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Public awareness of the economic potential and threats to sharks of a tropical oceanic archipelago in the western South Atlantic

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ABSTRACT

Conservation actions for sharks are hampered partly by the negative beliefs and inaccurate knowledge about them among the general public. This paper investigated the knowledge and attitude of residents and tourists towards shark species of Fernando de Noronha Archipelago, a marine protected area, and one of the major ecotourism destinations in Brazil. Findings showed that residents had a lower knowledge of sharks and less positive attitudes towards sharks than tourists. Even though residents did not see sharks as threats to humans and they were aware of the role of the archipelago as a shark nursery, they did not completely understand the sharks' ecological and economic importance. This distinction between residents' and tourists' perceptions of sharks demands different strategies to assure engagement in management and conservation policies relating to both groups. Management actions focusing on providing enjoyable experiences with sharks to residents and enhancing their participation in tourist activities related to sharks are presented. They would require innovative cooperation between scientific, management and environmental institutions to build initiatives aimed at increasing the knowledge and improving attitudes of residents towards shark conservation and to homogenise conservation values held by the entire public on the archipelago.

1. Introduction

Shark populations are declining worldwide due to a variety of human activities, including fishing, habitat destruction, pollution and climate change. Currently, the main threats to these animals are the incidental and directed fisheries, and the demand for their fins in the Asian market that results in the death of approximately 100 million sharks per year [1]. This decline is also exacerbated by the reproductive characteristics of most shark species, which are characterized by slow growth, late sexual maturity and having few offspring, when compared to bony fishes [2]; this results in a reduced population potential to resist or recover from the high mortality rates caused by commercial fishing. Indeed, 20% of the nearly 500 known shark species are currently included in one of the categories of risk of extinction in the Red List of the International Union for Conservation of Nature [3]. In the North Atlantic, for example, populations of pelagic species of sharks have declined by 90–99% in the last 60 years [4].

From an ecological viewpoint, most sharks are opportunistic apex predators and, as such, they contribute to regulating the populations of species in lower trophic levels and to maintain the balance of marine ecosystems [5]. The massive removal of sharks has direct and indirect effects that may result in trophic cascades in the marine ecosystems, which affect other organisms, human communities and commercial activities [6,7]. The loss of sharks in aquatic ecosystems also has socioeconomic consequences. Sharks represent a source of protein and products such as leather, cartilage, oil and fins that are important for several communities in both developed and developing nations [8], as well as the high income generated by their exploitation as a tourist resource [9]. In this sense, the economic value of shark ecotourism was estimated at US $78 million per year in the Caribbean and Bahamas [9] and at US $40 million per year in the Indo Pacific [10].

Despite their ecological and economic importance, one of the main problems faced by conservation efforts for sharks is their negative image produced as a consequence of their occasional attacks on humans. Most of the general public has a negative view of sharks and considers them as human-eaters or vicious murderers, a stereotype that is often exacerbated by the media

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through melodramatic representations and reporting inaccurate knowledge about them [11,12]. These negative preconceived notions about sharks, often disseminated by the way they are erroneously portrayed by the media, can hamper public support for their conservation [13]. In fact, specialists now recognise that not only the production of scientific knowledge for management will be sufficient to promote shark conservation [14]. Positive public attitudes influence the general support to conservation actions for shark protection, such as supporting the end of finning and the fin trade. As members of the public are not uniform in its opinions and knowledge, their engagement in shark conservation may differ [5]. Thus, the success of shark conservation ultimately depends on the ability of researchers and educators to communicate the functional role of sharks in regulating marine ecosystems [14] and to promote a change in attitudes [15].

In this sense, many variables may affect public attitudes in relation to the environment (such as age, gender, income, ethnicity and participation in environmental activities). Formal and informal knowledge has been identified as the factor most likely to change attitudes and perceptions [16]. Evidence has shown that one's knowledge level can significantly predict one's personal attitude and behaviour about conservation [17].

Hence, the main goal of this paper was to investigate the differences in knowledge and attitude towards sharks between residents and tourists of a tropical oceanic archipelago, which is a marine-protected area and a major ecotourism destination in Brazil. The hypothesis under assumption is that both groups present different perceptions, with tourists more informed and more prone to shark management actions than residents.

2. Methods

2.1. Study area

Fernando de Noronha Archipelago (hereafter referred to as Noronha) is an isolated group of volcanic islands with a total area of 26 km^2, located 345 km off the north-eastern coast of Brazil. About 60% of the main island of the archipelago and the insular shelf within the 50 m depth isobaths constitute a Marine Protected Area (MPA) established in 1988. This MPA is designed as a National Marine Park, a Brazilian category of conservation unit, which allows scientific research, environmental education and ecotourism activities. The remaining 40% of the archipelago's main island and insular shelf is an Environmental Protection Area, a conservation unit designed for sustainable use of natural resources. It consists of public and private lands, and is the area where the human population of Noronha is allowed to reside [18]. The population of Noronha consists of approximately 2800 permanent and 900 temporary residents, totalling 3700 residents. Ecotourism is the main economic activity of Noronha, which receives about 60,000 people annually, most of them coming from south-eastern Brazil [18,19, Administration of Noronha (ADEFN), unpublished]. Diving is one of the main attractions, with approximately 24,000 divers visiting Noronha annually [Brazilian Environmental Agency (ICMBIO), unpublished].

2.2. Sharks in Noronha

There are at least 20 shark species known to exist in Noronha [20,21]. The three most common shark species of Noronha, namely the Caribbean reef (*Carcharhinus perezi*), nurse (*Ginglymostoma cirratum*) and lemon sharks (*Negaprion brevirostris*), use the insular shelf as a nursery and mating area where their juveniles are resident [22–24].

Local diving business operators believe that a local fishery operating from 1992 to 1997 targeting sharks outside the protected areas of Noronha depleted populations of *C. perezi* and *N. brevirostris*. At least 498 *C. perezi* were caught in the last 18 months of this fishery, representing 60% of the total shark catch during that period (Noronha Pesca Oceânica, unpublished). This fishery became unprofitable in relation to marine ecotourism opportunities before being closed in 1997 (Veras, L., owner of Noronha Pesca Oceânica, personal communication).

2.3. Data sampling

Data on knowledge and attitude were collected by interviews with residents and tourists visiting Noronha. The questionnaire was composed of open-ended questions that collected information on gender, age, educational level, time of residence in Noronha (for local inhabitants) and place of origin (for visitors). Additionally, 10 questions assessed specific knowledge of sharks and six other questions assessed attitudes towards shark species. Both inhabitants and visitors were randomly approached, but, before any interview, the purpose of the study was given and those who agreed to participate were interviewed. All interviews were conducted between February and July 2011 and in January 2012.

Information sampled by the 10 questions was used to create an index to measure the degree of knowledge of sharks. Eight questions (Table 1) were described by binary values (0–1). Correct answers were scored as one while incorrect or unanswered questions were scored as zero. Two questions had scores ranging from one to four (regarding to shark species occurring in Noronha and on the role of sharks in the environment; Fig. 1). If the interviewee quoted just one shark species from Noronha and one role of sharks in the environment, the question was scored as a one. When two species and roles were quoted, the question was scored as a two. The same process defined when interviewees reached scores three and four. The value for the index of knowledge ranged from zero up to 16, which is the maximum value for all answers summed, assuming only correct answers.

Information sampled by the six questions on attitude was used to calculate an index of attitude. Four questions were described by binary values (Table 1). The two remaining questions (actions to protect sharks and people that should be in charge of this task, see Fig. 1) received scores ranging from zero to four, which were defined according to the number of actions and people/institutions quoted by interviewees. In case of just one action and one person/institution being quoted, the question was scored as a one. If two actions and people/institution were quoted, the question was scored as two and so on, until reaching the scores of three and four. The values of these questions were summed to create an index of attitude ranging from zero to 12. Higher values represented more favourable attitudes towards sharks.

2.4. Statistical analyses

For binary coded questions, *G*-test (Yates) analyses were performed to compare the proportions of binary answers (Yes=1; No=0) among residents and visitors. Questions that were not answered or were answered by "I do not know" were excluded from the analyses, due to their low frequency of occurrence. For non-binary coded questions, *G*-tests (Yates) were also used to compare the proportions of each category of answers among residents and visitors. The *U*-test was used to compare age, educational level, index of knowledge and index of attitude between residents and visitors. Spearman correlations were performed to determine whether there was an association between these variables. All analyses were performed with the software Statistica® and significance levels were set at 5%.