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The conflict between the southern right whale and coastal fisheries on the southern coast of Brazil

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ABSTRACT

The objective of this study was to identify the interactions and conflicts that exist between the southern right whale (*E. australis*) and the coastal fisheries performed in the Southern Right Whale Environmental Preservation Area (EPA) in the state of Santa Catarina, southern Brazil, through the knowledge of local fishers. Thirty-three ethnographic interviews held in October 2010 found that 81.8% ($N=27$) of the fishermen interviewed were able to identify the species by its area of occurrence, coloration, and body size. The subsequent analysis of interviews was based on those 27 fishermen selected. There were no reports of positive interactions, and 52% ($N=14$) of those interviewed described negative interactions related to whales "tearing and/or dragging the gillnets". Accidents between whales and fishing vessels were described by 44% ($N=12$) of the fishermen. Accidental captures in gillnets were mentioned in 48% ($N=13$) of the interviews and fishermen believed that these events were caused by whales failing to see gillnets in the water ($N=4$) and by the position of these nets in the routes frequented by the mammals ($N=9$). In the fishermen's eyes this type of interaction has minimal impact on fishery. Therefore, is suggested the monitoring of areas frequented by whales and fishery, the use of gillnets away from these animals' migration routes, the search for alternative and lower-impact fishing activities, and the training of local actors for sustainable whale watching tourism in the region.

1. Introduction

Commercial whaling in the state of Santa Catarina (27°S, 49°W), southern Brazil, began in the mid-17th Century with the installation of whaling stations in this region. The oil extracted from the animal's fat was used for illumination, as a lubricant, and in the fabrication of mortar used in the masonry of buildings in the coastal cities of the state. A portion of this oil was also exported to Portugal [1].

The southern right whale (*Eubalaena australis* Desmoulins, 1822) became the main target of this whaling activity in the region due to its habit of remaining on the ocean surface for long periods of time. In 1987, Federal Law no. 7.643/87 prohibited whaling and since then the number of whales that migrate seasonally along the coastlines of the country appears to have increased with each passing year [2,3]. The last intentional whaling incident for which there is official registration occurred in 1973 near the municipality of Imbituba, state of Santa Catarina, with no other reports of this activity in the region thereafter [2,4].

Brazilian waters with the highest concentration of the species lie off the state of Santa Catarina, between Ilha de Santa Catarina (Florianópolis) (27°25′S, 48°30′W) and Cabo de Santa Marta (28°36′S, 48°48′W) [5–7]. The Southern Right Whale Environmental Preservation Area (Southern Right Whale EPA), a Federal Preservation Unit instituted in 2000, is located within this region and extends from the south of Ilha de Santa Catarina to Praia do Rincão (28°42′S, 49°16′W) [8]. Within the limits of the Southern Right Whale EPA local artisanal fishermen share their fishing waters with the southern right whale [2,9].

According to Diegues [10,11], artisanal fishermen consist of a group that makes use of family labor for subsistence activities based on fishing and local/traditional inherited knowledge. Fishery

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resources are generally sold in local or regional markets, a port of which is reserved for household consumption. These fishermen report that they interact positively with small cetaceans that are distributed in fishing areas, as for example when animals aid in human fishery by indicating the locations of schools of fish (e.g., [12–14]), but regarding baleen whales this kind of interaction is not described. Apparently, these interactions are positive only for humans. Negative interactions that involve dolphins and baleen whales are described, as in cases of cetacean entanglement in nets and collisions with boats (e.g., [15,16]). In relation to baleen whales, there are no studies based on local knowledge of small-scale fishermen or describing any type of interaction between fishermen and the large cetaceans.

In this context, ethnobiological studies have shown the importance of seeking local knowledge of fishermen to provide information about the biology and ecology of the cetaceans species based on empirical knowledge [14]. In Brazil, few ethnobiological studies have evaluated the local knowledge of artisanal fishermen with respect to whales and these studies do not expound the issues involving the interactions [17–19]. With respect to the southern right whale, little is known about fishermen perceptions related to conflicts among small-scale fishing, the species' preservation, and the whale watching tourism in the Southern Right Whale EPA [9].

2. Whales strikes in fisheries

Aquatic mammal populations distributed in areas with heavy motor vessel traffic and fishery are more vulnerable to such human activities [20,21]. The noise produced by the engines can affect the behavior of these animals, since they use echolocation to communicate and perceive their environment [22]. Some baleen whales may not be able to detect sounds originating from surface boats which can lead to collisions [23]. Those collisions could interfere negatively in the recovery of the populations of whales that suffered high losses due to past hunting [22]. Despite fishing boats being small and easily maneuverable, accidents involving these vessels can cause external damage to hulls in addition to causing injury or death of the animals [23,24].

Throughout the world, there is the need for a global database of incidents involving collisions between fishing boats and cetaceans [25]. In this sense, measures to mitigate the ship strikes are recommended as a matter of high priority [26]. Many such accidents could be avoided by training fishing crews to recognize the presence of cetaceans [22].

Another accident that involves fishery and large whales is entanglement in fishing gear that can cause impaired foraging resulting in starvation after many months; infection arising from open wounds and hemorrhage or debilitation due to gear-related damage to tissues [15]. Various studies carried out worldwide have described such accidents between fishery and large whales [27–34]. In order to maximize fishing yields, gillnets are designed to be nearly invisible when underwater [35]. Because of this, one of the factors that contribute to the entanglement of cetaceans is not detecting the strands of the mesh [36].

Whales' eyesight is not highly developed, having only low resolution related to the presence of monochromatic cones in the eyes that indicate levels of color blindness [37,38]. Limited color perception could be an unfavorable factor in an underwater environment because the spectral composition of light in the blue water of the ocean becomes more displaced at lower depths [38]. The problem of entanglements is not detection, but perception of the obstacle, as animals may perceive the mesh as a penetrable object [39]. Gillnets have their breaking strength and elongation reduced when exposed to sunlight. One year after the monofilaments have been used, the net can disintegrate and lose its fishing ability completely [40]. This photo-degradation leaves the net more brittle over time [41]. The hypothesis that fishermen could take advantage of the effect of photo-degradation of gillnets and blame the cetaceans of damaging the artifacts is not justified, since many times fishermen put new gillnets in the water and after a few hours they are damaged.

In Southern Brazil, Simões-Lopes et al. [6] reported bycatch of southern right whales calves by gillnets and Zerbini and Kotas [42] related that baleen whales can be released alive from entanglement, but sections of net may remain attached to their bodies. In most cases, deaths occur among calves due to their relatively small size. In the state of Paraná, Southern Brazil, Przbylski and Monteiro-Filho [43] related the sighting of one southern right whale which remained a few days with fishing net stuck in its head. According to fishermen, as there is an increase of fishing in oceanic and coastal areas, larger numbers of nets are positioned in the water, increasing the number of cetaceans killed [42,44]. Baleen whale entanglement has been regarded as both a major challenge for preservation efforts and a threat to the well-being of each affected individual [15].

In the Southern Hemisphere, the number of southern right whales in their wintering grounds and the annual growth rates of these populations range have been estimated between 7% and 8% [45–48]. In Brazil, more *E. australis* are seen each year and apparently the population has increased at a rate of 29.8% per year [3]. There have been no studies on the number of accidental captures and collisions of southern right whales with fisheries vessels in their EPA region [1]. Informal observation has led some people to report an increase in the number of accidental entanglements of this species, especially with respect to calves (M.L. Danielski, personal communication).

So, because of the increment, in each year, of sightings of whales in Southern Brazil, increased too the occurrence of conflicts with human activities [3]. In this sense, the increase of southern right whales population in the Southern Right Whale EPA and the fishery practices in the region, this study aims to describe through reports of artisanal fishermen the interactions between fishermen and southern right whale and the occurrence of conflicts arising from these interactions. With the results, the authors propose possible solutions for the conflicts.

3. Materials and methods

3.1. Area of study

The municipality of Garopaba (28°01′S, 48°36′W), located on the mid-southern coast of the state of Santa Catarina, possesses a coastal area of 108 km^2 that lies within the Southern Right Whale EPA (Fig. 1). This region is home to the Z-12 Fishermen's Colony and according to Rebouças [9] there are 11 fishing associations in operation. In these associations, 500 fishers of diverse Garopaba communities and neighboring municipalities are registered. This study was performed on the beaches of Gamboa, where there are 30 registered fishermen, and on Garopaba beach, where 50 fishermen are registered.

3.2. Procedures

Studies related to local ecological knowledge are subjective and complex, because they are based on beliefs and symbols of a community [49]. The qualitative approach, in which reports of local members are obtained, showed to be appropriate for these studies related to cultural perception, because it does not quantify, but allows the approach between subject and object. This enables