



Research article

Tourism as a driver of conflicts and changes in fisheries value chains in Marine Protected Areas



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ABSTRACT

Although critical tools for protecting ocean habitats, Marine Protected Areas (MPAs) are sometimes challenged for social impacts and conflicts they may generate. Some conflicts have an economic base, which, once understood, can be used to resolve associated socioenvironmental problems. We addressed how the fish trade in an MPA that combines no-take zones and tourist or resident zones creates incentives for increased fisheries. We performed a value chain analysis following the fish supply and trade through interviews that assessed consumer demand and preference. The results showed a simple and closed value chain driven by tourism (70% of the consumption). Both tourists and local consumers preferred high trophic level species (predators), but the former preferred large pelagics (tuna and dolphinfish) and the latter preferred reef species (barracuda and snapper). Pelagic predators are caught with fresh sardines, which are sometimes located only in the no-take zone. Pelagic species are mainly served as fillet, and the leftover fish parts end up as waste, an issue that, if properly addressed, can help reduce fishing pressure. Whereas some of the target species may be sustainable (e.g., dolphinfish), others are more vulnerable (e.g., wahoo) and should not be intensively fished. We advise setting stricter limits to the number of tourists visiting MPAs, according to their own capacity and peculiarities, in order to avoid conflicts with conservation goals through incentives for increased resource use.

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1. Introduction

Establishing and maintaining Marine Protected Areas (MPAs) should be a priority for all countries, especially those that have committed to protecting at least 10% of their marine habitats by signing the United Nations Convention on Biological Diversity (Coad et al., 2009). Yet, this goal has been hard to reach on a global scale. While advances towards conservation initiatives have been considerable in some countries (Halpern, 2014), they have been delayed in others, such as Brazil (Schiavetti et al., 2013). There are various reasons for that, many associated to some economic interest (Cheung and Sumaila, 2008; Di Dario et al., 2015; Soares-Filho et al., 2014). Commercial fisheries are one such example

that tends to see conservation as an obstacle (Di Dario et al., 2015), despite the growing evidence for the positive effects of conservation on fishery catches (Garcia et al., 2015).

Fisheries have removed fish biomass from the oceans at alarming rates (Pauly and Zeller, 2016). This has resulted in many collapsed and collapsing stocks, including those exploited by small-scale fisheries (Costello et al., 2012). Although some of these stocks have been giving signs of recovery after proper management (Costello et al., 2016), this mostly happens in developed countries able to afford long term funding (Worm et al., 2009). All this makes it vital to explore how to better manage fisheries. MPAs are typically proposed by conservationists as a suitable candidate (Costello and Ballantine, 2015; Edgar et al., 2014), based on evidence suggesting that well planned and enforced MPAs can result in significant improvements in fish biomass and ecosystem health (Bonaldo et al., 2017; Mumby et al., 2006).

On the other hand, conservation efforts should consider the

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economic and social relevance of fisheries (Coulthard et al., 2011; Damasio et al., 2016). Although fisheries represent a relatively small percentage of global GDP, with one estimate at 1% (The World Bank et al., 2010), they are highly relevant in many regions of the world for local livelihoods (Béné et al., 2016, 2009; Damasio et al., 2016). Such regions are often biodiversity-rich but economically poorer, where establishing no-take MPAs can negatively impact livelihoods and meet strong opposition by fishery dependent stakeholders (Agardy et al., 2003; Lopes et al., 2013; Nayak et al., 2014).

Brazilian small-scale fishers, although loosely organized, have in some instances questioned the legitimacy and the limits of Brazilian MPAs (Diegues, 2008; Lopes et al., 2013). In most cases, fishers complain about losing their access rights, without previous consultation or involvement in conservation initiatives (Lopes et al., 2013; Prestrelo and Vianna, 2016). In such cases, the protection level or the limits of an MPA might be revised.

A first step to gather evidence to support or avoid changes in MPAs should be a better understanding of the underlying economic reasons driving resource exploitation (Cheung and Sumaila, 2008; Garcia Rodrigues and Villasante, 2016; Thyresson et al., 2013) and conflicts due to people being forced to comply with conservation initiatives (Lopes et al., 2013). For example, it is important to understand the fisheries and fish trade that depend directly or indirectly on MPAs (Bennett and Dearden, 2014; Roberts et al., 2001). The structure of local, regional and international markets may be responsible for a significant part of the fishing pressure on local stocks (Cinner and McClanahan, 2006). Fishers, often the first to be blamed, may be the weakest link in a process that begins in the sea and ends on a consumer's plate.

Like fishers, consumer choice also needs to be better understood, first because consumers create the demand and second because preferences can vary over time. Preferences are shaped by multiple factors, such as universal values (caring for nature), perceived effectiveness of their choices, conformity, and even peer pressure (Aertsens et al., 2009; Hoogland et al., 2007; Vermeir and Verbeke, 2006). Even when geared towards more sustainable behavior, consumers could be misled into believing that eating local and unprocessed food may have no or few consequences on the ecosystem (Edwards-Jones, 2010). However, the recommendations for sustainable consumption should consider fish species, their life history, as well as fishing methods. That is so because some fish species have longer lifespans with low fecundity, which make them more vulnerable to exploitation (Begossi et al., 2012). Other species play key roles in the ecosystem, controlling the presence and abundance of other species (Cheal et al., 2010; Myers and Worm, 2003). Besides, some fishing methods are more detrimental to the environment, either because they present low selectivity (Arellano-Torres et al., 2006; McClanahan and Mangi, 2004), destroy the seabed (Brennan et al., 2015) or demand unsustainable baitfish (Rahel, 2016).

In this context, the main goal of this study was to evaluate the role of economic forces underlying the cause of management conflict in a tropical oceanic island MPA. We used the archipelago of Fernando de Noronha (Brazil) as a case study, which includes no-take zones and areas that allow tourism and residency. While the possibility of a near future re-categorization of this MPA and its no-take zones added weight for choosing Fernando de Noronha, many protected areas currently face similar risks of losing their legal conservation status (Bernard et al., 2014; Mascia and Pailler, 2011). Specifically, we investigated how the fish value chain, including the supply and trade pathway from the boat to the plate, can be an important driver of conflicts and how different types of consumers (locals and tourists) have different indirect impacts on fish exploitation. We expected to identify economic aspects along the

fish value chain that could be addressed in order to avoid or decrease socio-environmental conflicts that threaten the effectiveness of conservation. We believe that it is important to understand if the same invisible hand of the market that hampers conservation initiatives could also hold the solution for more effective MPAs.

2. Material and methods

2.1. The case study

Fernando de Noronha is a volcanic archipelago formed by 21 islands, islets and rock outcrops, located about 345 km offshore the Brazilian northeastern (Fig. 1). The archipelago is home to multiple reef and rock fishes (e.g., snappers, jacks and parrotfishes), a nursery spot for others (e.g., lemon and nurse sharks), and it is on the migratory route of large pelagic species (e.g., tunas, rainbow runner, wahoo and dolphin fish) (Table S1).

The Fernando de Noronha MPA is divided into two management categories: 70% of its area is a no-take zone (controlled tourism is allowed) and 30% is a sustainable use zone (dwelling, fisheries and tourism are permitted). Following the Brazilian protected area system, known as “conservation units”, the no-take zone is called “Park”, while the remaining is called “Environmental Protection Area”. The archipelago holds an estimated resident population of over 5000, plus the average flow of almost 6000 tourists per month (ICMBio, personal communication). The administration of the island and its infrastructure (roads, hospital, school, etc.) is a state responsibility. The state charges tourists a daily fee, benefitting directly from tourism through tax collection. The entrance of visitors and tourists in the archipelago is limited by the number of flights per day, which has been growing regularly in the last decade, due to the state political pressure and interests to promote tourism in the area.

Such interests conflict with the MPA interests. According to recent reports and studies, the archipelago has reached its carrying capacity and has a large tourism ecological footprint (Feitosa and Gómez, 2013), giving signs that it cannot deal with the increasing water use, sewage, and waste produced (Pagano, 2001). For the most part, the MPA warnings regarding the carrying capacity have been ignored or dismissed, except for the no-take area where the MPA has full control and enforces visitation limits (Falcão, 2010). There are additional charges to enter the no-take zone, which is directed to the institute in charge of managing federal protected areas in Brazil (ICMBio). Some areas do not allow any tourist visitation.

The fishing of pelagic and reef fish is done with powerboats, using fishing rods, outside the no-take zone, and, for the most part, outside the outer limits of the MPA. However, fishers want to access the no-take zone during part of the year, due to the arrival of swells that limit the catching of baitfish in the 30% allowed area. This demand has generated escalating conflicts in the last six years. However, the roots of the conflict go back to 1988, when the park was created. At the time, the advocates of the MPA and the fishers reached an understanding that allowed some level of extraction even within the no-take area. Sardines, for instance, could be caught inside the no-take zone, under adversary conditions (swell) outside its limits. Although conflicts happened during this period, sardine fishing continued to happen. In 2000, all conservation units in Brazil started being managed under a specific law (SNUC) that clearly forbade resource extraction in areas classified as “parks” (i.e., no-take zones) (Rylands and Brandon, 2005). Still, the Fernando de Noronha MPA kept some of its old permissiveness by maintaining managers that turned a blind eye or implemented informal deals with fishers to some eventual use of the no-take

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