



## Mapping fishers' perceptions of marine conservation in Brazil: An exploratory approach

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### ABSTRACT

This paper proposes an 'exploratory mapping' approach that can be employed in the early stages of a marine protected area planning process. While stakeholders' involvement in conservation has increased, it often only starts after the decision has been made about where the protected areas will be located. The lack of proper engagement with resource users raises questions about transparency and legitimacy of marine conservation initiatives, hampering their successful implementation. The proposed mapping approach offers a simple way to incorporate in the planning process what small-scale fishers consider to be important to conserve, what they value in their fishing livelihoods, and their perception about the likely impact that multiple uses of the area may cause. Conducted in a small group setting, the exploratory mapping approach is casual and conversational, using paper maps and markers to capture information and stories as they are told. The approach was tested with 14 small-scale fishers living near the Marine National Park of Currais Islands, Southern Brazil. The mapping results, based on the GIS analysis, show a high level of agreement among the study participants with respect to the ecological importance of the area under protection. The participants emphasized that, in addition to its ecological significance, the area is also important in economic and socio-cultural terms, aspects that should be considered in the planning. The study highlights how the exploratory mapping approach can provide decision makers with useful information about small-scale fishers' values and knowledge, which can help identify potential conflicts and enhance support for marine protected areas.

### 1. Introduction

Marine ecosystems around the world are facing unprecedented biodiversity loss and fisheries overexploitation (Halpern et al., 2008; Pauly and Zeller, 2016; Worm et al., 2006). To help address this issue, marine protected areas (MPAs) are widely promoted as a tool that can contribute to conservation, and in some cases to fisheries management (Halpern, 2003; Halpern and Warner, 2002). In addition to contributing to the enhancement of species biodiversity and biomass within delimited areas (e.g. Edgar et al., 2014; Lester et al., 2009), MPAs have been shown to support increases in catches outside of their boundaries (Costello, 2014; Halpern et al., 2009; McClanahan and Mangi, 2000).

Many countries have more actively created MPAs in response to the call to expand MPA networks to 10% of national waters by 2020, a goal set by the Aichi Target agreed upon at the 2010 Conference of the Parties to the Convention on Biological Diversity (CBD, 2010). However, with less than 5% of the world's coasts and oceans currently protected by MPAs, a question is raised about the likelihood that the

target will be reached (Sala et al., 2018).

Since quantity does not necessarily convey quality, what hampers ocean sustainability is not only the low MPA area coverage, but also the numerous challenges facing MPA implementation (Chuenpagdee et al., 2013; De Santo, 2013; Wood et al., 2008). There is still no consensus, for instance, about what MPAs are for and how best to implement them. Some studies have criticized MPAs for making too much compromise with stakeholders and the existing socio-economic activities at the cost of conservation (Devillers et al., 2014; Meinesz and Blanfuné, 2015). Other studies show that the focus on biological and ecological criteria dominating most MPA designation can undermine social and economic issues considered important by various user groups, especially small-scale fishers (Mascia et al., 2010; Thorpe et al., 2011). Thus, it is imperative to pay attention to small-scale fishers' perceptions towards MPA designation and implementation (Christie et al., 2017; Martins et al., 2014; Silva and Lopes, 2015), and to the values that fisheries stakeholders attribute to resources and ecosystems (see e.g. Jentoft et al., 2012; Martins et al., 2014; Mascia et al., 2010; Silva and Lopes,

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2015; Song et al., 2013). Incorporating these ‘meta-order’ elements, such as values, images and principles (Kooiman and Jentoft, 2009) in MPA design and implementation, especially at the ‘step zero,’ can help enhance their effectiveness (Chuenpagdee et al., 2013).

While the role of local people in MPA implementation and the importance of understanding their values and perceptions is recognized (Ferse et al., 2010; Xavier et al., 2018), there are many challenges when fostering participation of stakeholders, especially those who are marginalized or under-represented. It is far too common, for instance, for MPAs to be designated through a top-down process, without meaningful public involvement (Araujo et al., 2017; Diegues, 2008; Lopes et al., 2013; Trimble et al., 2014). Thus, conflicts and tension often arise as a result of many MPA design and implementation (Said et al., 2018), creating a perception of ‘social failures’ (Christie, 2004). Weak enforcement can also turn many MPAs into ‘paper parks’ not reaching their objectives and failing to show conservation outcomes (Rife et al., 2013). Moreover, an absence of buy-in from local stakeholders can generate resistance and lack of compliance (Jentoft et al., 2007).

The complexity in MPA design and implementation invites careful considerations about ways to engage with stakeholders. Several methods have been used to involve stakeholders in a participatory planning process, many of which advocating for the inclusion of socio-economic data into spatial planning (Le Cornu et al., 2014; Stephanson and Mascia, 2014). Among them is participatory mapping, either through Geographic Information Systems (GIS) or other software tools, which aims not only to engage stakeholders in the planning process but also to incorporate local knowledge (Baldwin et al., 2013). Other applications of participatory GIS include mapping of human-nature interactions in coastal and marine environments (Levine and Feinholz, 2015), and integration of local and traditional ecological knowledge with scientific knowledge (De Freitas and Tagliani, 2009; Hall and Close, 2007; Leite and Gasalla, 2013; Martins et al., 2014; Schafer and Reis, 2008), in the implementation of MPAs. Mapping of stakeholders’ values has also been used for informing marine spatial planning (Bryan et al., 2010; Sherrouse et al., 2011), in some instances through the use of mental maps and perceptions (Teh et al., 2012). Other planning efforts aim at including socio-economic variables in the design of MPAs through multi-criteria analysis using the systematic conservation planning software Marxan (Adams et al., 2011) and ecosystem modeling platforms such as Atlantis (Ainsworth et al., 2012). These methods often require either large amounts of data or precise information about the marine areas or the socio-economic system, which may not be readily available. Further, while these tools are useful in the planning process, an early engagement with stakeholders in the process is also important.

This paper proposes a simple mapping approach that can help explore how stakeholders value the marine areas, in terms of ecological, economic, and socio-cultural importance. Because it also aims at identifying areas of possible conflicts, such exploratory mapping approach can contribute to the early stages of an MPA planning process, including in the development of a management plan. Finally, the inclusive nature of the method can help enhance the legitimacy of the MPA, leading eventually to successful implementation. We tested the approach in a coastal area of Paraná State, Southern Brazil, where a management plan for the Marine National Park of Currais Islands (MNPCI), designated in 2013, is being developed. The following section describes the study area and the MNPCI, and the exploratory mapping approach. Results are presented in Section 3, and contributions and limitations of the approach are discussed in Section 4. The paper concludes with general implications for marine resource governance.

## 2. Study area and methods

### 2.1. Fisheries in Paraná coast

Paraná coast extends for about 100 km, intersected by two main waterbodies, the Guaratuba Bay at the southernmost part and the

Estuarine Complex of Paranaguá in the northern part (Fig. 1). The main economic activities on Paraná coast are tourism, port development and small-scale fisheries (Pierri, 2003; Pierri et al., 2006). Recent estimates show that about 6000 small-scale fishers live in 144 fishing villages in six coastal municipalities along the entire Paraná coast (Mendonça et al., 2017).

According to the latest national report (MPA, 2011), all marine capture fisheries catches from Paraná (about 3000 t) are made by small-scale fisheries. Small-scale fisheries in Paraná region are defined as commercial and subsistence fishing practices characterized by the use of canoes (2–10 m in length) with engine powers of 11–24 horsepower, or by the use of medium size vessels (10–14 m in length and 18–48 horsepower). Dominant small-scale fishing gears are small trawling nets, driftnets and gillnets (Andriguetto-Filho et al., 2006, 2009; Carniel and Krul, 2012; Caldeira and Pierri, 2014), as well as hook and line fishing and spearfishing (Medeiros and Azevedo, 2013).

From a total of 272 fish species that occur along Paraná coast, 93% are of economic importance (Spier et al., 2018). Targeted species vary throughout the year according to resource availability and coastal features (Andriguetto-Filho, 2003; Caldeira and Pierri, 2014). For instance, mullets (‘tainha’, *Mugil liza*), mackerel (‘cavala’, *Scomberomorus brasiliensis*), and castin leatherjacket (‘salteira’, *Oligoplites saliens*) are caught around Currais Islands during the austral winter. While small-scale fisheries are predominant in the coast of Paraná, larger scale vessels from neighboring states also use this area, generating competition for fishing grounds and resources with local small-scale fishers (Andriguetto-Filho et al., 2009; Caldeira and Pierri, 2014). Almost 40% of the total number of fish species that occur in the region are considered to be endangered (Spier et al., 2018).

Pontal do Paraná municipality encompasses 13 fishing villages, seven being distributed along the oceanic coast and six located around the estuary (Caldeira and Pierri, 2014). In 2014/2015, there were about 346 people participating in various aspects of fisheries, including harvesting, processing and marketing, representing about 2% of the total population of Pontal do Paraná municipality (Caldeira and Pierri, 2014; Mendonça et al., 2017).

The fishing villages selected for this study, namely Vila dos Pescadores, Barrancos, Shangri-lá, and Ipanema (see Fig. 1), account for more than 40% of estimated 346 fishers in the municipality in 2014/2015 (Mendonça et al., 2017). Villages were selected based on their characteristics such as distance from and dependence on the MNPCI, fishing gears used, and general opinion about the MPA (Leis, 2016). They are situated along the coast of Pontal do Paraná municipality, with Vila dos Pescadores located near the estuary inlet, and the other three villages along the oceanic coast, at different distances from the MPA. The small-scale fishers mainly use gillnets in Vila dos Pescadores and Ipanema, and a mix of gillnet and bottom-trawl in Barrancos and Shangri-lá.

### 2.2. Conservation strategies and the MPA

The Paraná coastal region presents a high diversity of natural environments (Lana et al., 2001) and includes a UNESCO World Heritage Site, the ‘Atlantic Forest South-East Reserves’, due to the presence of the largest continuum of remaining Atlantic forest (UNESCO, 2017). More than 82% of the Paraná coast is protected either as ‘sustainable use’ areas, balancing nature conservation and extractive uses of natural resources (e.g. fisheries), or as ‘no-take’ areas, preventing any type of extractive use while allowing some other human uses (e.g. recreational, scientific) (Pierri, 2003; Pierri et al., 2006). Other conservation efforts include the installation of artificial reefs (Brandini, 2014), and environmental legislations that restrict fishing activities through seasonal and spatial closures, gear and vessel restrictions.

In June 2013, the MNPCI was designated as a ‘no-take’ MPA (IUCN category II), covering an area of 13.5 km<sup>2</sup> located six nautical miles off the coast of Pontal do Paraná municipality (Fig. 1). The MPA was established mainly to protect three uninhabited rocky islands, which are

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