conservation (Anderson & Waheed, 2001; Topelko & Dearden, 2005).

Shark diving tourism is a growing industry focused on viewing sharks underwater by either snorkelling or scuba diving (Gallagher & Hammerschlag, 2011). Since the early 1990s, when the picture of the killer shark began to fade, many divers started to spend money to get as close as possible to sharks of all temperament and sizes. As a result, sharks rapidly became important attractions in many dive sites around the world, contributing to local, regional

* Corresponding author.

E-mail address: biol.paulo@gmail.com (P. Torres).

and national economies in several countries such as South Africa, Maldives, Philippines, Thailand, Australia, Myanmar, Bahamas, United States and even Canada (Topelko & Dearden 2005). The industry is estimated to supply more than half of a million participants annually, distributed through approximately 85 countries (Cisneros-Montemayor, Barnes, Al-Abdulrazzak, Navarro-Holm, & Sumaila, 2013). Aside from its direct economic benefits, shark watching industry can also provide jobs and stimulate local economies through increased demand for transportation, lodging, food, nature interpretation and additional revenues from souvenirs, photography, postcards, the sale of dive equipment and other merchandise (Gallagher & Hammerschlag, 2011; Vianna, Meekan, Pannell, Marsh, & Meeuwig, 2012). It can also generate other indirect significant income as tourists attracted to an area to observe sharks also undertake other activities (Davis, Banks, Birtles, Valentine, & Cuthill, 1997).

This type of non-consumptive use of sharks has been growing in popularity and some studies suggest that the economic benefits may be considerable (Clua, Buray, Legendre, Mourier, & Planes, 2011; Dicken & Hosking, 2009; Gallagher & Hammerschlag, 2011; Rowat & Engelhardt, 2007; Vianna et al., 2012). However, research is still scarce as discussion continues to focus on the central question of knowing if the economic benefits/incentives associated with shark watching are sufficient to encourage a reduction in fishing pressure, contributing at the same time to shark conservation (Brunnschweiler & Ward-Paige, 2014; Catlin, Hughes, Jones, Jones, & Campbell, 2013; Gallagher et al., 2015).

The Azores is an emerging touristic destination for marine-related activities such as sailing, surfing, whale and dolphin watching and, more recently, scuba diving and shark diving (Calado, Borges, Phillips, Ng, & Alves, 2011). Although hunted in the past, whales nowadays play an important role within the touristic sector. Whale watching generates over US\$ 2.1 billion dollars worldwide, with a 15.5% annual growth rate just in the Azores (O'Connor, Campbell, Cortez, & Knowles, 2009). After a number of decades such activity is now viewed as a profitable alternative to whaling (which has ceased for conservation purposes). Shark diving is a new and emerging (it started in 2011) marine wildlife touristic activity with economic potential (Bentz, Dearden, Ritter, & Calado, 2014; Ressurreição & Giacomello, 2013). The blue shark *Prionace glauca* (Linnaeus, 1758) and shortfin mako shark *Isurus oxyrinchus* (Rafinesque, 1810) are the main shark attractions (mainly the former) of a diving experience that it is only performed in a few Islands.

Prionace glauca is the most commonly caught pelagic shark, with worldwide annual catches estimated around 10.7 million individuals or 360,000 t (Clarke et al., 2006). In the North Atlantic, this species constitutes 60–80% of the catches of the European pelagic longline fishery (Oceana, Fundación, 2009). *Isurus oxyrinchus* is also an important component of these fleets, for both meat and fins, and some concern over its population status has emerged as recent literature suggests significant declines in certain areas (Baum & Myers, 2004). In this context, and according to IUCN conservation status, *P. glauca* is listed as Near Threatened and *I. oxyrinchus* as Vulnerable. In the Azores both species are landed as bycatch of the swordfish pelagic longline fishery (Torres, Tristão da Cunha, & Rodrigues, 2016). This fishing pressure contrasts with their recent economic ecotourism use in the Mid-Atlantic which should be addressed, especially given that studies on the subject are absent.

Given the unique features of the Azores, socio-economic needs and potential natural resources availability, it is vital to undertake a first study focused on a quantitative assessment of sharks' value as a tourism economic resource. The present paper aims to estimate the economic value of shark diving industry in the Azores and to gather data on participant knowledge, expectations, experiences and expenditures. This information is then used to discuss the recreational usage value of sharks contrasted with fisheries and

the potential implications to shark conservation, vital in developing and maintaining a sustainable shark diving industry.

2. Methods

2.1. Study area

The Azores are a small, archipelagic and a dispersed island region, with nearly 250,000 inhabitants. The archipelago is composed of nine islands forming three groups (Western: Flores and Corvo Islands; Central: Faial, Pico, Graciosa, São Jorge and Terceira Islands; Eastern: São Miguel and Santa Maria Islands). The main economic activities are public services, commerce, fishing, cattle and dairy products. Tourism expanded in the Azores over the last two decades and is considered a promising activity. Indeed, as a result of a policy orientated towards its promotion as an ecotourism destination and the increase of the accommodation capacity, the number of guests in the accommodation units rose by 155% between 1994 and 2014, yielding an average annual growth rate of approximately 4.8%. The growth rate sharpened from 2014 to 2015, reaching a figure equal to 22%, likely due to the entrance of low cost airlines which started to fly to the region from the mainland.

The Azores includes a maritime territory of about 1,000,000 km² with an average depth of 3000 m located in the Mid-Atlantic region (36–39°N and 25–31°W) (Fig. 1). Given the absence of a continental shelf, fishing occurs around the island slopes and in the seamounts within the area (Morato et al., 2008). Fishing is part of the Azores history and culture and is vital for its economy, and traditionally is characterised as artisanal (the use of traditional, passive fishing gears and methods and labour intensive) small-scale (reduced vessel size with limited area of operation) and considered sustainable (Carvalho, Edwards-Jones, & Isidro, 2011).

Pelagic longlines targeting swordfish were first introduced in the Azores in 1987 (Pereira, 1988), for which blue sharks (*Prionace glauca*) and shortfin mako sharks (*Isurus oxyrinchus*) were the main elasmobranch discarded species (Simões, 1998). The Azores do not have an elasmobranch directed commercial fishery, although some species are landed as bycatch and sometimes through multi-species fishing techniques. Nonetheless, *P. glauca* was the main elasmobranch species landed as bycatch by the Azorean fleet in the last decade (Torres et al., 2016).

2.2. Shark diving

Shark diving started as an industry in 2011, between July and September, and nowadays there are seven operators in the Azores, only in Pico and Faial, two very close-by Islands (around 8 km). To identify these specific established shark ecotourism operation the following criteria were considered: (a) a banner on the website homepage featuring a shark image and/or text advertising a shark encounter; (b) operations directly promoting a specific shark 'adventure', 'encounter', or 'package'; (c) operations providing specific pricing for shark-related activities; and (d) verbal descriptions citing sharks as the main goal or objective of a given diving or snorkelling activity. All operators require at least 50 logged dives and a level similar to PADI Advanced Diver Course, so only divers with some level of expertise can dive and each dive costs between 165 and 175€ depending on the operator.

Prionace glauca is the main attraction of this activity which is mainly performed in a single dive site, the Condor Seamount, located about 18.5 km (10 nautical miles) southwest of Faial Island (Fig. 1). This seamount has been used for about three decades as a fishing ground by local bottom longline commercial fleet. However, since 2009 it has been temporarily closed to demersal commercial

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