IMPLEMENTATION OF MARINE PROTECTED AREAS AS A GOVERNABILITY CHALLENGE IN SOUTHERN BRAZIL

by

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ABSTRACT

Marine Protected Areas (MPAs) have been endorsed internationally as a tool promoting marine conservation. MPAs implementation can however be challenging, with many not achieving conservation objectives while creating conflicts with small-scale fishers, often overlooked. This study aims at exploring how MPA implementation can be improved, taking as a case study the Marine National Park of Currais Islands in Southern Brazil. Specifically, this thesis offers a theoretical contribution by applying the interactive governance framework to analyze both the natural and the social systems, focusing on small-scale fishers, governed by the MPA as an institution. The thesis also presents a methodological contribution, as it develops and applies an exploratory mapping approach. We surveyed 65 small-scale fishers from eight communities at Pontal do Paraná municipality, and conducted an exploratory mapping approach in small groups. Main findings point to challenges and opportunities to MPA implementation, and offer a way to involve small-scale fishers in the discussion about MPAs.

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Table of Contents

List of Tables

List of Figures

List of Abbreviations and Symbols

CBD: Convention on Biological Diversity

GIS: Geographic Information System

IBAMA: Brazilian Institute of Environment and Renewable Natural Resources (Brazilian Federal Environmental Agency)

ICEHR: Interdisciplinary Committee on Ethics in Human Research

ICMBio: Chico Mendes Institute for the Conservation of Biological Diversity (Brazilian Federal Environmental Agency for protected areas management)

IUCN: International Union for Conservation of Nature

MFA: Brazilian Ministry of Fisheries and Aquaculture

MMA: Brazilian Ministry of Environment

MPA: Marine Protected Area

PPGIS: Public Participation Geographic Information System

SNUC: Brazilian National System of Conservation Units

List of Appendices

CHAPTER ONE: INTRODUCTION AND OVERVIEW

This chapter introduces the thesis, first with an overview about Marine Protected Areas (MPAs), highlighting in particular some of the main issues related to them and identifying the research gap, which the thesis aims to address. This is followed by a synopsis of the two main chapters that compose this manuscript-based thesis, with an explanation of the interactive governance framework used as theoretical foundation for Chapter 2, and a presentation of participatory mapping approach used in Chapter 3. Next, the case study of an MPA in Southern Brazil is presented, along with the methodology employed for this research. The chapter concludes with the thesis organization and a brief outline of the chapters contained in the thesis.

1.1. MPA: Overview and research gap

Concerns about marine ecosystem degradation and declining fishing resources are widespread (Pauly et al. 1998; Pauly et al., 2005; Worm et al. 2006). Several approaches and solutions have been proposed to address these concerns. Popular among them is MPAs, which have been acknowledged as an effective tool to promote marine conservation and improve fisheries management (Pauly et al., 2002; Rice et al. 2012). MPAs are recognized for the benefits they can provide to marine resources by increasing diversity and richness within their boundaries and increasing fisheries catches through a spillover effect (Halpern and Warner, 2002; Lester et al., 2009). For these reasons, MPAs have been internationally endorsed through the Convention on Biological Diversity

(CBD, 2010), with countries signatories to the convention agreeing on the new Aichi Target 11, to increase the world's oceans and coastal areas protected to 10% by 2020. Even though this target includes other forms of protection, MPAs are the most used, present in 2.12% of world's oceans in 2015 (MPAtlas, 2015).

At the current rate of MPA establishment and considering several issues and challenges related to the implementation, it is unlikely that the Aichi Target 11 will be met. Many MPAs are referred to, for instance, as "paper parks" due to the lack of compliance from stakeholders and to the fact that the conservation objectives are not achieved (Rife et al., 2013). In other cases, MPAs have been designated in areas where no human activities take place, undermining thus the need for protection (Devillers et al., 2014).

MPAs are often criticized for being taken as technical fixes or panaceas, disconnected from local contexts and therefore producing disappointing results (Degnbol et al., 2006). Further, there has been difficulty in making social and ecological goals compatible (Jentoft et al., 2007), with some MPAs being a social failure even when there is biological success (Christie, 2004), and other MPAs as an example of a social success without many benefits to the species it aims to protect (Ennis, 2011). As such, there is growing recognition of the social, economic and cultural impacts that MPAs may cause (Mascia et al., 2010), which are often overlooked (Diegues, 2008).

Research on MPAs has been focused largely on biological/ecological aspects even though socio-economic and governance perspectives have gained more attention in the past ten years (Thorpe et al., 2011). For the most part, an integrative approach to incorporate social science research to study MPAs had been lacking (Christie, 2004;

Christie et al., 2003), contributing thus to lack of buy-in and poor compliance, but studies on the human dimensions of MPAs (Charles and Wilson, 2009), impacts of MPAs on resource users' livelihoods (Mascia et al., 2010) and MPA governance with emphasis on the interactions between a social and a natural system that are governed by the MPA as an institution (Jentoft et al., 2007; Paladines and Chuenpagdee, 2015) have been growing, and are crucial to implementation success. As posited by Jentoft et al. (2007), it is particularly important to consider MPAs as an institution that deals with both social and natural issues, which implies, in many cases, the need to acknowledge the role of small-scale fishers in determining either success or failure in achieving MPA's objectives.

1.2. Thesis scope and research questions

This thesis contributes to the understanding about MPA governance in order to address the recurring challenge on how to make MPAs work. As social support is important for better governance (Jentoft et al., 2007), this thesis argues that understanding how small-scale fishers relate to the marine environment and how to incorporate this information in the discussion about MPAs is critical to implementation success. The thesis follows the interactive governance framework (Kooiman et al. 2005) in considering that natural and social systems associated with an MPA, and the capacity of the MPA as a governing institution are key elements to making the MPA governable.

Using a case study of an MPA in Southern Brazil, the Marine National Park of Currais Islands, this thesis aims specifically to answer to the following questions:

1) What are the challenges and opportunities that the natural system and small-scale fishers, as crucial components of the social system, pose to the MPA as a governing system towards its implementation?
2) How to better understand small-scale fishers' relationships to the marine environment and include them in the MPA discussion?

The study is an empirical application of interactive governance framework in the context of MPAs, and involves a development of an exploratory mapping approach to elicit participation of small-scale fishers in the decision-making about the MPA. In addition to providing insights that can help in the elaboration about the management plan for the Marine National Park of Currais Islands, it offers lessons that are broadly applicable to help make MPAs more successful.

1.3. Theoretical foundation

1.3.1. Governance and governability

Interactive governance invites an examination of MPAs as socially constructed institutions, embedded in a particular context, and in need of stakeholder support (Jentoft et al., 2007). This conceptual framework is holistic and interdisciplinary, and is novel in its focus on interactions, considered to occur within the natural and social system-to-be-governed, the governing system, and also between the two systems (Kooiman et al., 2005). It therefore accounts for relationships between small-scale fisheries, their environment, and the MPA as an institution.

As interactive governance posits, the systems-to-be-governed and the governing system have emerging properties. These encompass diversity, i.e. the components of the systems such as species, ecosystems or stakeholders, complexity, which considers the relationships among the components, dynamics, or the interactions among components, and scale issues relating to spatial and temporal boundaries of the systems (Chuenpagdee and Jentoft, 2009; Kooiman et al., 2005). A thorough analysis of the systems is possible through a governability assessment, which is about evaluating the capacity of the governing system to address the needs of a system-to-be-governed, and the limits that the system poses to governance with its characteristics (Bavinck et al. 2013). By examining system's properties, a governability assessment aims at exploring where governance challenges can be found, while aiming at enhancing governability (Jentoft, 2007). Interactive governance has been previously applied to the context of MPAs, providing insights about their implementation, and how to approach it in order to enhance governability (Chuenpagdee et al., 2013; Jentoft et al., 2011; Jentoft et al., 2012), as further detailed in Chapter 2.

Taking into account the contributions of the interactive governance framework in understanding MPAs, this study applies this approach to the Marine National Park of Currais Islands, Brazil. It explores and describes the properties of the natural and social system-to-be-governed and of the governing system associated with the MPA. It does so, however, not as a comprehensive governability assessment, but with an emphasis on small-scale fisheries, a sector that relies on the area where the MPA is now located for their livelihoods and that has been overlooked. Further, it incorporates small-scale fishers' perceptions towards the MPA as well as other features such as attachment to

fisheries, and perception of changes in fishing resources and of future of fisheries in the region, which help understand the diversity of the social system in its relation to the MPA. In Chapter 2, the study sheds light on how governable the MPA is, and points to the challenges in the implementation, focusing on whether small-scale fishers can cope with the new restrictions while trying to maintain their livelihoods, and highlights opportunities for enhancing governability.

1.3.2. Participatory mapping

The benefits of including small-scale fishers into MPA planning and management have been acknowledged and involve increased buy-in and compliance, towards achieving conservation while maintaining small-scale fishing livelihoods (Diegues, 2008; Jentoft et al., 2007). Participatory mapping has been used as one of the approaches towards increasing participation of local stakeholders in natural resource management (Ferse et al., 2010). As further explained in Chapter 3, different approaches and techniques have been proposed and applied to involve fishers in the MPA planning process, many of which advocate for inclusion of social data into spatial planning (Le Cornu et al., 2014; Stephanson and Mascia, 2014).

The use of Geographic Information Systems (GIS) as tool for participatory mapping seeks public engagement, incorporation of local knowledge and empowerment (Baldwin et al., 2013; Sieber, 2006). In order to provide baseline information that can inform the implementation of MPAs, local and traditional ecological knowledge have been incorporated into map creation (Hall and Close, 2007; Leite and Gasalla, 2013; Martins et

al., 2014; Schafer and Reis, 2008), sometimes integrating these to scientific knowledge (De Freitas and Tagliani, 2009). Further, attributes that have been mapped include stakeholders' values (Bryan et al., 2010; Sherrouse et al., 2011), spatial access priorities (Yates and Schoeman, 2014) and fishers' preferred resource spaces from a human dimensions perspective, through the use of mental maps and perceptions (Teh et al., 2012).

However, elaboration of maps that integrate relevant information for MPA management can face challenges (Brown and Kyttä, 2014) as it is often time-consuming, costly, and requires technical skills. There are also issues related to information disclosure of local and traditional knowledge and misuse of data acquired. Thus, this study makes a methodological contribution by presenting an exploratory mapping approach that involves a rapid assessment of what small-scale fishers consider as being important and threatening to the marine environment to which they rely on. This approach is innovative as it is conversational, based on knowledge sharing and consensus amongst participants, requires minimal level of technical skills and is non-threatening as it avoids asking sensitive questions such as fishing locations. The application of the approach to small groups of fishing people using paper maps, later transferred to ArcGIS, allows gathering useful information on potential areas of conflict and of agreement between small-scale fishing communities. Thus, it provides baseline information about marine ecosystem according to small-scale fishers' knowledge, valuable for the development of a management plan and inclusion of small-scale fishers towards the implementation of an MPA. Further details are provided on Chapter 3.

1.4. Case study and methodology

This thesis studies the case of the Marine National Park of Currais Islands, located in Paraná State, Southern Brazil. The Currais Islands and surrounding marine environment located off the coast of Pontal do Paraná municipality have recently been designated as of June 2013 as a no-take MPA, which currently has the management plan under elaboration. The MPA objective is to protect seabirds that nest in the area and marine species such as the threatened Atlantic grouper (*Epinephelus itajara*).

The context of coastal Paraná, in which the MPA has been designated, is of high biological diversity. More than 82% of the coastal region is under protection (Pierri et al., 2006), with 21 protected areas under integral protection category, encompassing an area of 199,454.25 ha, and 18 that are considered of sustainable use, in an area of 496,228.40 ha. Other spatial restrictions based on fishing gear and distance from the coast also apply.

More than 11,000 small-scale fishers and their families have relied heavily on the marine and estuarine area to exert their activity for over 100 years (Andriguetto-Filho et al., 2006). Small-scale fishers from the oceanic coast use the rocky substrate in the surroundings of Currais Islands to fish, especially in winter when mullets and mackerel are abundant in the area. However, MPA designation was government-driven and public consultation did not take place, thus overlooking small-scale fishers. Therefore, this study focuses on the small-scale fishing communities of Pontal do Paraná municipality that are located nearby the MPA and have traditionally used the coastal area to fish. This case was particularly chosen as it illustrates a common situation of a no-take MPA designation, top-down without public consultation (Diegues, 2006; Gerhardinger et al., 2011) with

lack of small-scale fishers' participation for a variety of reasons (Trimble et al., 2014), while small-scale fisheries rely on the marine environment and play a prominent role in the implementation of the MPA (Lunn and Dearden, 2006).

The methodology used in this study was tailored to the research questions investigated, and constitutes a novel approach to identifying challenges and opportunities to MPA implementation. First, its novelty comes from empirically analyzing a recently designated MPA in Southern Brazil using interactive governance as lenses. This provides adequate framing to study an MPA from an integrative and analytical perspective, rather than a technical one, which involves an assessment of the natural, social, and governing systems. For this, a governability assessment was conducted, based on information gathered from a literature review, informal conversations with key informants and questionnaires conducted with 65 small-scale fishers from eight communities at Pontal do Paraná municipality, to gauge demographics, fishing activities, attachment to fisheries, and perceptions about changes in catches, future of fisheries and about the MPA.

Additionally, this study innovates in designing and testing an exploratory group mapping exercise, with the objective of involving small-scale fishers in the discussion about the MPA, to which they had not been invited before. The approach uses paper maps and colour markers to elicit discussion in small groups (i.e. three to five participants) about the importance of the marine area and impacts associated to it in small-scale fishers' perception. The approach was conducted with fourteen participants from four small-scale fishing communities, which represent well the diversity on Pontal do Paraná coast. A combination of the two methods constitutes a novel methodology for evaluating the MPA as a natural, social and governing system and focus on small-scale fishers'

perceptions towards the MPA and the surrounding environment, representing an attempt to be conducive to MPA implementation while including small-scale fishers in the process.

1.5. Thesis organization and chapter outline

The thesis is structured into four chapters. Chapter 1 (Introduction) provides a general overview of the context in which the research topic emerges and the theoretical grounding, the research questions, the methodology used and a brief description of the case study. Chapter 2 focuses on identifying governability challenges and opportunities to MPA implementation using the interactive governance framework, with a focus on small-scale fishers. Chapter 3 presents a novel exploratory mapping approach for including small-scale fishers in the elaboration of the management plan, which provides simple and rapid information to assist MPA implementation. A summary and conclusion based on the main findings from the study are presented in Chapter 4, along with some suggestions about the development of the management plan of the MPA investigated in this study, as well as for other MPAs elsewhere.

1.6. Co-authorship statement

The first paper (Chapter 2) shares co-authorship with the supervisor, Dr Ratana Chuenpagdee. The second paper (Chapter 3) shares co-authorship with the supervisor and the two committee members, Dr. Rodolphe Devillers and Dr. Rodrigo Pereira Medeiros. The candidate is the principal author of both papers, having formulated

research questions, conceived the study design, collected and analyzed primary and secondary data, and prepared initial drafts. The supervisor and committee members provided advice and comments at all stages and the preparation of final manuscripts incorporated critical input and editorial suggestions of the supervisor.

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CHAPTER TWO:

CHALLENGES AND OPPORTUNITIES TOWARDS MPA IMPLEMENTATION IN SOUTHERN BRAZIL

Abstract

Marine Protected Areas (MPAs) are being promoted around the world but their operationalization still faces several challenges. Many studies have been conducted to identify factors affecting the successful implementation of the MPAs. Little attention has been paid, however, to systematically examine MPAs, with a focus on small-scale fishers as important stakeholders to achieve implementation, on the natural system and on the MPA as a governing institution. To address this gap, we follow the interactive governance framework, which argues that how fishers perceive the MPA plays an important role in how governable the MPA will be. Thus, the case of the Marine National Park of Currais Islands was analyzed based on features of the natural system, on small-scale fishers' demographics and perceptions as part of the social system, and on the existent institutional arrangements. Field observation, informal discussion, and literature reviews were employed to describe the systems. Additionally, questionnaires were administered to 65 small-scale fishers in eight communities along coastal Paraná, aiming to elicit fishers' perceptions about the MPA and its effects on fishing livelihoods. The study points to challenges to MPA governance and reveals that the MPA is highly diverse and complex in terms of the natural and social systems. While small-scale fishers live in

close proximity of each other and share marine resources, they differ in their perceptions and acceptability of the MPA mainly according to the fishing gears and techniques used. The paper concludes with suggestions about ways to improve governability, for instance, through enhancing the sense of ownership and stewardship among fishers, building on their cultural connection and conservation values demonstrated towards the islands.

2.1. Introduction

Marine Protected Areas (MPAs) are endorsed worldwide as a strategy to address issues related to ecosystem degradation and resource decline, and to protect biodiversity and promote conservation (Pauly et al., 2002; Rice et al., 2012). A growing number of MPAs have been established in order to achieve international targets set by the Convention on Biological Diversity (CBD, 2010), one of which (Aichi target 11), is to reach 10% of world's coastal and marine areas protected by 2020. Many authors argue, however, that quantity does not necessarily mean quality (De Santo, 2013), and that areas designated for protection have often failed in achieving their objectives (Agardy et al., 2011). Studies show, for instance, that MPAs can be a biological success, but a social failure (Christie, 2004) and vice-versa (Ennis, 2011), not delivering conservation outcomes (Rife et al., 2013).

Challenges to MPA governance are related to lack of enforcement (Guidetti et al., 2008), poor data, insufficient technical, financial and logistical support (Pomeroy et al., 2005), weak coordination (Bennett and Dearden, 2014), and lack of professional motivation (Gerhardinger et al., 2011). Jentoft et al. (2007) add that the stated goals of

MPAs are often difficult to achieve, partly because of the incompatibility between ecological and social objectives. While inclusion of fishers' knowledge in resource governance is increasingly advised to avoid major flaws (Johannes et al., 2000), their perceptions are often ignored or misrepresented, when designing or managing MPAs (Diegues, 2008). Chuenpagdee et al. (2013) further suggest that success or failure of MPAs depends also on what happened at the time the idea about the MPAs was first conceived and how it was communicated, which may influence stakeholders' perception and their wiliness to cooperate. The lack of consideration about the above factors in the entire process, from establishment to management, contributes to MPA governance challenges, making them less governable. As a result, rather than achieving conservation outcomes on the ground (Rife et al., 2013), social conflicts are exacerbated, impacting people's livelihoods (Mascia et al., 2010), and leading to resistance to rules and non-compliance (Ferse et al., 2010; Jentoft et al, 2007; Yates, 2014).

Extensive research has been conducted on various topics of MPAs, such as on its ecological significance and effects (Halpern and Warner, 2002; Lester et al., 2009), design, size and location (Devillers et al., 2014; Halpern 2003), and operational strategies for MPA effectiveness (Pomeroy et al., 2005). Much less attention is given to examining social aspects of MPAs (Thorpe et al., 2011), or to employing more integrative (Christie, 2004) and trans-disciplinary approaches (Degnbol et al., 2006) to facilitate their implementation. The need to understand MPAs in the broader context that they are embedded in, considering them as socially constructed institutions that govern both natural and social systems, has been highlighted (Jentoft et al., 2007). According to

interactive governance framework (Kooiman et al., 2005), the comprehensive understanding of the MPAs is required in order to improve its governability.

This study contributes to the discussion about how to make MPAs more effective as a tool to promote marine conservation. It takes a holistic approach to looking at MPAs, not as technical solutions (Degnbol et al., 2006) or with a focus on one aspect such as ecological or biological, as they have been often assessed (Thorpe et al., 2011). Rather, using the Marine National Park of Currais Islands in Southern Brazil as an illustration, the research employs the interactive governance framework in analyzing aspects of the natural system, and of the small-scale fisheries as an important part of the social system associated with the MPA as a governing institution, that may contribute to making it more or less governable. Since the MPA was designated through a top-down, government-driven process without any public consultation, the study examines the challenges that the MPA implementation may face given the context in which it is inserted, focusing on the perceptions of small-scale fishers in relation to their attachment to fisheries, to changes and the future of fishing activities in the region, and on the MPA itself. Specifically, perceptions of small-scale fishers and the MPA are assessed using a questionnaire containing close and open-ended questions to gauge the support that fishers may have for the MPA. Findings from the study provide a basis for suggestions about challenges and opportunities that should be considered in the development of the management plan for the MPA.

In the next sections, the conceptual framework used for analysis is presented, followed by the description of the Marine National Park of Currais Islands and the methods employed in the study. The results section begins with descriptions of the MPA

as natural, social, and governing systems, along with the account of interactions between them, with a focus on small-scale fishers, considering that these stakeholders did not participate in the MPA designation process and are greatly affected by marine spatial restrictions to areas they have traditionally used (Medeiros and Azevedo, 2013). The match between the properties of the natural and social systems that are being governed and the current governing system is discussed. The final section offers suggestions about opportunities towards better governance and implementation of this MPA and elsewhere.

2.1.1. Interactive governance framework and MPAs

Interactive governance is defined by Kooiman et al. as "*the whole of interactions taken to solve societal problems and to create societal opportunities; including the formulation and application of principles guiding those interactions and care for institutions that enable and control them*" (2005, p. 17). This conceptual framework is holistic and interdisciplinary, and with a special focus on interactions between and within a system-to-be-governed, comprising natural and social systems, and a governing system (Kooiman et al., 2005). Interactive governance has been applied in several contexts, including marine conservation (Chuenpagdee, 2011), fisheries and aquaculture (Chuenpagdee et al., 2008), and MPAs (Chuenpagdee et al., 2013; Jentoft et al., 2007; Jentoft et al., 2011; Jentoft et al., 2012; Paladines and Chuenpagdee, 2015; Voyer et al., 2015). When applied to MPAs, the interactive governance framework invites an examination of the MPAs as a governing system in one instance and as a system-to-be-governed in another. It also recognizes the presence of interactions between and within

systems, and with the broader context in which the MPA is inserted (Jentoft et al., 2007; Modino and Pascual-Fernández, 2013).

To operationalize the interactive governance perspective, the framework to assess governability helps to explore what properties and features of the governing system and the system-to-be-governed that may cause difficulties in governance (Bavinck et al. 2013; Chuenpagdee and Jentoft 2009; Kooiman et al. 2005). In the context of an MPA, the framework pays attention to the level of diversity, complexity and dynamics of the natural and social systems, as well as any scale issues associated with the MPA (Jentoft et al., 2007). On a governability assessment, the same analysis is conducted to evaluate these properties of the MPA governing system, and discuss whether they contribute to making the MPA more or less governable (Chuenpagdee and Jentoft, 2009). Interactive governance generally argues that the more diverse, complex and dynamic the system is, the more difficult it is to govern, unless the governing system is highly capable. Scale issues, especially in terms of boundary and jurisdictional overlap, also create low governability. Finally, the types and quality of interactions between the MPA governing system and the natural and social systems it tries to govern determine the level of governability (Jentoft et al., 2007). Interactions in this sense refer to "the various ways in which the governing system is made aware of, and sensitive to the diversity, complexity, dynamics and scale issues within the systems to be governed, and the ways in which it reacts" (p.113, Chuenpagdee and Jentoft, 2009). Further, governing interactions reveal the ways in which goals and objectives are negotiated, how conflicts are resolved and compromise is achieved (Chuenpagdee and Jentoft, 2009). Governing interactions are assessed based on presence of interactive attributes such as participation, communication,

collaboration, learning, adaptation, and the nature of the interactions (e.g. when and how it takes place) and quality of these interactions (Song and Chuenpagdee, 2010). The better the interactions, meaning higher quantity and quality of interactions between and within systems (e.g. the MPA and their environment, stakeholder groups and the MPA) throughout the process of establishment including the pre-implementation, the more likely it will be for the MPA to succeed in achieving its goals (Jentoft et al., 2007).

MPA studies, conducted mostly in Spain, Mexico and Thailand using the interactive governance perspective, provide useful insights about their implementation. For instance, Chuenpagdee et al. (2013) highlight the importance of looking at the pre-implementation process of MPAs, referred to as the "step zero", in order to understand what guides the designation and by whom the idea is put forward. Other studies show that images (or worldview) that stakeholders have towards the MPAs, and whether they match those of the governing system determines the overall governability (Jentoft et al., 2012; Modino and Pascual-Fernández, 2013). Further, Jentoft et al. (2011) argue that the goals and objectives of an MPA, along with the process of how they are agreed upon and whose opinions are considered, should be determined empirically since they are keys in making MPAs governable.

2.2. The Marine National Park of Currais Islands: History and current context

Since the early 1970's the Currais Islands (Figure 2.1) have been the focus of ornithological studies, with about 8,000 seabird specimens recorded (Borzone et al., 1994). In 1982, the Brazilian government granted use rights of the islands to the Federal

University of Paraná, to recognize the importance of the islands to the scientific community, and as a means to support research. Later, in 1986, a research laboratory was constructed in Currais' largest island. At the same time, worldwide concern on environmental issues brought Currais Islands to the public attention, with media announcing threats to seabirds and calling for urgent measures to protect the islands. As a response, the Center for Marine Studies of Federal University of Paraná issued a report calling for protection of the islands through National or State Park category (Borzone et al., 1994). Claims made through research and media culminated into the MPA Bill in 2002, which was approved by the Senate in 2012. According to a letter issued by the Brazilian Federal Environmental Agency for protected areas management (ICMBio) to the Ministry of Environment under request of the Federal Senate, while acknowledging the existence of scientific literature on Currais Islands, ICMBio states that technical studies were not conducted specifically aiming at the creation of the MPA, nor proposing the most suitable design for it, and that the required public consultation had not been conducted (ICMBio, 2012). Their recommendation was to conduct a study on the use of the marine area by small-scale and industrial fisheries and the impacts of these activities to regional biodiversity prior to the designation of the MPA, which was ignored with the MPA Bill being approved by the Senate and later put in effect by the president in 2013.

The Marine National Park of Currais Islands is a no-take MPA under the category of integral protection (IUCN IIa). Located six nautical miles offshore of Pontal do Paraná municipality, in Paraná State coastal zone in Southern Brazil, the MPA covers an area of 13.5 km² (Figure 2.1). The objective of the MPA is to protect three uninhabited oceanic islands for their importance as a seabird breeding colony (Carniel and Krul, 2010; Krul,

2004; Martins and Dias 2003), for Brown Booby (*Sula leucogaster*), Kelp Gull (*Larus dominicanus*) and Magnificent Frigatebirds (*Fregata magnificens*), and for their adjacent marine environment that provide habitat for reef fish species (Hackradt et al. 2011), including the critically endangered Atlantic Goliath Grouper (*Epinephelus itajara*) (IUCN, 2015). Currently, the MPA management plan is being developed and needs to be finished by 2018, which is five years after the creation according to Brazilian legislation.

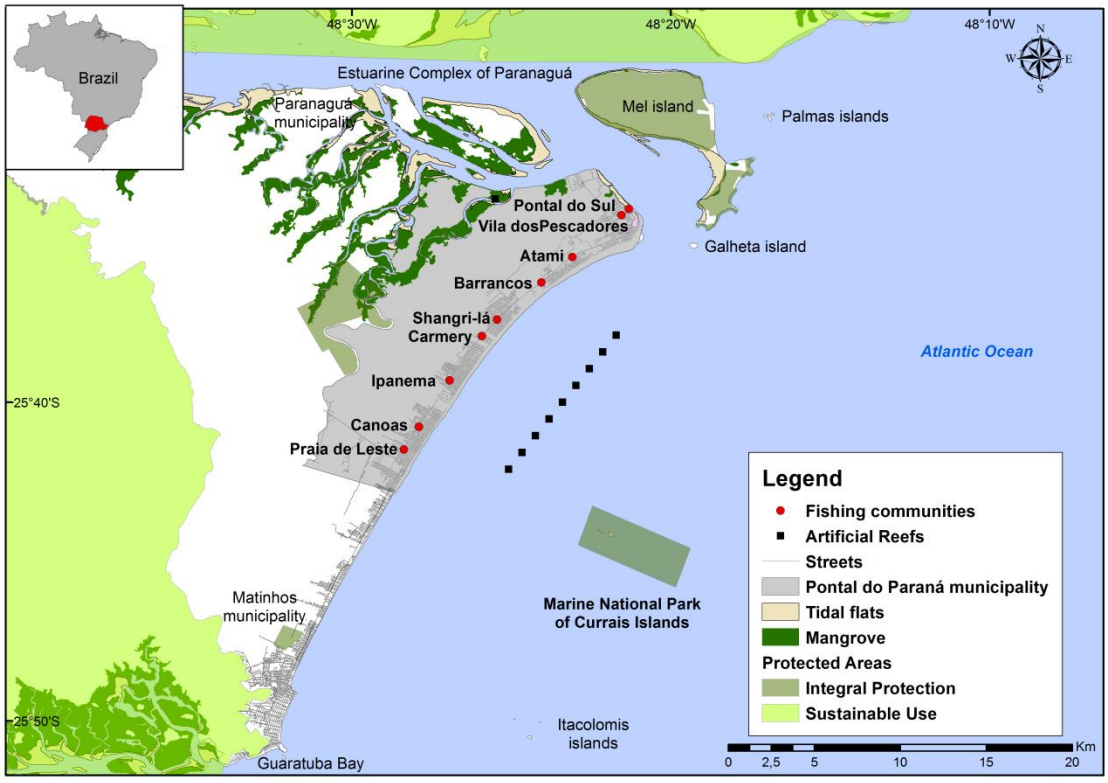

Figure 2.1 - Location of the Marine National Park of Currais Islands and nearby small-scale fishing communities from Pontal do Paraná municipality.

2.3. Data collection and analysis

Several methods were used to conduct the study. The first step involved an examination of secondary data related to the Currais Islands and adjacent coastal zone, as well as the fishing communities from Pontal do Paraná municipality and their small-scale fishing activities. This was done in order to describe and understand the ecological, social and institutional contexts in which the MPA is situated. The material analyzed included published peer-reviewed papers and unpublished documents in both Portuguese and English, such as theses, technical reports, government reports, and digital media.

Primary data collection took place during two visits to the study sites. The preliminary visits (June to July of 2014) involved field observation and informal conversation with key informants, such as elder fishers, owners of fish stores and the MPA Park manager. This phase of research helped understand the context and issues in the region, make contacts with community members, and finalize the questionnaire.

During the second visit between August and September of 2014, questionnaires were administered to 65 respondents at eight small-scale fishing communities in Pontal do Paraná municipality. The questionnaire contained quantitative and qualitative open-ended questions related to demographics, fishing activities, attachment to fisheries, dependency on fisheries, perceived changes in fisheries resources, and perception about the MPA. Active fishers over 19 years old were approached either at the beach after returning from the sea, in front of their homes or at the fish markets. Purposive and convenience sampling method was employed. The first author administered the questionnaires by reading the questions and recording the answers in Portuguese, her

native language. At the start of the data collection, fishers were presented in oral and written form all information related to the research, and only when they gave verbal consent that the first question was asked. This research was reviewed by the Interdisciplinary Committee on Ethics in Human Research and is in compliance with Memorial University's ethics policy (ICEHR Number: 20150229-AR).

Data collected through the questionnaires was numerically coded and recorded using an MS-Excel spreadsheet. Qualitative data from open-ended responses were analyzed by creating themes and categories to which responses were assigned. The qualitative nominal and ordinal data had its counting and frequency calculated. For quantitative variables, central tendency and dispersion measures were calculated. The free software RStudio® was used for non-parametric statistical analysis. In order to identify relationships between perception of MPA and fishing gear, a Fisher's exact test was conducted for significance of variables analyzed, which was determined at $\alpha=0.05$ (Kincaid et al., 2014). The Fisher exact test is a non-parametric test used to examine the significance of the association between two nominal variables in a two-way contingency table, with the null hypothesis of independence between variables (Clapham and Nicholson, 2013; Upton and Cook, 2014). Fisher's exact test is more accurate and commonly used when the expected numbers are small, too small to use the Chi-square test (McDonald, 2009; Sprent, 2014).

2.4. Results

2.4.1. The MPA system

2.4.1.1. The ecological system

Paraná coastal zone, where the Currais Islands are located, extends for 107 km and is intersected by two main water bodies: the Guaratuba bay at the southernmost part and the Estuarine Complex of Paranaguá at the northern part. This represents a highly biological diverse area, comprised of sandy beaches, rocky shores, seagrass beds, mangroves, tidal flats, and Atlantic forest (Lana et al., 2001).

Currais consist of three rocky oceanic islands, with depths ranging from 1.5 to 18 m (Veiga et al., 2004). They are located on the inner continental shelf, which presents a gentle slope of 1/700 m and is mainly dominated by a sand-muddy sediment composition (Veiga et al. 2004). The consolidated substrate in Currais makes a particularly rare natural environment in Paraná continental shelf, represented also by other oceanic islands: Itacolomis, in the South, Palmas, Galheta and Figueira in the North. Currais Islands have been considered a priority area for conservation (Portaria MMA nº 9 from 23/01/07), and are known to support an abundant and diverse community of 20 species of ascidians (Rocha and Faria 2005), a diversity of benthic macro fauna (Borzone et al., 1994), and function as habitats for 48 reef fish species in 30 families, 11% of which are endemic to the Brazilian coast (Daros et al. 2012). The area is also home to Atlantic Goliath Grouper (*Epinephelus itajara*), a critically endangered species (Hackradt et al. 2011; IUCN 2015). The islands serve as a breeding area for seabirds throughout the year (Carniel and Krul,

2010; Krul, 2004; Martins and Dias, 2003). The guano contributes to determining zonation in the rocky shore (Borzone et al., 1994), while seabirds interact with small-scale fishing activities, feeding mainly from their discards (Carniel and Krul, 2012). These relationships make the natural system very complex.

Currais Islands have high dynamics, with migratory fish species such as mackerel (*Scomberomorus cavalla*) and mullets (*Mugil liza* and *M. platanus*). Mullets reach Paraná coast between May and August in their migration from South to North, following climatic and oceanographic conditions characteristic of the winter season: South winds and low temperatures (Herbst and Hanazaki, 2014). According to fishers participating in this study, the Currais Islands is the first area where mullets aggregate in Paraná coast when migrating from the open ocean, seeking a foraging and spawning ground. Similar observations were made by fishers from Santa Catarina state, South of Paraná, where fishers also referred to a rocky bottom as an area where mullet stops at the so-called "paradas" for resting, spawning, feeding and seeking refuge (Herbst and Hanazaki, 2014).

2.4.1.2. Small-scale fisheries and the fishing people

From a total coastal population of 236,000, small-scale fisheries represent the main economic activity and source of income for more than 11,000 people directly or indirectly related to the activity, living in over 60 communities located in coastal Paraná (Andriguetto-Filho et al. 2006). Although not representative at a national scale when compared to the production of marine capture fisheries from the neighboring states of Santa Catarina and São Paulo, Paraná's fisheries have a crucial importance to the

livelihoods of people who rely on fishing for survival in a context of poverty (Borges et al., 2004; Natividade et al. 2006; Pierri, 2003) with total yearly landings oscillating between 500 and 2,500 tonnes between 1975 and 2000 (Natividade et al., 2006), and 2,170 tonnes as of 2011 (MPA, 2011).

Although Paraná's production is small-scale with local importance, its coastal areas have national importance to industrial fisheries from neighboring states (Guanais et al., 2015), as these fleets have operated between Rio de Janeiro and Rio Grande do Sul States, therefore including Paraná coast (UNIVALI/CTTMar, 2013). The fishing gears and techniques that are mostly used by industrial fishing fleets exploiting the Paraná coast are bottom gillnets, pair trawls, and surrounding nets (UNIVALI/CTTMar, 2013). The industrial fisheries of the neighboring Santa Catarina state accounts for more than 13% of the national production with 121,960 tonnes per year, leading the national ranking (MPA, 2011). Main targeted species comprise pelagic fishes, such as sardine (*Sardinella brasiliensis*), followed by skipjack tuna (*Katsuwonus pelamis*) and croaker (*Micropogonias furnieri*), with main fishing gears used being surrounding nets, followed by double-rig beam trawlers and pole and line fishing. Similarly, São Paulo's production has national importance, ranking 7th amongst Brazilian coastal states, with around 20 to 30 thousand tonnes fished yearly from 2009 to 2011, an estimate profit of 80 to 120 million Reais (Brazilian currency) (Instituto de Pesca, 2015). Historically, the main targeted fishing resource is the sardine (*Sardinella brasiliensis*), followed by seabob shrimp (*Xiphopenaeus kroyeri*), croaker (*Micropogonias furnieri*) and other demersal fish species (Instituto de Pesca, 2015). Main fishing gears include surrounding nets, accounting for the majority of fishing landings, followed by pair trawl and double-rig beam trawlers.

At a municipal scale, as of 2008 about 400 people participated in various aspects of fisheries, including harvesting, processing and marketing, representing about 2% of total population of Pontal do Paraná municipality (Caldeira and Pierri, 2014). There are 13 fishing communities in the municipality, seven being distributed along the oceanic coast and six located around the estuary. Fishing practices vary spatially and temporally according to availability of targeted fish species and the coast configuration (Andriguetto-Filho, 2003). At the oceanic coast, 60% of the fishers use gillnets while the rest use bottom-trawl, and to a lesser extent, hooks and lines and spear, which is snorkel-based and practiced mainly by fishers from Mel Island (Fuzetti, 2007) and a few from communities throughout the coast. The overwhelming majority of the boats are 6 to 12 m, many of which are canoes, with 11 to 24 horse power engine, and can be adapted to either gillnet or bottom-trawl fishery (Andriguetto-Filho et al., 2009; Caldeira and Pierri, 2014). One to three fishers operates a canoe, depending mainly on the fishing gear used, with at least two fishers required for gillnetting. The majority of fishers own and work on their boats, sometimes with crew members.

Bottom trawl fisheries in Paraná consist of one or two cone-shaped nets that are kept open by otter boards and towed by a single canoe on the bottom, generally reaching 9 m in length and less than 10 GRT, with an engine of 11 or 18 HP, targeting shrimp (Malheiros, 2008). Bottom-trawling is the most widespread fishing technique in coastal Paraná, with the highest landings (Natividade et al., 2006).

Gillnet fisheries are generally performed by a motorized canoe, wooden or fiberglass, and encompass a high diversity of techniques employed, including set (“fundeio”) and drift (“caceio”) gillnets, which can be positioned either at the bottom or

at the surface of the water column; encircling gillnets; “caracol”, in which the gillnets are towed concentrically; and beach seine (Caldeira and Pierri, 2014). Net dimensions and mesh size vary according to targeted species, with fish as the main fishing resource, accounting for 26% of total landings (Natividade et al., 2006).

Coastal Paraná’s fishers in general target 27 different fishing resources, representing 72 species and 19 groups (Correa, 1987; Natividade et al., 2006). Shrimp, particularly sea-bob shrimp (*Xiphopenaeus kroyeri*) and white shrimp (*Litopenaeus shimitti*) represent the main economically important species (Andriguetto-Filho, 2002), accounting for 73% of landings in weight (Natividade et al., 2006). They are caught throughout the year except during the closed season from March to May (Caldeira and Pierri, 2014). Among fish, Serranidae and Scianidae encompass the majority in number species caught, with Clupeidae and Scianidae representing a majority in weight (Natividade et al., 2006). Hake (*Macrodon ancylon*) are caught throughout the year, but castin leatherjacket (*Oligoplites saliens*), common snook (*Centropomus undecimalis*) and other species of hake (*Cynoscion leiarchus*, *C. microlepidotus* and *C. acoupa*) are fished from spring to summer, and croaker (*Micropogonias furnieri*) during spring. In autumn and winter months, the main targeted species are mullets (*Mugil liza*), mackerel (*Scomberomorus brasiliensis* and *S. cavalla*), and flounder (*Paralichthys spp.*).

As found in this study, catch destinations vary between communities, depending on access to markets, seasonal availability and fluctuation in demands. Seasonality also influences demand from tourism, which peaks in the summer. Generally, direct sale to tourists takes place in the summer, and sale to middlemen in the winter when local demand is low. Household consumption, on the other hand, is largely determined by food

preferences, with some fishers declaring that they cannot eat fish after working with it all day, and by amount caught (too low to sale). It is also related to the sale value of the fish, with fish of less value such as non-target species called “misturinha” being consumed in households.

While the majority of fishers depend on fisheries for income, about 17% rely on fishing as the only income source. According to Borges et al. (2004), the average monthly income for small-scale fishers from Paraná is R$749.0 as of 1998, and from that, 55% was from fishing activities and 31% from other sources. As recorded in this study, other sources of income include those that are fishing-related such as boat pilot, commercializing and processing fish or mending gears, as well as non-fisheries income such as construction, house rental for tourists and as security guard. Some fishers receive government assistance, “Bolsa Família,” as supplements to household income.

2.4.1.3. Interactions between a natural and a social system

Also important to understand are the interactions between small-scale fisheries and the natural system’s components of Currais Islands. Given that one of the objectives of the Marine National Park of Currais Islands is to protect seabird populations, it is crucial to understand how these interact with fishing activities, and whether they are subjected to impacts from these. Impacts from fishing activities to seabird populations through bycatch have been documented worldwide being pointed out as one of the main threats to seabirds (Croxall et al., 2012), and efforts have been made to mitigate such impacts (Lokkeborg, 2011). Seabird bycatch has been historically related to longline industrial

fisheries (Bugoni et al., 2008b; Anderson et al., 2011), but other fishing practices and gears have also been considered as threats, such as hook and line fishery (Bugoni et al., 2008a), trawling (Sullivan et al., 2006) and gillnet fisheries (Zydelis et al., 2013). Although seabird bycatch impacts usually relate to industrial fishing fleets, impacts of small-scale fisheries on seabirds have also been documented (Bugoni et al., 2008a; Shester and Micheli, 2011). However, there are no records for Paraná State related to impacts from small-scale fisheries to seabird populations through bycatch, and in this study small-scale fishers did not demonstrate any evidence of such impacts. These would need to be further investigated.

Seabirds from coastal Paraná (*Larus dominicanus*, *Sula leucogaster* and *Fregata magnificens*) highly depend on small-scale fisheries' discards as main dietary source (Carniel and Krul, 2012), an interaction that has been recorded in other locations for scavenging seabirds (Traversi and Vooren, 2010). Regular et al. (2013) found that diver seabirds and scavenger surface-feeders seabirds are impacted differently from a ban on gillnet fisheries, with scavenging seabird species being negatively affected by reduction on discards availability. Similarly, Laneri et al. (2010) found that during periods of trawling inactivity, seabird bycatch by longline fisheries is increased due to food scarcity. According to Bicknell et al. (2013), a ban in discards, as has been suggested by the EU Fisheries Policy following an international trend, might have negative consequences for seabirds by generating a food shortage, which would impact seabird foraging, distribution and population dynamics. However, some positive impacts to a ban on fishing activity include seabird bycatch reduction and a reduction in generalist species that dominate some seabird communities (Bicknell et al., 2013). Thus, a displacement of fishing

activities and a potential reduction on fishing discards could be expected to impact foraging seabird species from Currais Islands if seabird bycatch is not an impact in the region. However, incidental capture of other species have been associated with gillnet fisheries and documented in the region, for marine mammals (Rosas et al., 2002) with special attention to the threatened species *Pontoporia blainvillei* (IUCN, 2015), and for sea turtles, including the leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*) (Fiedler et al., 2012), and green sea turtles (*Chelonia mydas*) in Paranaguá Bay, Paraná (López-Barrera et al., 2012).

Another objective of the newly established MPA is to protect marine species' habitat, given that rocky reefs are a rare coastal feature in coastal Paraná. Thus, as this habitat is used by reef fish, including the threatened Atlantic Goliath grouper, it is important to estimate impacts of spear fishing and gillnetting to local reef fish species, especially related to illegal catches of Atlantic Goliath grouper for Paraná. Further, it is known that ghost fishing (i.e. lost or abandoned fishing gear that continues to induce mortality of aquatic organisms, without human control) might constitute an important threat to marine species (Matsuoka et al., 2005). This might be considered a potential impact to marine organisms in Currais Islands, as in this study a group of small-scale fishers was interviewed while mending gillnets after they got tangled around the rocky reefs of Currais Islands. According to some small-scale fishers in this study, this is common when they are fishing for fish schools close to the rocky islands and therefore may constitute a real threat to marine species. Small-scale fishers seem to be aware of the impact in this study as they mentioned the need to prohibit fishing too close to the rocks, suggesting different buffer distances ranging from 100 to 1000 m. This further

demonstrated the lack of knowledge of existing legislation, which already prohibits gillnet fishing within 50 m from the islands for drift gillnets and within 100 m from the islands for set gillnets, thus indicating a lack of compliance.

The threatened Atlantic Goliath grouper (*Epinephelus itajara*) aggregates in the artificial reefs installed by the NGO Mar Brasil and rocky islands such as Galheta, Currais, and Itacolomis in coastal Paraná during the summer season for breeding (Brandini, 2014; Félix-Hackradt and Hackradt, 2008). In this study, the surroundings of Currais and Itacolomis Islands have also been attributed as habitat for the species, according to small-scale fishers. Despite a moratorium from 2002, the Atlantic Goliath grouper (*Epinephelus itajara*) has still been captured and commercialized illegally in Brazil with an annual catches average of 393 tonnes (Giglio et al., 2014). Thus, increasing enforcement of legislation along with the establishment of priority areas for conservation of the species has been highly endorsed (Giglio et al., 2014). According to Félix-Hackradt and Hackradt (2008), illegal catches of Atlantic Goliath grouper have been reported for coastal communities of Paraná. Although in this study there were no records of illegal catches of the species, this should be considered a potential impact, especially because groupers are a common target to spear fishing that takes place in the area.

As Brandini (2014) argues, the occurrence of Goliath groupers in the artificial reef area has attracted scuba diving operators and generated revenue from tourism. Therefore, in the particular case of the Atlantic Goliath grouper, ecotourism could be an appealing alternative to spearfishing and should be further explored as to include small-scale fishers. This would be especially relevant with regards to the MPA, under National Park category, which allows tourism and research. However, this should be considered with

caution, as impacts from tourism to Currais Islands have been identified by Borzone et al. (1994), which are still recurring according to small-scale fishers that participated in this study. These include seabird handling by tourists, causing injuries to nestlings and eggs, provoked seabird flight with noise from speed boats, and littering (Borzone et al., 1994). In theory, MPAs' are supposed to function by providing alternative income sources to the fishers whose activities are disrupted by the establishment of the MPA, with ecotourism often promoted as the alternative employment sector that will keep fishers in the water without harming fish populations and or marine habitats (Agardy, 1993). Options for local tourism initiatives in Currais Islands could be then explored, creating another income source to local people, which currently have relied on few alternatives (Pierri, 2003). But this approach does not appear to work in Currais Islands, as access to ecotourism is currently limited to tourism and dive operators as well as to speed boats' owners from Curitiba, the State's capital. Another problem to that would be the willingness of fishers to remain fishing, mainly because they like their activity, as found in this study and by Trimble and Johnson (2013).

2.4.1.4. The governing system

Environmental and fisheries management in the region are largely organized as a top-down, hierarchical governing system. The Ministry of Fisheries and Agriculture and Ministry of Environment operate at the Federal level. Operating under the Ministry of Environment are ICMBio and the Brazilian Institute for Environment and Renewable Resources. ICMBio is a federal agency dealing specifically with federal protected area

management, and therefore is in charge of the Marine National Park of Currais Islands. The Brazilian Institute for Environment and Renewable Resources is a state level agency responsible for management and enforcement of natural resources. Additionally, the Environmental Police is responsible for enforcement of environmental legislation at the State level. Both perform a role in enforcing this MPA's regulations. Environmental legislation at State and Federal levels have restricted fishing activities through seasonal and area closures, gear and vessel restrictions and licenses, as well as other conservation initiatives as the installation of artificial reefs by a local non-governmental organization called Mar Brasil (Brandini, 2014).

Governments are not the only actors in the governing system. Fishing communities have their own organization at the municipal level, the fishing guilds or "colônia", which is established by municipality as a formal organization of fishers, first created in Brazil in the 19th century and recognized by Federal Law since 2008 (Law nº11,699/2008), with the objective of defending fisher's rights and interests. The fishing guild of Pontal do Paraná municipality is located in Shangri-lá community. The "Movement of Artisanal Fishers of Paraná State" (MOPEAR) is a fishers' organization created in response to conflicts with a protected area situated at the Northern Paraná coast, the Superagui National Park. Through this organization, small-scale fishers fight for their rights and for the recognition of their traditional livelihoods, connecting them with one another at regional and national scales, and with the governmental institutions.

2.4.2. Perceptions of small-scale fishers

As previously mentioned, a questionnaire was developed to examine the perceptions of small-scale fishers about the MPA. Sixty-five people from eight communities completed the questionnaire (Table 2.1). These numbers represented the majority of active small-scale fishers in each community, an assessment based on direct observation and data retrieved from Caldeira (2009) of the number of canoes operating in each place, and considering that each canoe has 1-2 people working on it. The non-response rate, considering all communities, was 20%. The average time taken to complete the questionnaire was 38 minutes, ranging from 15 to 180 minutes. The participants were all male, as that is the only gender working as active fishers on the oceanic coast. The average age of the respondents was 47 years, and the majority (55%) did not complete elementary school. Unless specified, the results below are presented based on the aggregation of all the 65 respondents.

Communities have differences and similarities according to their demographics (Table 2.1). Data shown represents the category with majority of responses. In cases when about half of respondents cited each category, such as in main fishing gear and boat ownership, the community was determined here as "mixed". Number of canoes could not be determined at all locations, thus for Vila dos Pescadores and Pontal do Sul, and for Canoas and Praia de Leste the number was based on data from Caldeira (2009), who treats them as two integrated communities and provides only the total number for each pair.

Table 2.1 - Characterization of fishing communities from Pontal do Paraná. The name of these communities are: 1 = Vila dos Pescadores; 2 = Pontal do Sul; 3 = Barrancos; 4 = Shangri-lá; 5 = Carmery; 6 = Ipanema; 7 = Canoas; 8 = Praia de Leste. n = Number of fishers who completed the questionnaire.

Demographics	**1 (n=5)**	**2 (n=5)**	**3 (n=6)**	**4 (n=17)**	**5 (n=8)**	**6 (n=17)**	**7 (n=4)**	**8 (n=3)**
Origin (%)								
Native	80	40	100	71	62.5	76.5	75	0
Non-native*	20	60	0	29	37.5	23.5	25	100
Number of canoes	10**		8	21	14	25	8**	
Boat ownership (%)								
Boat owner	80	80	83	65	62.5	65	25	33
Crew member	20	20	17	35	37.5	35	75	67
Main fishing gear (%)								
Gillnet	100	0	67	47	37.5	94	25	67
Bottom-trawl	0	100	33	53	62.5	6	75	33
Public fish market	No	No	No	Yes	No	No	No	No
Income (%)								
Non-fishing	20	40	0	53	50	35	0	67
Fishing	80	60	100	47	50	65	100	33

*Non-native refers to small-scale fishers who were born in another municipality;
**According to Caldeira (2009).

2.4.2.1. Attachment to fisheries

The study posits that attachment to fisheries can be understood by examining fishers' perceptions on their activity in relation to the reasons for working in fisheries and whether they would like to sustain it for themselves or for their children. The majority of

fishers (83%) has family members in fisheries and has lived in their communities for an average of 40 years, or an entire life for some of them. They started fishing at an average age of 14 years, and 77% of them indicated that they learned how to fish from a family member, such as their father or grandfather. The majority of fishers said that they mainly work in fisheries because they like fishing. Other reasons were also mentioned, however, such as they come from a fishing family or they find fishing profitable. About 38% indicated, however, that they have this occupation because they lack alternatives. On fishers' attachment to their occupation, the majority of them (78%) would not change their activity for the same income, mainly because they like fishing, and for economic reasons such as the investment made in the equipment or for insurance benefits. Some, however, also rely on supplementary income sources from non-fishing related activities (Table 2.1). Those who would like to change activity mainly cited the hardship with fishing occupation as the reason. Although the majority of fishers like fishing and are willing to continue doing it for themselves, they would not like their children to be working in fisheries (Table 2.2). In addition to the hardship associated with the occupation, some fishers recognized that better opportunities exist for their children and they prefer to send them to school. One of the reasons given by those who would like their children to work in the fisheries was the desire for their children to help the family or maintain the fishing heritage. Limits imposed by environmental legislation were also cited as one of the reasons for some of the fishers not want their children in the activity.

2.4.2.2. Changes and future of fisheries

Fishing resource dynamics are good indications of interactions between small-scale fishers and the MPA. About 88% of the respondents indicated changes in catches, with 75% of those believing the change to be negative (decreasing catches). Fishers referred to a reduction in abundance and diversity of targeted species in general, but main species cited were mullets, hake and sea-bob shrimp. Reasons mentioned for the declining catches are increased fishing pressure, either from industrial fisheries fleets from neighboring states (39%), which exploit Paraná's coast as mentioned earlier, or other local small-scale fishing practices considered destructive (35%), such as bottom-trawling, spear fishing and gillnet with small mesh size or high dimensions.

Respondents also mentioned pollution and port-related activities as additional causes for the decline observed, given the proximity of the access channel to Paranaguá port, the largest in grain export port terminal in Latin America (APPA, 2016). The decline in catches affected daily fishing activities for 76% of fishers responding to the questionnaire, resulting in loss of fishing grounds and fishing farther from coast or causing an increase in fishing effort. Some respondents felt constrained by the environmental legislation that restricts fishing activities, and ended up with low compliance in the situation of declining catches or tried to find alternative income sources and invested less in fisheries.

On a positive note, about 25% of fishers, mostly from Barrancos and Shangri-lá, observed an increase in catches (Table 2.2), mainly due to conservation measures such as the installation of artificial reefs and the environmental legislation that resulted in industrial fishing fleets moving further away from coast. Fishers mentioned that the

artificial reefs contributed attract reef fish species such as the grey triggerfish (*Balistes capriscus*), and reduced industrial fishing was related to an increase in white shrimp, occurring for a longer season. The use of new technologies, such as motorized boats, smaller mesh sizes, nets of bigger dimensions, which led to increase fishing effort, was also attributed as another reason for catch increase.

Some of the fishing communities relied on species that gather around Currais Islands during the winter season (June to September), when days out in the sea are fewer due to the increased frequency of cold fronts, restraining fishers' access to the rough seas. Fishers referred to this as a "natural closed season", as they are prevented from fishing due to the inclement weather. According to them, this adds to the "legally closed-season" from March to May when they are not allowed to fish for shrimp. Additional reasons for low catches during the winter months are decreased demand for fish outside of the tourist season (thus poor price), and few fish available for catches (especially mullets). Fishers refer to fishing during the winter rather negatively, e.g. "August is the month of disgust".

Irrespective of the perspective about the present situation, fishers were generally pessimistic about the future of fisheries in the region, with 80% of the respondents perceiving a tendency of decline or even end of the activity. Evidence of this sentiment was provided, for example, with fishers giving up their job and a low recruitment of new fishers into the activity, mostly due to a lack of interest from youth. The decrease in catches as a result of increased pressure over resources was cited as another cause for this perception, followed by government-related problems, such as the lack of financial support, prioritization of few and limits imposed by legislation. Concern about sustainability related to the technologies was mentioned by some fishers, both those who

engage in these practices and others who do not. The rest of the fishers, who showed optimism about the future of fisheries in the region believe in conservation initiatives with adequate enforcement and investment in new technologies to increase fishing effort would contribute to make small-scale fisheries prosper in the future.

Table 2.2 - Small-scale fishers' perception by community (1 = Vila dos Pescadores; 2 = Pontal do Sul; 3 = Barrancos; 4 = Shangri-lá; 5 = Carmery; 6 = Ipanema; 7 = Canoas; 8 = Praia de Leste).

Small-scale fisher's perceptions	**1 (n=5)**	**2 (n=5)**	**3 (n=6)**	**4 (n=17)**	**5 (n=8)**	**6 (n=17)**	**7 (n=4)**	**8 (n=3)**
Willing to have children working in fisheries (%)								
Yes	0	0	83	23	25	18	0	0
No	100	100	17	71	72.5	76	100	67
Don't know	0	0	0	6	2.5	6	0	33
Willing to change activity (%)								
Yes	0	60	17	23	0	23	0	0
No	100	40	83	71	100	71	100	100
Don't know	0	0	0	6	0	6	0	0
Changes in catches (%)								
Decrease	100	100	50	50	72	53	50	100
Increase	0	0	50	44	14	27	0	0
No changes	0	0	0	6	14	20	50	0
Future of fisheries (%)								
Pessimistic	100	80	83	59	86	80	100	100
Optimistic	0	20	17	41	14	20	0	0

2.4.2.3. The MPA and what it means to fishers and their environment

With regard to the Marine National Park of Currais Islands, 92% of fishers knew about the MPA, mainly through media (41%), community members (32%) or meetings organized by the fishers' association or the local non-governmental organization, Mar Brasil (20%). Oral communication was the main way through which they learned about the designation of the MPA, with TV as another important media and with community members helping to spread the information. Of the overall fishers responding to the questionnaire, 57% believed that the MPA objective was environmental conservation, followed by 20% who thought that there was no reason to designate an MPA, or that its objective was to harm small-scale fishers or for personal or political interests. This latter point of view was mainly expressed by fishers from Barrancos, Ipanema and Praia de Leste, who resented the government actions to designate the MPA. About 10% of respondents, particularly from Pontal do Sul community, indicated that they did not know what the MPA was for.

In general, the MPA was perceived as being good to the environment (Figure 2.2), because it promotes conservation (46%). Conversely, fishers who responded that the MPA would be neutral or bad to the environment explained that it is because they did not believe that the MPA would make any difference to conservation or fisheries sustainability. While small-scale fishers who shared this opinion did not perceive the MPA as being threatened and did not think government would provide adequate enforcement. Rather, they felt that Currais Islands would be better protected by

themselves, showing a sense of ownership towards the archipelago. This perspective is illustrated by the quote from one of the respondents:

> "[The MPA] won't be of any help. We don't kill the birds; they are the first to welcome the fishers who go there. No one has ever destroyed anything there. Fishers take good care of that place. And it is possible that when they take fishers out of there, people will destroy it. This law will not protect anything, [the island] is better off without it, than with it." (Translated from Portuguese – see Appendix V for original quote.)

Small-scale fishers' sense of ownership towards Currais Islands is also expressed when they refer to feeding the seabirds fish discards. This is demonstrated in the quote: "[The government] has created [the MPA] to protect the Kelp Gulls, the Brown Boobies. But the fishers are the ones who feed them, by throwing them the discards from bottom-trawling." (Translated from Portuguese – see Appendix V for original quote.)

Also, when they mention taking care of the islands they refer to not killing or disturbing sea birds and their nests, nor disembarking on the islands, in opposition to what they reported about the tourists. Further, always being around fishing is regarded as a way of surveillance, as they do not consider fishing around the islands a threat to the islands and the birds, as shown in the statement: "We are the ones who take care of those islands, who are always around fishing." (Translated from Portuguese – see Appendix V for original quote.)

Thus, by doing this they consider to be protecting the islands from others regarded as threat, such as tourists. Another threat identified by small-scale fishers is the trophy spearfishing, which targets the largest fish, such as the threatened Atlantic Goliath grouper. Some small-scale fishers also make a distinction between the "coloured fish",

that use the rocky reef as habitat and should be preserved, and the fish that are migrating, targeted by them. By knowing Currais Islands well, some demonstrate a sense of attachment to it, and perceive as part of their homes, as it can be perceived by the following quote: “I don’t understand why to do that [the MPA]. There are lots of birds. This is stupid, there is nothing there to preserve. I know that island as I know my bedroom”. (Translated from Portuguese – see Appendix V for original quote.) In this quote, this is further evidenced when a sense of resentment towards the MPA designation without small-scale fishers’ consent is felt as an emotional and personal offense, as it can be noted from the statement:

> “This is hurting the coastal family. What hurts the most is to know that it is [the park designation] for political interests. No one makes a law if there are no interests behind it. Who is going to decide what is good is ourselves. People in Curitiba do not know that. We do.” (Translated from Portuguese – see Appendix V for original quote.)

Here a small-scale fisher talks about the park creation, as if something was taken away from all coastal communities from Paraná who rely on fishing activities. Through the park creation it is assumed that governors from the State’s capital, Curitiba, know better than small-scale fishers what is best for Currais Islands. The fisher further explained that this is taken as an offense because if something you feel belongs to you is taken away from you, is usually because it is assumed that you did not take good care of it.

Fishers were divided when asked about the effects of the MPA to the community, as shown in Figure 2.2. The majority of the respondents felt that the MPA was bad to the community because it prohibited the extractive use of the area, affecting fishing activities.

Those who perceived the MPA to be positive to the community argued, however, that it would help increase fish and promote conservation. Similar divergent was found on the question about how the MPA would affect individual fishers directly. The main reason for the negative perception was the high dependency on the area for fishing. One fisher explained it further: "Our income from this week came from there [Currais Islands]. It is the first place where fish stop when coming from the open ocean." (Translated from Portuguese – see Appendix V for original quote). On the other hand, the protection and increase on fishing resources was attributed as examples of how the MPA could affect fishers positively. As mentioned by a fisher: "[The MPA] will help me, because it will be a shelter to the fish: there they reproduce, grow, and come to the coast." (Translated from Portuguese – see Appendix V for original quote). These fishers, who make up 27% of respondents, mainly perceive that the MPA would increase fish diversity and abundance inside the MPA and could result in a spillover effect. Those who considered the MPA as neutral to them did not use the area and therefore did not think that they were going to be affected.

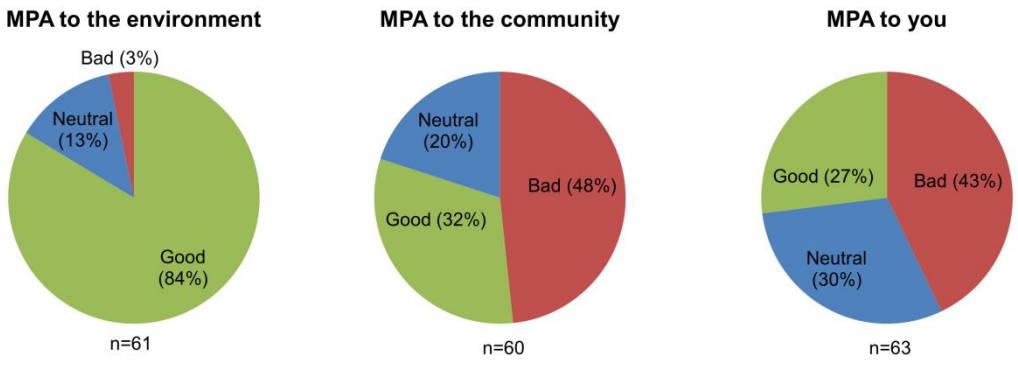

Figure 2.2 - Fishers' perceptions towards the Marine National Park of Currais Islands.

Small-scale fishers differed in how they perceive the MPA based on the fishing gear used (Table 2.3). The Fisher's Exact test shows that difference was significant in relation to how small-scale fishers perceive the MPA to themselves (p-value=0.01), with the majority of gillnet fishers indicating they rely on Currais to fish.

Table 2.3 - Perception of fishers towards the MPA according to fishing gear used, showing the most frequent responses to each category (i.e. environment, community and fishers).

Perception of MPA	**Main fishing gear used**	
	Gillnet (N=39)	**Bottom-trawl (N=26)**
To the environment (%)	Promotes conservation	Promotes conservation
Positive	80	87
Negative	4	4
Neutral	16	9
To the community (%)	Prohibits fishing	Increases catches/Prohibits fishing
Positive	25	42
Negative	56	37
Neutral	19	21
To fishers (%)	Prohibits fishing	Increases catches/Not affected
Positive	21	40
Negative	56	20
Neutral	23	40

2.4.3. What contributes to MPA governability?

As shown in the above analysis, fishers from the eight fishing communities differ in terms of the fishing gear and technique used, their experiences, and what they expect on the future of fisheries. All of these factors influence how fishers perceive and support the MPA as a conservation initiative, and thus its governability. While governability is system and context-specific, learning about common features that communities share and

discuss how they may give rise to the overall governability is useful to improve governance. For instance, this information can help governing authorities establish rules and regulations that can be applied to similar communities, thus making enforcement less complicated. Therefore, features of the social and natural systems, and fishers' perceptions towards the MPA are analyzed in terms of their influence on the MPA governability. It should be noted that small-scale fishers do not constitute the only stakeholders affected by the MPA, thus this analysis focuses on their influence on MPA governability based on the assumption that they constitute a marginalized group that relies on their fishing activity as main or only source of income, which needs to be included in the process as important allies to MPA implementation. The analysis results in two main groupings of the eight small-scale fishing communities, as shown below. Suggestions are then made about what to do to enhance governability in each case.

Group 1: Lower governability - MPA is good to the environment but bad for small-scale fisheries. This group refers to fishers who claimed that the MPA would conserve the environment, but be bad to the community and to themselves, mainly because it would prohibit them to use the area. These corresponded mainly to gillnetters (Table 2.3) from communities that rely heavily on Currais Islands to fish, such as Barrancos, Shangri-lá, Ipanema, and Carmery. Therefore, the majority of small-scale fishers from these communities has more at stake and is directly affected by the MPA. Despite the concern on small-scale fishing livelihoods, some features of the social system in these communities constitute opportunities for matching the conservation objectives of the MPA with the needs for maintenance of livelihoods. For instance, these were the only communities that pointed out an increase in catches, which matched in some cases to an

optimism related to the activity in the future (Table 2.2). This was especially the case in Shangri-lá, where experience with increased catches generated by the artificial reefs led to optimism in conservation initiatives. Further, fishers from Barrancos were willing to have their children to be fishers, mainly to maintain the fishing heritage. Even though this viewpoint does not represent the majority of the people in the area, the optimism related to conservation initiatives in increasing catches may be a starting point for defining rules and regulations in which small-scale fishers would have faith in, and to which they would be able to abide to, which will help increase the MPA governability. Further, having non-fishing activities as a supplementary source of income, as with small-scale fishers from Shangri-lá and Carmery (Table 2.1), and giving other communities the opportunity to have a local fish market (i.e. besides Shangri-lá) could help as alternatives to increase the fish value and the household income while decreasing fishing effort in Currais.

Group 2: Higher governability - MPA is neutral to the environment and good/neutral to the community. Formed by fishers from Vila dos Pescadores, Pontal do Sul, Canoas and Praia de Leste, this group shares the perception that they could be either positively affected or not affected by the MPA. Fishers from these communities do not generally rely on Currais Islands to fish, including bottom-trawlers from Pontal do Sul and Canoas, and gillnetters from Vila dos Pescadores and Praia de Leste. In the case of Vila dos Pescadores, they are located at the estuary mouth, which is the furthest away from Currais, and they fish predominantly in the bay and areas from the Northern Paraná coast. Fishers from Praia de Leste are the closest to Currais (i.e. about six nautical miles) but they do not use the Currais area because they fish with gillnets targeting hake and shrimp that occur closer to coast. In relation to the effect of MPA to the environment,

there are divergent perceptions within this group. Fishers from Canoas and Praia de Leste mainly think the MPA will not make a difference, due to issues of low enforcement and considering that the MPA will not address other impacts such as pollution. On the other hand, fishers from Vila dos Pescadores and Pontal do Sul share the opinion that the MPA could be good to the environment, as it could promote conservation, contributing to an increase in fishing resources closer to coast. It is notable, however, that almost all fishers from these four communities reported a decrease in catches, and are pessimistic about the future of fisheries (Table 2.2), which could easily lead to lowering governability. Many of them also indicated little attachment to fishing livelihoods. Nevertheless, the high governability attributed to this group is associated with the fact that fishers share similar images about the MPA and will most likely be in compliance with the rule, given the low level of conflict in the use of gear and fishing areas.

2.5. Discussion

The diversity, complexity and dynamic features of the Marine National Park of Currais Islands pose challenges to the MPA governance. As noted by Chuenpagdee and Jentoft (2009), governability is about the capacity of the natural, social, and governing systems to respond to the challenges posed by its inherent features. Thus, the more diverse, complex and dynamic a system is, the more difficult it will be to govern its functioning. In order to increase governability of the MPA, the properties of the natural system should be considered, exploring further the biological diversity and the relationships between species. Such knowledge would increase our capacity to define

potential threats and develop appropriate conservation objectives. In particular, the dynamics of fish species that use the Currais Islands' surroundings as habitat, such as mullets and mackerel, need to be understood and considered when designing the management plan. For instance, given that these two main species only occur in the winter, the option of having an 'open season' during the winter months for small-scale fisheries using gillnets targeting these species could be studied, accounting for impacts that this could generate.

Significant differences in the characteristics between the eight small-scale fishing communities and the way fishers perceive the MPA imply that MPAs may affect small-scale fishing livelihoods differently. As argued by Andriguetto-Filho et al. (2009), the generalizations cannot be made about small-scale fisheries in Paraná state. In this study, distance from the MPA does not seem to play a role when defining which communities might or might not be affected by it, while other features of the social system such as fishing gear and techniques, perception of changes and future of fisheries, and attachment to fisheries, seem to have a much larger role in how much they have at stake and in how fishers perceive the MPA. The diversity in fishing communities' characteristics and perceptions at a local scale was also found by Yates (2014) in Northern Ireland fisheries and by Kincaid et al (2014) at the small-scale fishing communities related to the Mafia Island MPA in Tanzania. Their findings, as well as those from the current study, reinforce the caution noted by Degnbol et al. (2006) when applying MPAs as technical fixes to management problems. Further, assumptions made without consideration about local contexts may not only generate conflict, but also result in negative feedbacks for future management approaches (Jentoft et al., 2007). The diversity in fishers' perceptions and in

how the MPA would affect their livelihoods can pose challenges to governability of the MPA if this is not taken into account. It also implies that communities cannot be treated as a homogeneous whole, as also suggested by Agrawal and Gibson (1999), in the study exploring the concept of community and how it has been approached in conservation of natural resources. By acknowledging the different perceptions of the MPA and the social and economic dependency to maintenance of fishing livelihoods in the implementation of the MPA, governability could be increased. However, it should be noted that this would ideally be achieved in conjunction with other stakeholders, which would also be responsible for contributing to achieving MPA's goals.

As shown in this study, small-scale fishers' perception of the MPA, in relation to the community and to themselves, varied according to the fishing gear used. This is because the fishing gear used and species targeted reflect on whether fishers directly rely on the archipelago, and therefore on how affected they are by the MPA. The relationship was more evident on how fishers using different gear perceived the effect of the MPA to themselves. As the MPA poses restrictions that mostly apply to gillnet users, it may be indirectly favoring and endorsing bottom-trawl fisheries, which are considered more impacting to the marine environment. Further, small-scale fishers' response to reduced catches in general has been increasing fishing effort and expanding fishing grounds to farther from coast. By restricting activities at Currais Islands, fishing effort could be expended in other areas, which would undermine environmental conservation in the region when considered at a larger scale. The effects of overfishing and impacts of fishing activities to marine species and their habitat have been acknowledged in the literature (Chuenpagdee et al., 2003; Dayton et al., 1995), and strategies to address these impacts

include promoting the use of bycatch reduction devices associated to MPAs (Guanais et al, 2015), as well as endorsing the use of fishing gears that are considered less impacting in comparison to others (Chuenpagdee et al., 2003). As decisions made inside the MPA are not restricted to its boundaries, scale issues should be considered as the MPA could represent a threat to governability of the entire coast, having an impact on how and where fishers operate.

Challenges to the implementation of the Marine National Park of Currais Islands could lie on the interactions between the natural and the social systems. The understanding of the dynamics that operate between these systems-to-be-governed is fundamental in order to realize whether fishers will be able to cope with the new restrictions imposed by the MPA while trying to maintain their livelihoods (Jentoft et al., 2007). An example of this is the difficulties faced by fishers during the winter, which could be exacerbated by prohibiting fishing activities in the surroundings of Currais Islands, where most of their catches from this season come from. The difficulty in maintaining fishing livelihoods in a context of declining catches is enhanced, also with urban and tourism expansion that threatens fishers' livelihoods in the region (Andriguetto-Filho, 2003; Pinheiro et al., 2010). Similar to what Trimble and Johnson (2013) found in their study, the majority of small-scale fishers in this study are not willing to change activity. Fishers face increasing difficulties when their access to an important fishing ground is restricted. Such exclusion could bring about not only economic hardship, but also cultural impacts, as fishing represents, not just livelihoods, but a way of life to many, especially small-scale fishers (Jones, 2009; Onyango, 2011). As the MPA prevents fishers to exert their effort, the expected response would be lack of support,

which would lower governability of the MPA. Further, it could compromise reaching conservation goals and generate conflict, thus diminishing the capacity of the MPA to address the needs of these fishers.

As a governing institution, the MPA authority needs to define MPA objectives and the threats it aims at addressing. Right from the start, the designation of the Marine National Park of Currais Islands was guided by research recommendations especially in terms of the category chosen, of integral protection (Borzone et al., 1994), based on the assumption that fisheries in general pose threats to the area. However, this study raises the question that threats to Currais Islands and to coastal Paraná as whole, whether real or perceived, may also come from other activities, such as industrial fisheries from neighboring states, port-related industry and pollution, as pointed out by small-scale fishers. This finding should be considered in the development of the management plan for the MPA, with a need for evidence on real threats to Currais Islands' terrestrial and marine ecosystem.

Further, the MPA authority could explore ways to benefit from the sense of ownership that small-scale fishers participating in this research demonstrated towards the islands, and their willingness to conserve what they rely on, in enhancing governability. In this study, some fishers perceived themselves as the ones protecting the islands, and considered the MPA something they took ownership of. Focusing on fishers as allies, instead of excluding them from the process, could be an important step towards enhancing MPA's governability and leading to successful implementation.

Grouping communities into 'relative governability' based on their features is another way to help determine appropriate pathways to deal with communities. While the

specific characteristics and experience of each fishing community play important role in how they view the MPA, some communities have more in common than others, and they thus can be considered together when applying rules and regulations. This can then help address issues related to lack of compliance and low enforcement, which often affect the overall governance and are common throughout Brazil's protected areas (Diegues, 2008) and worldwide (Guidetti et al., 2008). Since governability is not a quality that is given once and for all (Chuenpagdee and Jentoft, 2009), grouping of communities as suggested in this study is also neither permanent nor perfect. It should therefore be seen only as a way to approach communities with the proposed governance options.

2.6. Conclusion

The implementation of the Marine National Park of Currais Islands requires a thorough and systematic understanding of the MPA. The study sheds light on how governable the MPA would be, based on small-scale fishers perceptions and systems' features, and points to the opportunities for enhancing its governability. For instance, the natural system's dynamic features, such as the mackerel and mullet occurrence in the archipelago, and the impacts of small-scale fishing activities on the Currais Islands' marine ecosystem should be better understood. Further, the implementation of the MPA needs to recognize the differences in fishing gear, attachment to fishing livelihoods, and perceptions about changes and the future of fisheries on fisher's support towards the MPA. Importantly, the study highlights the need for different engagement with small-

scale fishers who have high stake in the MPA debate, with those who do not, taking into account the diversity and complexity of the social system.

From the governing system perspective, a clear definition of MPA's goals and objective is needed, as well as the assessment of the impacts that the MPA has on the environment and on the communities. Stakeholders' diverse interests may play a diffuse role and it is fundamental that the image of the MPA to those governed matches what it means to those who govern. Future research could focus on how to involve different communities in defining management actions, which will help enhance the MPA governability.

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CHAPTER THREE:

AN EXPLORATORY MAPPING APPROACH FOR ASSESSING WHAT MATTERS TO SMALL-SCALE FISHERS: A CASE ILLUSTRATION OF A MARINE PROTECTED AREA IN SOUTHERN BRAZIL

Abstract

Benefits of involving local stakeholders in the design and implementation of marine protected areas (MPAs) are well recognized, resulting in increased support and enhanced compliance. Various approaches have been used to encourage stakeholders' involvement, one of which being participatory GIS mapping. While maps can be beneficial, issues remain around information disclosure, lack of technical skills, and the time required to generate these mapping products. To address these concerns, an "exploratory mapping" approach is proposed to capture what ecosystems and resources stakeholders consider as being important and what activities they believe to generate negative impacts. The approach is conversational, voids of sensitive questions, and focuses mostly on knowledge sharing among participants. Information from this simple mapping exercise can be used as inputs in the discussion about the MPA and its governance, especially when tension and conflicts are anticipated. An illustrative case study was performed in the Marine National Park of Currais Islands, Southern Brazil, which was designated in 2013 without public consultation. Fourteen small-scale fishers from four communities located near the park participated in the study. They generally concur that the area designated as the MPA is very important from ecological, economic and sociocultural perspectives. Further, the maps indicate high level of agreement between groups of

fishers with respect to the ecological importance, which could be a starting point for the discussion about conservation efforts at a regional scale. Overall, the study highlights how exploratory mapping approach can provide baseline information about marine ecosystem according to fishers' knowledge, identify potential for conflicts, and be valuable for the development of a management and implementation plan for an MPA.

3.1. Introduction

With a global increase in anthropogenic impacts, marine biodiversity loss and fisheries overexploitation are unprecedented (Halpern et al., 2008; Worm et al., 2006). Marine Protected Areas (MPAs) are now used worldwide as a key tool to support marine conservation efforts (Halpern, 2003; Halpern and Warner, 2002). This area-based conservation measure has been acknowledged to benefit biological conservation (Lester et al., 2009), also resulting in some cases in increased catches outside of MPAs boundaries (Costello, 2014; Halpern et al., 2009; McClanahan and Mangi, 2000). Recognizing the potential benefits of MPAs, the international community agreed at the Aichi Convention on Biological Diversity to expand MPAs networks to 10% of the world's oceans by 2020, a goal captured by the Aichi Target 11 (CBD, 2010).

With 2.12% of the oceans currently protected by MPAs (MPAtlas, 2015), it is unlikely that the Aichi target will be reached by 2020. One reason lies in the challenges that MPAs implementation can face (Chuenpagdee et al., 2013; De Santo, 2013; Wood et al., 2008). The focus on biological and ecological criteria that dominates most MPA designation process (Thorpe et al., 2011) can undermine social issues. MPAs that focus exclusively on conservation benefits at the cost to local communities have been called

'social failures' by Christie (2004). On the other hand, studies have criticized MPAs for compromising too much with stakeholders and existing socio-economic activities at the cost of conservation (Devillers et al., 2014; Meinesz and Blanfuné, 2015). Many MPAs end-up being 'paper parks', not reaching their objectives and failing to show conservation outcomes (Rife et al., 2013). Another reason for difficulties in implementing MPAs is the lack of buy-in from local stakeholders, which generates resistance and lack of compliance to regulations (Jentoft et al., 2007). While the importance of public consultation is recognized, and is, in some cases, a legal obligation, it is still common for MPAs to be designated through a top-down process, without any public involvement (Diegues, 2008; Lopes et al., 2013).

MPAs can negatively impact fishers' livelihoods, especially small-scale fishers who rely heavily on local fisheries resources and may not have alternative sources of income (Mascia et al., 2010). Getting support from local communities during the MPA planning and implementation is hence very important (Ferse et al., 2010). Different methods have been proposed and applied to involve fishers in the MPA 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). An example of method is participatory mapping using Geographic Information Systems (GIS), which seeks public engagement and empowerment through the mapping of an area and the incorporation of local knowledge (Baldwin et al., 2013). Mapping of local ecological knowledge (Hall and Close, 2007; Leite and Gasalla, 2013; Martins et al., 2014), traditional ecological knowledge (Schafer and Reis, 2008) and integration of traditional and scientific knowledge (De Freitas and Tagliani, 2009) have also been promoted to provide baseline

information that can inform the implementation of MPAs. This is possible through a spatialization of coastal uses, natural features, and species occurrence (Gerhardinger et al., 2009). Mapping of stakeholders' values has also been used for informing marine spatial planning (Bryan et al., 2010; Sherrouse et al., 2011). Other techniques involve mapping spatial access priorities (Yates and Schoeman, 2014) and fishers' preferred resource spaces from a human dimensions perspective, through the use of mental maps and perceptions (Teh et al., 2012). Efforts have also looked at including socio-economic variables in the design of MPAs through multicriteria analysis using the systematic conservation planning software Marxan (Adams et al., 2011) and ecosystem modelling platforms such as Atlantis (Ainsworth et al., 2012).

Despite their benefits, these techniques have limitations, including concerns about the introduction of bias and lack of spatial accuracy when representing qualitative information derived from non-scientific knowledge on a quantitative platform as GIS (Close and Hall, 2006). In a study identifying issues for public participation GIS (PPGIS), Brown and Kyttä (2014) discuss issues about sampling, degree of public engagement, and the integration of PPGIS data into planning decision support (Brown and Kyttä, 2014). It has been shown that the use of simple techniques, involving paper maps and markers, results in increased participation and contributes to reduce participant bias (Pocewicz et al., 2012). Given the limitations of current approaches to participatory mapping, our study offers an approach to mapping what fishers consider as being important to them and the impacts to which the marine environment is subjected to. It does so based on interactive governance (Kooiman et al., 2005), a conceptual framework with a holistic and interdisciplinary approach that innovates in its focus on interactions. According to this

framework, interactions are considered to occur between and within a system-to-be-governed, comprised by its natural and social systems, and a governing system. It highlights the need to look at the context in which MPAs are inserted, something that can greatly influence how the MPA will be formed and function when implemented (Jentoft et al., 2011). Also important to consider is the fact that stakeholders have different attitudes and perceptions towards MPAs (Chuenpagdee et al., 2013), which will also influence the outcomes of how MPAs will be accepted and the level of compliance by resource users (Voyer et al., 2015). This study is framed by the Interactive Governance Framework, which suggests focusing on what local stakeholders consider as being important, and incorporating it into the decision-making process, as a means to improve governance.

This paper presents an 'exploratory' mapping approach that allows capturing information about the importance of places in the ocean for small-scale fishers, based on different characteristics (e.g. ecological, economic, socio-cultural). The approach is exploratory in that it aims to collect data in a simple and rapid way, without high degree of spatial or thematic precision. Such method can help provide general information about the importance of marine areas, as well as of possible conflict, and can be incorporated in the discussion about the development of an MPA management plan. The approach was tested on the coastal area of Paraná state, Southern Brazil, where the Marine National Park of Currais Islands has been recently designated as of 2013 without public consultations. The protected area management plan needs to be developed within five years after the declaration, according to the Brazilian National System of Conservation

Units (SNUC). Findings from this research may contribute to the development of the MPA's management plan.

The following section gives an overview of the Paraná coastal zone to provide context for the study area and the Marine National Park of Currais Islands. Next, we describe the exploratory mapping approach that can be used as a rapid tool to incorporate small-scale fishers' inputs for the elaboration of the MPA's management plan. Results from the approach are presented and the contributions and limitations of the proposed approach are discussed in the context of MPA, as well as general implications for marine resource governance.

3.2. Methods

3.2.1. Study area

This study was conducted in coastal Paraná, near the Marine National Park of Currais Islands, Southern Brazil (Figure 3.1). Paraná coast extends for about 100 km, intersected by two main water bodies, the Guaratuba Bay at the southernmost part and the Estuarine Complex of Paranaguá in the northern part. The region presents a high diversity of natural environments (Lana et al., 2001) and was nominated as a UNESCO World Heritage Site for its largest continuum of remaining Atlantic forest, encompassing 25 protected areas in Paraná and São Paulo States (UNESCO, 2015). Partly due to its ecological importance, more than 82% of the Paraná coast region is protected under the sustainable use or integral protection categories of the Brazilian National System of

Protected Areas (SNUC; Pierri, 2003; Pierri et al., 2006). Protected areas in coastal Paraná State sum up to 39 in number and comprise over 695 thousand hectares in area protected, including land and water territories, and at municipal, state and federal levels. These protected areas include 21 under the integral protection category and 18 of sustainable use, shown in Figure 3.1., the latter category comprised mainly by Environmental Protected Area (APA) and Private Reserve of Natural Heritage (RPPN) types. The majority of protected areas in coastal Paraná still does not have a management plan in place, which is fundamental to guide management actions and define, based on the best available knowledge, how implementation should proceed. Other conservation efforts took place in the coastal region of Paraná, including the installation of artificial reefs by a local non-governmental organization (Mar Brasil) (Brandini, 2014) and fishing restrictions from the federal and state environmental legislations, through seasonal and spatial closures, gear and vessel restrictions and fishing licenses.

In June 2013, the Marine National Park of Currais Islands was designated (Law number 12,829/2013) as a no-take MPA under the IUCN category IIa ('integral protection'). The MPA encompasses an area of 13.5 km² located at six nautical miles off the coast of Pontal do Paraná municipality (Figure 3.2). The MPA is established mainly to protect three uninhabited rocky islands, which are the breeding grounds of the seabirds Brown Booby (*Sula leucogaster*), Kelp Gull (*Larus dominicanus*) and Magnificent Frigatebirds (*Fregata magnificens*) (Carniel and Krul 2010; Krul 2004; Martins and Dias 2003). It also aims to protect the adjacent marine environment, which embodies unique habitats for reef fish species (Hackradt et al. 2011) and the critically endangered Atlantic Goliath Grouper (*Epinephelus itajara*) (IUCN, 2015).

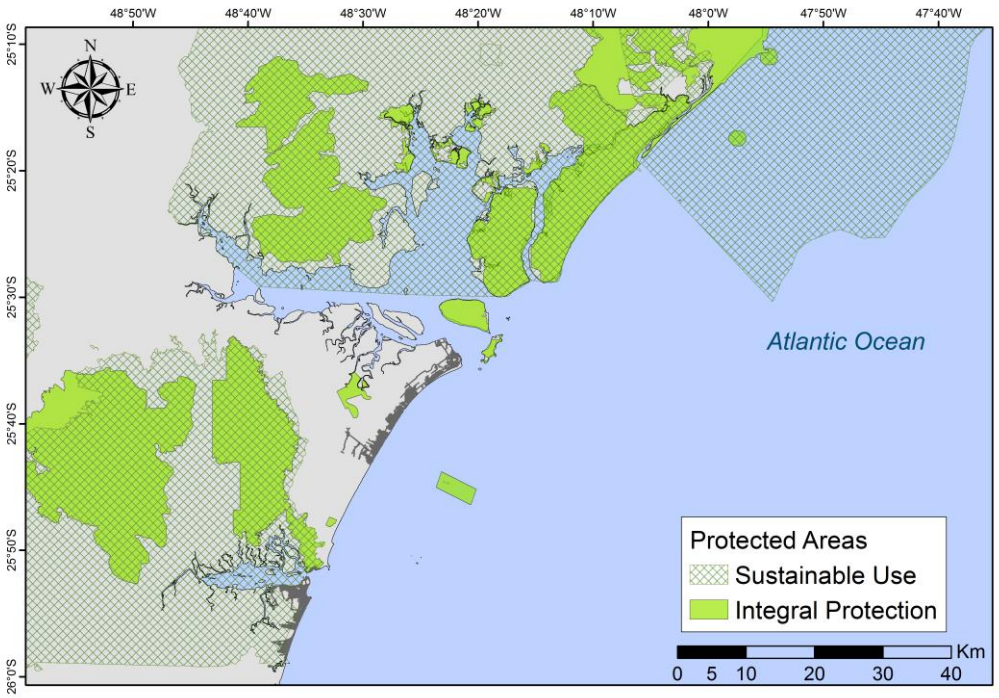

Figure 3.1. - Protected areas of sustainable use and integral protection categories in coastal Paraná state, Southern Brazil.

Impacts to the marine ecosystem in this region have been documented for the last four decades (Caldeira and Pierri, 2014), with all targeted species from Paraná coast being currently overexploited (Haimovici et al, 2006). The ecosystem degradation is further enhanced by oil spill incidents (Noernberg et al., 2008), and increasing sedimentation in the estuary due to deforestation and pollution from port-related activities (Lana et al., 2001), such as dredging of the access channel to Paranaguá port, the largest in grain export port terminal in Latin America (APPA, 2016).

According to the federal last report from 2011, catches from marine extractive fisheries from Paraná varied from 3,141 tonnes in 2010 to 2,170 tonnes in 2011 (MPA, 2011). While small-scale fisheries are predominant in the area, the coast of Paraná is

important for regional fisheries, such as small and medium-sized trawlers from São Paulo and Santa Catarina States (Guanais et al, 2015). These vessels from neighboring municipalities and States use this area both as the fishing grounds and local landing sites, generating conflicts with local small-scale fishers (Andriguetto-Filho et al., 2009; Caldeira and Pierri, 2014).

More than 70% of São Paulo State landings are from industrial fishing fleets, at around 20 to 30 thousand tonnes yearly from 2009 to 2013 and an estimate profit of 80 to 120 million Reais (Brazilian currency), ranking 7th among Brazilian coastal states (Instituto de Pesca, 2015). Historically, the main fishing resource is the sardine (*Sardinella brasiliensis*), followed by seabob shrimp (*Xiphopenaeus kroyeri*), croaker (*Micropogonias furnieri*) and other demersal fish species (Instituto de Pesca, 2015).

The industrial fleet from Santa Catarina State presented more than 157 thousand tonnes of landed production for the year 2012, a record for the last 22 years (UNIVALI/CTTMar, 2013). Between 2009 and 2012 the landings ranged from around 113 to 157 thousand tonnes. Targeted species comprise pelagic fish species, caught mainly using surrounding nets. All fleets from these neighboring states have operated between Rio de Janeiro and Rio Grande do Sul States, therefore including Paraná coast (UNIVALI/CTTMar, 2013). The fishing gears and techniques that are most used in Paraná coast are bottom gillnets, pair trawls, and surrounding nets (UNIVALI/CTTMar, 2013).

Figure 3.2 – Location of the Marine National Park of Currais Islands, Paraná State, Southern Brazil, with the four small-scale fishing communities studied.

The main economic activities on Paraná's coasts are tourism, port development (both in expansion) and small-scale fisheries (Pierri, 2003; Pierri et al., 2006). Small-scale fisheries have played an important role in the region since the 18th century as a means of subsistence for local population, and later gained market importance from the 19th century onwards (Andriguetto-Filho et al., 2009; Pierri et al., 2006). It is estimated that more than 11,000 people, in over 60 fishing communities in Paraná's six coastal municipalities, currently rely on fisheries (Andriguetto-Filho et al., 2006). Small-scale fishing is done using multiple gears and varies spatially along the estuarine system (Andriguetto-Filho, 2003; Angulo, 1993). More than 60 fish and shellfish species are targeted, with total landings around 1,500 t/year (Corrêa, 1987; Natividade et al., 2006).

Four small-scale fishing communities from Pontal do Paraná municipality were selected for this study (i.e. Vila dos Pescadores, Barrancos, Shangri-lá and Ipanema) for their proximity to the MPA (Figure 3.2). They were chosen to represent communities with different distances from the MPA and with distinct fishing gear. In Pontal do Paraná municipality, about 2% of the total population (about 400 people) were registered as fishers as of 2008 (Caldeira and Pierri, 2014). This includes workers involved in fish harvesting, processing and marketing (Caldeira and Pierri, 2014). Fishing gears and practices used to target finfish include drift gillnets (surface and bottom), set gillnets, encircling gillnet (occupying the entire water column), "caracol" (gillnet pulled by a motorized vessel), and beach seine fishery (Caldeira and Pierri, 2014). Hook and line fishing and spearfishing also take place in the region (Medeiros and Azevedo, 2013). Targeted species of shellfish and finfish vary throughout the year according to resource availability and coastal features (Andriguetto-Filho, 2003; Caldeira and Pierri, 2014) with mainly mullets (*Mugil liza*), and mackerel (*Scomberomorus brasiliensis and S. cavalla*) being caught around Currais Islands during the winter.

3.2.2. Data collection, processing and analysis

Data collection took place between August and September 2014. Fishers over the age of 19 were approached at the beach, when returning from fishing trips, at the fish market, or in front of their houses, and invited to take part in the study. Fishers were presented with all the information related to the research. The research protocol was

approved by the Interdisciplinary Committee on Ethics in Human Research and complies with Memorial University's ethics policy (ICEHR Number: 20150229-AR).

The data collection process involved three steps (Figure 3.3). First, the researchers prepared a base map, which included location of coastal communities, bathymetric contours as reference, and a grid dividing the area of interest in 4km² cells, created using ESRI ArcGIS 10.2.2. fishnet tool (Figure 3.3). Second, printed base maps were used in the communities to guide conversation and mapping exercise in a small, focused group setting, at a location chosen by the fishers. When familiar with the map, fishers were given colour markers and asked to mark areas according to the six attributes investigated, which were: (i) ecological importance, (ii) economic importance, (iii) sociocultural importance, (iv) areas where other uses occur, (v) areas of concern, and (vi) areas requiring protection. The researchers guided the discussion around these topics during and after the marking, to elicit the reasons why some areas were more important than others and the types of concerns, use and protection related to the impacts perceived by them. The exercise was 'conversational', meaning that fishers explained why these areas were important, and exchanged ideas, sometimes making changes to the map as the conversation progressed and consensus reached. At the end of the mapping exercise, a digital photo of the map was taken and used by the researchers for transferring the information into the GIS. Both quantitative and qualitative data were collected using this method.

The third step corresponded to data processing and analysis, which started with the transfer of information collected on the paper maps into a digital map using ArcGIS (Figure 3.3). Each grid cell was assigned a numerical value corresponding to the number

of times it was identified by a given community for any of the six attributes analyzed. Thematic choropleth maps were produced for each of the six attributes, with colour value (darkness) representing the number of communities identifying each cell. Additionally, an index indicating the agreement on each cell's importance was designed, capturing the total number of times a given cell was chosen for any importance criteria (e.g. ecological, economic, sociocultural). Cell values ranged from 0 to 12 (4 communities x 3 criteria). Areas of concern (i.e. where impacts occur) were overlaid to the importance index map, which shows areas considered to be important and under threat at the same time.

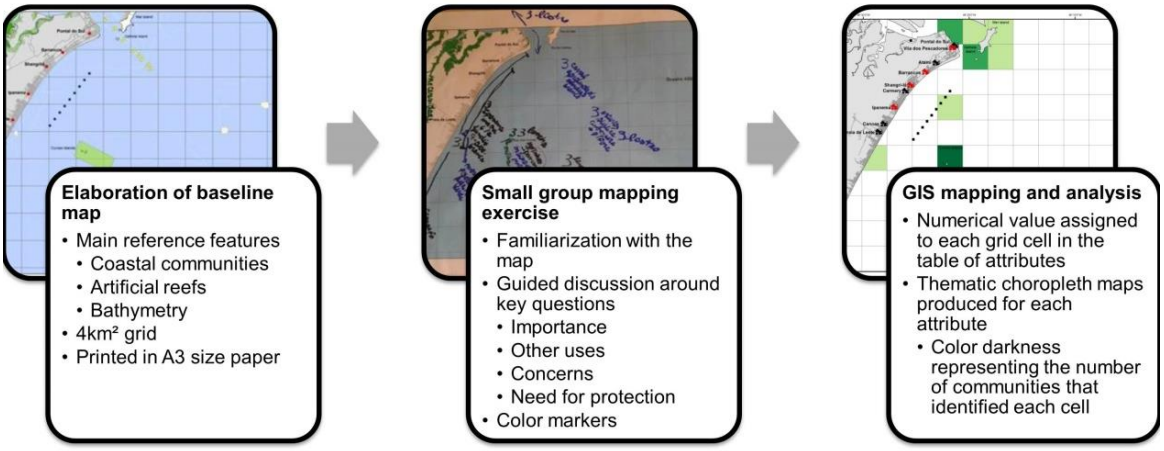

Figure 3.3 - Flowchart illustrating the three steps of the rapid exploratory mapping approach: the baseline map elaboration, the data collection in small groups and the data analysis and mapping in a GIS.

3.3. Results

The number of participants involved in each mapping exercise ranged from two to five per fishing community, with a total of 14 participants for the four communities. Participants corresponded to a sample of the population of active small-scale fish

harvesters at each community, estimated based on the number of canoes in use (i.g. accounting for one to two small-scale fishers operating by canoe). Participants were from Vila dos Pescadores (three participantes, five canoes); Barrancos (two participants, eight canoes); Shangri-lá (five respondents, 21 canoes); and Ipanema (four participants, 25 canoes). They were all male, with average age of 52 years, and did not complete elementary school (64%). On average, the exercise duration was 55 minutes.

Mapping indicates an overlap in the areas of ecological importance identified by fishers from the different communities, and diverse reasons provided in support of the identification of areas, indicating an overall agreement. Currais Islands were identified by the largest number of communities as having ecological importance (Figure 3.4a). Areas of ecological importance identified by the fishers (Figure 3.4a) were rocky islands, including Itacolomis and Currais, the artificial reefs along the coast, and the rocky bottoms near Praia de Leste, indicated on Figure 3.2. Those areas were selected for their role as nursery and foraging areas for fish species, sometimes referred as "colourful fishes". Some of the species associated with these substrates were cited by fishers during the mapping exercises, such as common snook (*C. undecimalis*), at Galheta islands, Mel islands and rocky bottoms; grey triggerfish (*Balistes capriscus*) at the artificial reefs; and mackerel (*S. brasiliensis* and *S. cavalla*) and mullets (*Mugil liza*) associated to Currais islands. One community surveyed extended the ecological importance to an area located between of Currais and Itacolomis islands called "Parque dos Meros", meaning a park of Atlantic Goliath Groupers (*Epinephelus itajara*), a threatened species (IUCN, 2015) that cannot be fished under the Brazilian legislation. Some fishers also identified the adjacent

Estuarine Complex of Paranaguá, an area of ecological importance due to its nursery role for shrimps.

While targeted species, fishing gears and strategies employed varied amongst fishing communities, the majority of participants identified areas used for small-scale fishing activities as having economic importance (Figure 3.4b). They indicated that fishing activities had already been largely restricted along the coast, with exclusion areas for beach seine, gillnets and bottom-trawl. Mapping also indicates an agreement with the economic importance of rocky habitats formed by Currais and Galheta islands, as well as the rocky bottom near Praia de Leste, indicated on Figure 3.2. Finally, the first three nautical miles of waters along the coast was identified as areas of economic importance by most communities.

Only a few locations were identified as areas of socio-cultural importance, which were mostly associated with leisure activities, such as recreational fishing near artificial reefs (Figure 3.4c). Recreational fishing mainly targets the reef fish species *Balistes capriscus* that became available after the installation of concrete structures on the seafloor. Currais Islands were identified as socio-culturally important due to their role as a shelter during stormy weather at sea.

Fishers participating in the mapping exercises identified industrial fisheries, tourism, recreational fishing, recreational diving and spearfishing as other activities taking place in the areas (Figure 3.4e). They associated those uses mostly with people from outside of their communities. Currais and Itacolomis islands and a near shore rocky bottom area were heavily used by spear fishers and speed boats for recreational fishing, diving and tourism. In those cases pointed out in the exercises, small-scale fishers

explained that tourism activities mainly consist of speed boat tours for small groups operated during summer by boat owners from Curitiba, who keep their boats at the local marinas and in some cases hire locals from Vila dos Pescadores or Pontal do Sul communities as boat pilots. These tourists often practice recreational fishing with hook and line for trolling (locally named as "corrico"), or spearfishing (Borzone et al., 1994). Spearfishing in Currais is also practiced by some residents from Encantadas community at Mel Island, or by a few small-scale fishers from Pontal do Paraná municipality, as noted in this research. According to Borzone et al. (1994), common targets for spearfishers at the rocky islands of Paraná coast include Serranidae such as groupers (*Epinephelus itajara*, *E. guaza, E. morio*, *E. niveatus* and *Rypticus randalli*) which are mostly threatened (IUCN, 2015). As documented by the same authors, in 1994 there were about 800 privately-owned speed boats at the marinas of Paraná coast, concentrated at Guaratuba municipality and Pontal do Sul community in Pontal do Paraná. From the total of 200 boats at Pontal do Sul's marinas, only a minority of less than 10% was reported to visit the oceanic islands (Borzone et al., 1994). Tourists seldom disembark at Currais Islands for walking or recreational fishing, despite its rocky and steep terrain, as documented by Borzone et al. (1994) and reinforced as personal communication from participants. Recreational diving tours are conducted by some of the five scuba diving schools from Curitiba (Borzone et al., 1994), or by the local NGO Mar Brasil.

Two communities mentioned the same areas along the coast as being used by the industrial fishing fleets from neighbouring states using pair trawl, as being one area in between the coastline and Currais, and the other East of Currais. Pair trawls are prohibited within the first five nautical miles from the shore, making this fishery illegal in this area.

Pair trawling consists of a fishing technique employed only by industrial fishing fleets, of the neighboring states of Santa Catarina and São Paulo. In Santa Catarina, the landings from pair trawling account for 7,5% of the total production, corresponding to 11,855 tonnes of fish, mainly Sciaenidae such as Argentine croaker (*Umbrina canosai*), Whitemouth croaker (*Micropogonias furnieri*) and Stripped weakfish (*Cynoscion guatucupa*) (UNIVALI/CTTMar, 2013). The pair trawling fleets from Santa Catarina operate between São Paulo (24º S) and Rio Grande do Sul (34.5º S) states, thus including Paraná, and at depths ranging from 25 to 200 m. In São Paulo state pair trawling represents the second largest fishery with 2,178 tonnes of fish caught in the first semester of 2015, only behind encircling gillnets (Instituto de Pesca, 2015).

Some fishers also cited small-scale fishing activities practiced by other communities or by groups using other fishing gears. The first three nautical miles from the coast were identified as being the most used areas for bottom trawling, while rocky habitats were used by encircling gillnet small-scale fisheries.

The question about areas of concern aimed at understanding the impacts in the region. As shown in Figure 3.4f, areas of concern were indicated for the first nautical mile from the shore where small-scale bottom-trawling occurs, and for two parallel lines along the coast that are used by industrial fishing fleets from neighbouring states reaching shallower waters. Two communities related the impacts of dredging the channel giving access to Paranaguá port, generating sediment suspension to reducing the availability of white shrimp. The area where the ships are anchored while waiting for entering the port through the access channel constitutes another issue, due to the disposal of garbage and ballast water. Fishers discussed potential impacts that a new port in the municipality may

cause, adding to those observed for the Paranaguá port. Currais Islands were considered an area of concern due to the amount of garbage washed up to the islands, the use of encircling gillnets and spearfishing activities targeting reef fish species, including the threatened ones. Spearfishing in rocky bottom habitats near Praia de Leste was also indicated as a concern for the same reasons.

When asked to indicate areas in need of protection on the map, participants minimally addressed the topic. While areas of ecological concerns were identified during the discussion, only one community discussed and identified areas on the map for this attribute (Figure 3.4d).

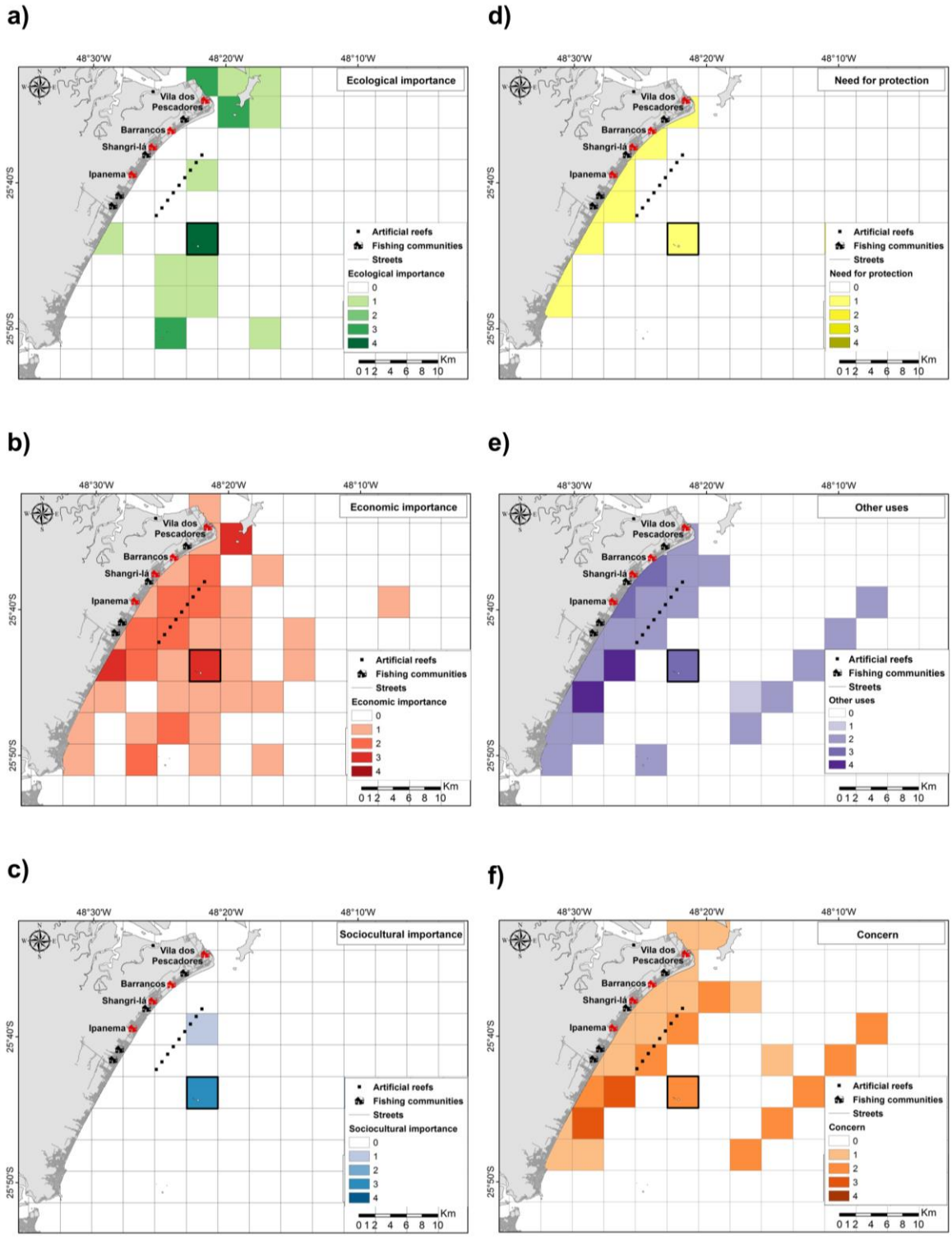

Figure 3.4 - Maps of (a) ecological, (b) economic and (c) socio-cultural importance; and areas (d) in need for protection, (e) with other uses, and (f) of concern. Cell values, represented by colour intensity indicate the number of communities that selected a given cell. Red symbols show fishing communities studied, and black symbols show fishing communities not studied.

Figure 3.5 shows the cumulative importance of grid cells in the area. It highlights overlap between areas of importance (i.e. ecological, economic and sociocultural) and areas of concern for fishers, the latter being mainly related to the occurrence of other users, considered impacting by small-scale fishers. The level of importance is determined by adding the number of times a cell was considered as being important. In general, small-scale fishers were in agreement with respect to areas of importance, with structured habitats receiving the highest importance index. These included Galheta Island in the north, the artificial reefs, and a rocky bottom located near Praia de Leste community in the south (see Figure 3.2). Currais Islands receives the highest level of agreement with respect to its importance.

Another key finding from the mapping exercise, shown in Figure 3.5, is that areas indicated as important by the majority of communities are often areas of concern due to environmental impacts. An example of this is Currais Islands, considered to be important and an area of concern at the same time. Impacts at Currais Islands were mainly related to spearfishing, pollution and ghost nets. On the other hand, Galheta Island was deemed important, but was not indicated as being of concern by any community. This could be because fishers could have focused more attention on Currais Islands rather than Galheta due to the MPA designated there.

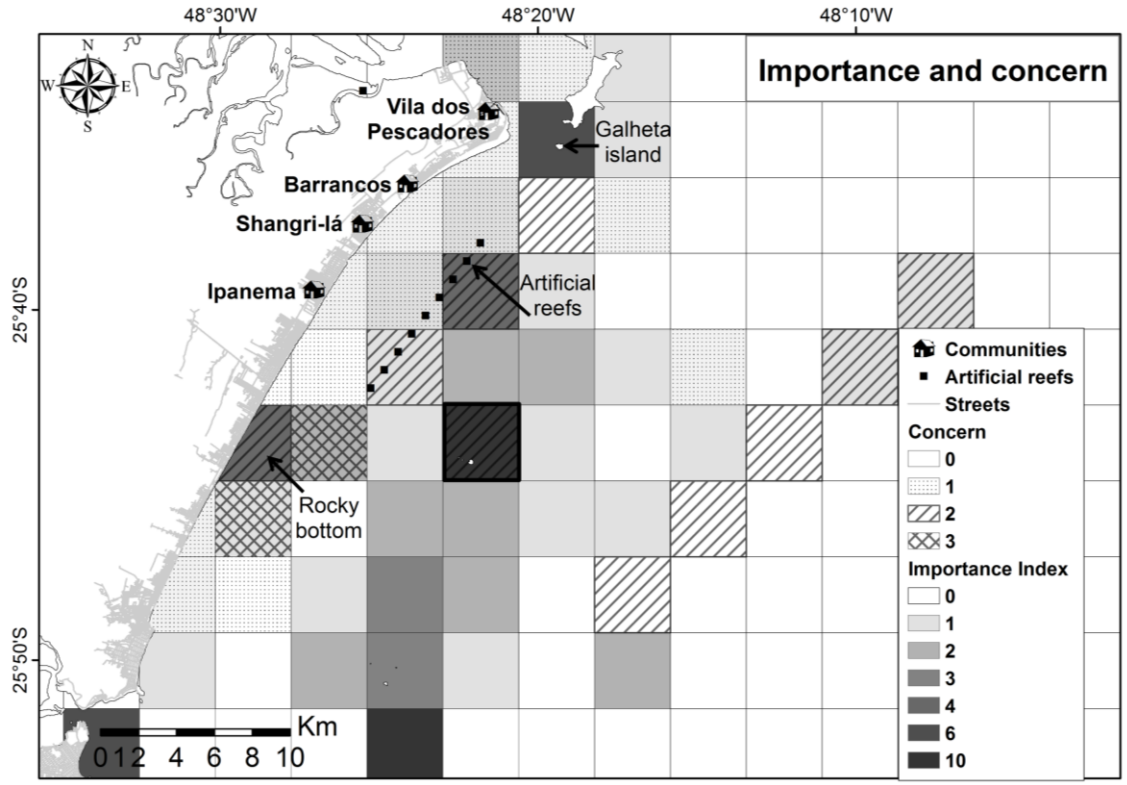

Figure 3.5 - Map showing the cumulative importance of grid cells in terms of both importance to small-scale fishers (i.e. ecological, economic and sociocultural) and concerns of small-scale fishers in relation to the marine environment (i.e. impacts). Colour intensity indicates how many times a given cell was identified as being important by communities.

3.4. Discussion

The context in which the Marine National Park of Currais Islands was designated illustrates a common situation worldwide where new MPAs are established without public consultations and broader community engagement (Diegues, 2008). Results from the exploratory mapping approach reveal areas where tension and conflicts may arise in the implementation of the MPA and highlights where opportunities for moving forward may be found. Currais Islands is an area recognized by small-scale fishers as being ecologically, economically and socio-culturally important, making it thus what Ruiz-Frau

et al. (2011) referred to as “hotspot areas for the provision of values.” This circumstance could lead to conflicts, for instance when the MPA objectives as no-take compromise economic activities (i.e. extractive uses) and prevent people from enjoying socio-cultural values of the area (e.g. use of the islands as a shelter). However, the fact that the MPA management plan is under development can potentially bias the importance perceived, as fishers may be concerned about being excluded from this area. Brown and Brabyn (2012) have documented in their Public Participation GIS study a tendency for participants to favour areas that are proximate to them, or where they have familiarity. The importance attributed to the Currais Islands in this study suggests the need for incorporating small-scale fishers in the consideration about the management plan.

Even though fishing communities in the region use different fishing gears and practices (Andriguetto-Filho et al., 2009), having different perceptions about the MPA, they were in agreement on the location of ecologically important areas. Further, small-scale fishers provided similar reasons for the ecological importance of the areas. Such consistency could be used as a starting point to incorporate fishers in the process of MPA implementation and discuss conservation at a regional level. Fishers in this study identified the role of the estuarine system as a nursery ground for shrimp and fish species, which has been recognized in the literature (Beck et al., 2001). This was also the reason why fishers from Tijucas Bay estuary in South Brazil consider the estuary as being ecologically important (Martins et al., 2014). The ecological importance of rocky substrate as habitat for reef fish species and of the artificial reefs identified by fishers in this study are in line with the findings from Hackradt et al. (2011), which compared the fish assemblage from the artificial reefs in Paraná with Currais Islands.

Areas of economic importance are widely spread along the coast, with few overlap between communities. This is most likely due to the different fishing areas used by fishers, following resource availability throughout the year. Areas of economic importance generally coincide with those considered ecologically important. The close relation between what is considered economically and ecologically important could be explained, following Caldeira and Pierri (2014), by the fact that fishers search for areas where catches are high, which often correspond to high-productivity habitats, such as areas close to shore, rocky islands and rocky bottoms.

It has been acknowledged that MPAs often displace fishing effort to other areas (Stevenson et al., 2013). Martins et al. (2014) also noted a displacement of fishing effort since the designation of the Arvoredo MPA in Southern Brazil, causing an unanticipated increase in fishing activity inside the bay, considered as a nursery ground and more vulnerable to anthropogenic impacts. By spatially restricting fishing activities, fishing displacement could result in new and unpredictable governance challenges, as fishers adapt to changes in ocean use and regulations (Abbott and Haynie, 2012). Fishing displacement could also increase the cost and travel time to reach further fishing grounds (Stevenson et al., 2013), something that could potentially impact small-scale fishers (Mascia and Claus, 2009). In the case of the Marine National Park of Currais Islands, fishing displacement could occur from Currais to other areas considered in this study as being of equivalent ecological importance. For instance, the Itacolomis islands, considered ecologically important by both fishers in this study and by the Brazilian Ministry of Environment, could potentially be used by fishers from Pontal do Paraná. This could lead to concentrating fishing activities at an area not currently exploited by

small-scale fishers from Pontal do Paraná, mainly due to the distance from their ports. Those reasons call for a larger scale governance of the region, taking for instance into consideration the potential for a new MPA to be designated in Itacolomis islands in the South.

Areas where other uses occur (e.g. tourism, spearfishing, industrial fisheries) were considered as being of concern, and corresponded in part to those indicated as important to small-scale fishers (i.e. economic, ecological or sociocultural). This could possibly imply the existence of conflicts among resource users, related to the designation of the MPA. Some conflicts have been identified by Giraldi-Costa and Murata (2015) at the neighboring Matinhos municipality, in which about 300 small-scale fishers with 35 fishing fleets also highly depend on Currais Islands' fishing grounds, and are in conflict with the MPA designation. More specifically in this research, potential conflicts arising from or being enhanced by the MPA designation have been noticed, for instance, between commercial fishing activities and other uses, based on small-scale fishers' perceptions of tourists as one of the main threats to the islands being further enhanced by the indirect prioritization of these resource users by the MPA category. Also, between different commercial and recreational fishing activities, especially with regards to recreational spearfishers, acknowledged by small-scale fishers as those who target the resident and threatened species, and those whose activity would be difficult to enforce for being submerged and easily confused with recreational diving. Potential conflicts among small-scale fishing gear users could also occur, with those who operate with encircling gillnets being more prejudiced than the bottom-trawlers. Also among small-scale fishing communities, with those in which the beach seine for mullets takes place in winter (e.g.

Pontal do Sul and Vila dos Pescadores) benefiting from the closure of Currais Islands' fishing ground, as more fish are expected to come closer to shore, while other communities who rely heavily on the area are prohibited of exhorting their activity. This reallocation of rights through MPAs creates "winners and losers", which may result in a ripple effect of economic, social and cultural impacts depending on the properties of the natural and social systems (Jentoft et al., 2007; Mascia and Claus, 2009). Conflicts between resource user groups have been previously described in the literature, such as the use of Paraná's fishing grounds by industrial fishing vessels from other Brazilian States and municipalities (Andriguetto-Filho et al., 2009; Caldeira and Pierri, 2014). Some of the concerns that fishers have towards the coastal area are related to impacts that would not be addressed by an MPA, including waste disposal, oil spill, sediment suspension and ballast water. These have been previously described in the literature for the region (Caldeira and Pierri, 2014; Haimovici et al, 2006; Lana et al., 2001; Noernberg et al., 2008) and would need to be addressed at a much larger scale.

Areas identified by the small-scale fishers as being in need of protection mainly correspond to locations where other activities take place (e.g. spear fishing, bottom-trawling), indicating possible conflicts between activities at those locations. This suggests that, when identifying areas that need protection, fishers perceive protected areas as a barrier to other uses, not only diminishing the impacts caused by other activities on the environment, but also reducing conflicts with small-scale fisheries. Jentoft et al. (2012) discuss the importance to explore the images that small-scale fishers have of MPAs to better understand how fishers can respond to MPAs and hence improve governability and implementation. Areas in need of protection were only identified on the map by one

community, which could either show distrust on disclosing information that could potentially be used to define further MPAs, or a lack of support for more protection measures. Due to the open-ended question, fishers may have interpreted the question on need for protection differently (e.g. "where would you like to see another protected area?"). Generally, as expected, small-scale fishers expressed a need to protect Currais Islands, as long as it does not affect small-scale fishers, and with a smaller area than the one defined by the law. A need for protection was also mentioned for the first nautical mile from the shore, due to the intense small-scale bottom trawling and concerns related to the impacts of this fishing practice. With a regulation already in place to prohibit trawlers to fish within one nautical mile from the coast (IBAMA 29/2004), fishers were claiming for better enforcement, since compliance is low. In this area, the use of gillnets by motorized boats is also prohibited (MFA/MMA 12/2012). Another community that discussed areas in need of protection cited Currais Islands, but then made clear that they should still be allowed to fish there. In this sense, this could be also related to the "not-in-my-backyard" problem, explained by Jentoft et al. (2012) as a reason why fishers could be supportive of the idea of an MPA in general, but not of a particular MPA being located close to them. Fisheries management in Brazil, and to a lesser extent MPA management, may have failed to create a proper environment for institution innovation (Silva et al, 2013). Fishing regulations have been based on spatial and seasonal closure (Medeiros et al., 2013), with no room for balancing conservation objectives with maintenance of fishing livelihoods. This has resulted in a focus on no-take protected areas, with little experimentation of institutional innovations already present in Brazil, such as the Marine

Extractive Reserves that preserves traditional uses and fishing livelihoods (Diegues, 2008; Kalikoski et al., 2009; Seixas and Kalikoski, 2009)

The approach used in this study to capture what fishers consider as being important in relation to the marine environment enabled an initial discussion about the main challenges to the MPA implementation. The small-group exercise promoted sharing and validation of knowledge between fishers in a non-threatening way, avoiding sensitive questions and using grid cells as spatial units instead of exact locations not to disclose specific areas of interest. This is different from participatory mapping studies in which small-scale fishers had been asked to disclose information about the spatial and temporal distribution of fishing activities and main harvested species (Leite and Gasalla, 2013; Schafer and Reis, 2008). Other approaches have also focused on gathering information on local ecological knowledge on species distribution and aggregation areas (Félix-Hackradt and Hackradt, 2008; Gerhardinger et al., 2009). The method developed and applied in this study is particularly useful when lack of trust exists among participants, as a result of past experiences with research in the region and of the past decisions by the government, something present in this study. Other spatial methods have focused on the mapping of social values attributed by resource users towards their territory (Bryan et al., 2010; Sherrouse et al., 2011), and this relates to the method employed in this study in a way that it explores fishers' perceptions towards the marine environment they rely on and the impacts to which it is subjected to, rather than focusing on pointing out where and how fishing activities occur. However, social values mapping differs from the approach employed in this study, as the approach used here does not systematically employ the social values for ecosystem services' typology (Sherrouse et al., 2011). Rather, the map is

generated constructively around two main categories (i.e. importance and impacts) with a focus on acquiring qualitative information on the reasons behind choices and the participants' arguments towards reaching consensus before drawing on the map. The approach employed here also differs from Volunteered Geographic Information (VGI), which constitutes user-generated content that is assorted with spatial coordinates (Jiang and Thill, 2015), because it is conversational and interview-based, where information is derived from a small group discussion, with the assistance of a moderator. Contrary to Map Biography, which records an individual's life history and resource use spatially through time and is usually applied to mapping indigenous land use (Chapin et al., 2005), the method employed in this study focuses on a community's shared perception of their surrounding environment at a particular time frame, when a Marine Protected Area is being implemented.

The approach was also adequate to the context of Paraná coastal zone where there is a low educational level and where most of communication occurs orally. It can be argued, however, that the low level of education could be a barrier to the level of cartographic knowledge necessary to understand the map presented and provide valid information. This was not the case in this study though, as the fishers did not have difficulties locating themselves on the map, especially after having been given time to familiarize with it. The use of the grid cells and the elaboration of the baseline map with main reference features helped reduce bias associated with the accuracy of recording information on the paper map sheet, following recommendations from Close and Hall (2006). It was important to make sure that small-scale fishers knew where the main references were on the map before starting the discussion, and a map tailored to the study containing those main

references was fundamental. The elicitation process involved discussions about each attribute studied and provided supporting qualitative data, which reduces misinterpretations and offers rich information on the reasons behind particular choices made while indicating areas on the map. The exercises provided a space for debate between fishers, allowing them to meaningfully engage in a discussion on the topic, to reach consensus within their group on the areas thought to be important and impacted.

3.5. Conclusions

This study presented a simple exploratory mapping approach that helps capture information on areas fishers consider as being important. The approach was used in the case of the Marine National Park of Currais Islands in Brazil, an MPA designated recently without public consultations. The approach offered small-scale fishers an opportunity to share their views and provide valuable information to the government designing a management plan for the MPA. It provided insights on areas that need attention in the region, showing that the Currais Islands MPA is an important area for fishers for a variety of factors. As there was an overall agreement on ecologically important areas, there might be potential for working closely with fishers using the information collected as a starting point for discussion on conservation and sustainable use of the area. Challenges lie on impacts associated to coastal uses that are not counteracted by a MPA, such as pollution and sediment suspension from port-related activities.

The rapid assessment done using an exploratory mapping approach could ideally be used before any MPA implementation. The approach provides insights on how to proceed, using a breadth of information on what is important to people and which areas need attention, identifying avenues for future more in-depth, technical approaches. One of the values of this participatory mapping method is that it may aid the inclusion of economically or politically disenfranchised stakeholders in consultations, thus creating avenues to increase small-scale fishers' participation in the MPA implementation, arguing for social acceptance and better governance.

Future research could extend the use of the approach to other small-scale fishing communities from Paraná coastal zone, as well as other stakeholders such as tourists, divers, recreational fishers, researchers and government for a more comprehensive participation and understanding of what matters to people and incorporating it into the process to inform decision-making in coastal governance. Also, a need for a discussion at a more regional scale when elaborating the management plan for the Marine National Park of Currais Islands was identified, considering the potential for a new MPA at Itacolomis Islands and the possible displacement of fishing effort to other ecologically important areas. For that, the issues should be discussed at the scale of the marine environment inner continental shelf of Paraná state, encompassing the oceanic islands. Other MPAs could incorporate this approach as a first evaluation of potential challenges to MPA implementation and as a means to include local stakeholders in the discussion.

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CHAPTER FOUR: SUMMARY AND CONCLUSION

This thesis has presented a theoretical contribution to interactive governance framework and added to the existing literature on MPAs and small-scale fisheries. It did so by empirically applying a governability assessment to address the questions on how governable MPAs are, and what challenges the natural and social systems posed to MPAs as an institution towards their implementation, as explored in Chapter 2. The thesis also offered a methodological contribution by designing and testing a novel exploratory mapping approach to involve small-scale fishers in the MPA discussion in a simple, rapid and non-threatening manner, presented in detail in Chapter 3. In this way, it addressed the research question on how to better understand how small-scale fishers relate to the marine environment and how to incorporate this information in the discussion about MPAs. The case study on the Marine National Park of Currais Islands, in Southern Brazil, illustrated this contribution by identifying potential challenges to MPA governance and suggested what can be done to help improve its implementation. Further, the case study offered a simple and innovative 'map-based' approach to involve small-scale fishers in the MPA discussion. Thus, this concluding chapter (Chapter 4) reiterates what has been done in this study and gives a summary of the main lessons learned in Chapters 2 and 3. It also discusses research implications and provides recommendations to improve the governance of the Marine National Park of Currais Islands, and generally. The chapter concludes with limitations of the study and prospects for future research.

4.1. Main findings

Chapter 2 of the thesis explored how governable an MPA is and what can create governability challenges to its implementation. It has also identified where opportunities to improve governance can be found. Through a governability assessment, the highly dynamic nature of the natural system, both spatially and temporally, is highlighted as an important feature to consider in the MPA design.

Further, this study posits that small-scale fishers do not represent a homogeneous group, and therefore should be treated differently. In other words, the social system associated with the MPA is very diverse and complex, with small-scale fishers sharing the same coastal areas but making different uses of the coast and having different perceptions of the MPA in terms of its contribution to the marine environment, to their community, and to themselves. The difference is due mainly to the main fishing gear and techniques used, with encircling gillnets being used by those who rely most on the area designated as the MPA. Other features, such as attachment to fisheries and perception of changes in catches and of future of the activity seem to also influence on how fishers relate to the MPA. The fishing communities in which the use of encircling gillnets is more widespread show strong attachment to fisheries and are comparatively more optimistic about the future of fisheries. Given that they have more at stake in the fisheries, they should be more directly involved in the discussion about the MPA and in defining future management actions.

The designation of the MPA was largely a top-down process, guided by research interests, and did not comply to the Brazilian National System of Protected Areas

regulations, which requires public consultation to be conducted prior to establishing a new MPA. It is therefore not surprising to find mismatches between the images that small-scale fishers have of the MPA and its objective, compared to those of the governments. Small-scale fishers sometimes perceived the MPA as unnecessary, considering that the islands are not under serious threats, except from other impacts not addressed by the MPA (e.g. from port-related activities and pollution). Further, by prohibiting gillnetting in the area, the governing system may be prioritizing the interest of bottom-trawlers, even though they are considered to create more impacts. Such discrimination could pose challenges to governance at a much larger scale than the MPA, especially when considering the potential relocation of gillnet fishing effort to other ecologically important areas.

Opportunities to improve the MPA implementation could arise by embracing the sense of ownership towards Currais Islands displayed by some small-scale fishers, particularly those relying most in the area for their fishing livelihoods. Some fishers also demonstrate optimism about conservation efforts in the region, attributing them to increased catches and a better future for fisheries. This shows space where dialogue can be fostered to find a balance between conservation needs and maintenance of livelihoods of small-scale fishing people.

In Chapter 3, a simple mapping approach was employed to enable fishers to identify importance of the marine area and impacts that different activities create. The approach is conversational and non-extractive, with respect to local knowledge, and can be used as a rapid appraisal method prior to the designation of the MPA or during the consultation about the MPA planning. The study highlighted how this exploratory mapping approach

can provide spatial baseline information about marine ecosystem according to fishers' knowledge and judgments, revealing areas of conflict and of agreement, valuable for the development of a management and implementation plan for an MPA.

In the Marine National Park of Currais Islands case study, small-scale fishers show common ground when assigning ecological importance mainly to areas with rocky bottom, relating this to the presence of fish and importance to their life cycle. Small-scale fishers place high economic importance to areas most used by them for their fishing activities, explaining that these are where their targeted resources are located. The areas of high economic importance largely correspond with those having ecological importance. Thus, 'hotspots' of importance could be identified, with Currais Islands being the most cited area having the highest ecological, economic and socio-cultural importance. Currais Islands are also considered, however, threatened by spearfishing and tourism activities as well as other impacts.

The method developed and employed in this study provides an opportunity for small-scale fishers to interact with each other, discussing points of view and reaching consensus before marking areas on the map. The approach was appropriate given the low level of formal education of small-scale fishers from Pontal do Paraná municipality, as it draws largely from the tradition of oral communication, and does not require prior cartographic knowledge. Fishers can easily identify where things are on the map using reference features provided. The exploratory mapping approach could ideally be used before any MPA implementation, providing insights on how to proceed, using a breadth of information that is rapidly available, as well as identifying avenues for more in-depth, technical approaches, if desired.

4.2. Policy recommendations and future research

The case of the Marine National Park of Currais Islands represents an example of how MPA designation is often conducted, i.e. without public consultation, through a top-down process (Arruda, 1999; Bensusan and Prates, 2014; Diegues, 2008), despite requirements from the Brazilian legislation for broad stakeholder participation in the definition of location, dimensions and boundaries of the protected areas (MMA, 2004). Further, implementation is difficult as about 78% of all designated Brazilian protected areas at federal and state levels do not have a management plan (Sousa et al., 2011). Therefore, this study reveals challenges that arise when recommendations for stakeholder participation are not considered and aims at highlighting avenues for inclusion and better governance.

The study is also timely since the management plan for the Marine National Park of Currais Islands is currently under development. Specific recommendations related to the case study include focusing on the small-scale fishing communities and gear users who have more at stake in terms of the MPA, and using the exploratory mapping approach presented here as elicitation tool towards including these small-scale fishers in the discussion of the management plan. Also, even though the MPA was designated under the National Park category, which does not allow any extractive uses while focusing on tourism, research and recreation according to Brazilian legislation (SNUC, 2000), there is space for discussing and exploring ways of including small-scale fishers' opinions into the MPA management plan. This would include fishing agreements made between fishers and the environmental agency, which could for example legally allow an open season

during winter for targeting migratory species that constitute an important source of income to small-scale fishers this time of the year, as long as its impacts are assessed, making it feasible for small-scale fishers to maintain their livelihoods.

Generally speaking, MPA implementation elsewhere could benefit from the analytical assessment applied in this thesis (i.e. interactive governance), to explore the properties of the natural and social system that the MPA aims to govern. There is a need to acknowledge the context in which the MPA is embedded in, including the diversity, complexity, dynamics and scale that it encompasses in the MPA design. By applying a governability assessment, it is possible to identify where challenges to a potential MPA could be before designating it, and help find characteristics inherent to the systems (i.e. sense of ownership) that might be conducive to better governance if considered. Further, use of the exploratory mapping approach presented in this thesis is expected to help include small-scale fishers in the process, thus by understanding how they relate to the marine environment may shed light on what would potentially lead to buy-in and compliance, thus enhancing the changes of success of an MPA.

Limitations of this study include the reduced precision of the maps produced through the exploratory mapping approach, which was adequate to the objective here, but could be limited if the objective would be to indicate a precise location. Also, when exploring fishers' perceptions towards a particular MPA already designated (e.g. Marine National Park of Currais Islands), information collected through the questionnaires and mapping may reflect the current context, which therefore may have been influenced by the implementation of the MPA.

Another limitation could be the inclusion of only male small-scale fishers, which were the focus of this study because as active fish harvesters, they were presumably the most affected by the Marine National Park of Currais Islands and who are experiencing daily changes to the marine environment and its uses. While women, who are involved in post-processing, as well as other resource users such as divers, recreational fishers, tourists and researchers, were not the focus of this study, they could have different perceptions about the MPA and will also have to abide to MPA's rules, being also important towards an effective implementation. Further, this research represents a time frame of the entire process of an MPA designation and implementation that involves different phases, through which the way the MPA is perceived may change across small-scale fishers. Finally, the grouping of small-scale fishing communities could be different depending on the criteria used to determine the grouping. While the grouping in this study was considered to be reasonable and robust, since it was based on data obtained from the questionnaire, a change in criteria may lead to different groupings. For this reason, the governability level based on the grouping is only a relative measure and should be interpreted as such. In other words, the use of this information in the development of the MPA management plan should be done with caution and with this limitation in mind.

Recommendations for future research include exploring a clear definition of MPA's goals and the impacts it aims at addressing, which is needed so those governed and those who govern share a common image of what the MPA is intended to be. Future research could apply the exploratory mapping approach presented here to other contexts, prior to MPA designation or even to assess an existing MPA in order to guide management actions and as a means to include local stakeholders in decision-making. Based on the

limitations indicated here, research could work towards improving the exploratory mapping approach, in respect to incorporating diversity of resource users – including fisher women and other resource users, and at different stages of MPA designation and implementation. Some improvement can also be made about the method to assess governability to enhance its utility and robustness.

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APPENDIX I Questionnaire Cover Letter

This cover letter was provided in Portuguese, but translated for inclusion in the thesis.

August 2014

Dear Sir/Madam,

I am a graduate student from Memorial University of Newfoundland in St. John's Canada conducting a research that is part of a project named Too Big To Ignore (http://toobigtoignore.net/), which is a global partnership for small-scale fisheries research.

I would like to invite you to participate in my research about the challenges and opportunities to the implementation of the Marine National Park of Currais Islands by answering a few questions about the marine environment and fisheries that take place in the region. The objective of this questionnaire is to obtain your opinion and those of other fishers about the importance of this area to the fishing communities and the main concerns when it comes to the conservation of the marine environment.

There are no right or wrong answers to the questions, as they aim to reflect your personal opinion and point of view. Your participation is completely voluntary and all the data is **anonymous and strictly confidential**, and will be used for the purposes of this research only. I anticipate that we may take around 20-25 minutes to complete this questionnaire.

The proposal for this research has been approved by the Interdisciplinary Committee on Ethics in Human Research at Memorial University. If you have ethical concerns about the

research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at **icehr@mun.ca** or by telephone at +1 709 864 2861.

If you have comments or questions, or wish to receive a copy of the final report, please contact myself or my supervisor, Dr. Ratana Chuenpagdee at **ratanac@mun.ca** or by telephone at _____.

Thank you.

Sincerely,

Mirella de Oliveira Leis

☎ +55 41 _____ / +55 41 _____

✉ mirella.deoliveiraleis@mun.ca

APPENDIX II Questionnaire Consent Form

This questionnaire was provided in Portuguese, but translated for inclusion in the thesis.

Title: Implementation of Marine Protected Areas as a governability challenge in Southern Brazil

Researcher(s): Mirella de Oliveira Leis

Department of Geography

Memorial University

mirella.deoliveiraleis@mun.ca

Supervisor(s): Ratana Chuenpagdee

Department of Geography

Memorial University

ratanac@mun.ca

You are invited to take part in a research project entitled *"*Implementation of Marine Protected Areas as a governability challenge in Southern Brazil.*"*

This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. It also describes your right to withdraw from the study. In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. This is the informed consent process. Take time to read this carefully and to understand the information given to you. Please contact the

researcher, Mirella de Oliveira Leis, if you have any questions about the study or for more information not included here before you consent.

It is entirely up to you to decide whether to take part in this research. If you choose not to take part in this research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Introduction

I am a graduate student from Memorial University of Newfoundland in St. John's Canada. As part of my Masters' thesis, I am conducting research under the supervision of Dr. Ratana Chuenpagdee. The research is part of a project named Too Big To Ignore, which is a global partnership for small-scale fisheries research and intends to address the governability challenges to Marine Protected Area (MPA) implementation. MPAs have been internationally endorsed as a strategy to marine resource conservation and fisheries management, but implementation of MPAs remains a challenge worldwide, resulting in few conservation outcomes reported on the ground and generating social conflicts. This is the case especially where biodiversity-rich areas targeted for conservation coexist with high reliance on natural resources use, as of the coastal zone of Paraná in Southern Brazil.

Purpose of study:

The purpose of this study is to identify the challenges and explore opportunities to the effective implementation of MPAs in the context of Southern Brazil, by looking at the conflicts and compatibility between perceived resource use and nature conservation efforts.

What you will do in this study:

You are invited to participate in this study by answering a few questions about the marine environment and fisheries that take place in the region. The objective of this questionnaire is to obtain your opinion and those of other fishers about the importance of this area to the fishing communities and the main concerns when it comes to the conservation of the marine environment.

Length of time:

The completion of the questionnaire is expected to take around 20 to 25 minutes.

Withdrawal from the study:

Participation is completely voluntary, and respondents are free to withdraw from the study, as well as any information they have given, at any point while data is being collected.

As data is anonymous, individual questionnaires cannot be withdrawn after the data collection session has ended.

To stop and/or end involvement in the data collection, the participant can communicate to the researcher the willingness to stop and/or end the involvement in study.

Data collected up to the point of a participant's withdrawal will be destroyed.

There are no consequences associated to the participants' withdrawal from the study.

Possible benefits:

This research intends to provide practical potential benefits to the coastal communities of Paraná, such as contributing to share knowledge about the importance of and impacts to the area. Ideally, these benefits would include providing coastal communities affected by the designation of the MPA means to claim to government authorities the importance of the coastal area of Paraná state to both the maintenance of their livelihoods and

conservation of biodiversity. Also, provide government officials and managers better guidance during the elaboration of the MPA management plan, by highlighting the potential challenges and opportunities to the MPA implementation

Benefits to the scientific community involve contributing to the vast MPA literature by identifying the challenges and opportunities to MPA implementation through a first empirical application of the interactive governance analytical framework, which is broad in scope and adopts a systems perspective of analysis**.**

Possible risks:

There are no potential risks of being involved in the study.

Confidentiality

Confidentiality is ensuring that identities of participants are accessible only to those authorized to have access. Privacy of participants will be maintained and identity kept confidential, and this will be achieved as it follows:

- First, no questionnaire survey information will be collected that may directly reveal the identities of participants (e.g. name of the person or description of physical appearance);
- The returned questionnaires will be coded using identification numbers;
- Sorting and ordering data will be numerically transformed and recorded in a spreadsheet for further analysis;
- Information about the participants will be aggregated;

- Overall, data released will not contain names, initials or other directly identifying information, as it will be about the community as whole, not about individual opinions.

Anonymity:

Anonymity refers to not disclosing participant's identifying characteristics, such as name or description of physical appearance. Every reasonable effort will be made will be made to ensure the participant's anonymity, and they will not be identified in any reports and publications. Anonymous data will be achieved in this study through the protection of confidentiality of personal information and records.

Recording of Data:

There will be no audio, video or photographic record of data in this study, only written records.

Storage of Data:

The actual completed questionnaire survey and data files will be assigned a numerical code and will be kept in a locked data storage facility in the International Coastal Network housed in the Bruneau Centre for at least five years, according to the Memorial University policy on Integrity in Scholarly Research, before being destroyed.

Reporting of Results:

Data collected from this research project will be used to compose a Masters' thesis. Also, it will be tentatively published in journal articles and presented at conferences, and also published in the format of a report to be delivered to the overall public.

Data will be reported only in aggregated form, so that it will not be possible to identify individuals.

Sharing of Results with Participants:

By the end of the data collection phase, the results will be presented in a workshop format with open invitation and voluntary participation, in order to share the preliminary version of results in an aggregated form. The final results of the research will be shared with the general public, including participants of the study, through a report.

Questions:

You are welcome to ask questions at any time during your participation in this research. If you would like more information about this study, please contact:

Researcher: Mirella de Oliveira Leis

Email: mirella.deoliveiraleis@mun.ca. Phone number: +55 41 _____

Supervisor: Ratana Chuenpagdee

Email: ratanac@mun.ca Phone number: +1 709 _____

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

I have read and explained this consent form to the participant before receiving the participant's consent, and the participant had knowledge of its contents and appeared to understand it.

_____ _____

Signature of Principal Investigator Date

APPENDIX III Questionnaire

This questionnaire was provided in Portuguese, but translated for inclusion in the thesis.

Questionnaire number: ____

Location: _____

Date: ___ /___ /___

Time of the day: ___:___ □ a.m. □ p.m.

Resource user group: _____

Duration: _____

1) Is fishing your main occupation?
   a) □ Yes (continue the questionnaire)
   b) □ No, my main occupation is _____ (do not continue the questionnaire)

Demographics

2) Where are you from?
   a) □ From here
   b) □ From _____ but I have been living here for ____ years
3) What is your age? ____years
4) What is your highest level of education?
   a) □ Illiterate
   b) □ Elementary school (1^{st} to 8^{th} grade) incomplete

c) □ Elementary school (1st to 8th grade) complete

d) □ High school (9th to 11th grade) incomplete

e) □ High school (9th to 11th grade) complete

f) □ Superior education (university) incomplete

g) □ Superior education (university) complete

h) □ Master's degree

i) □ Doctoral degree

5) What is your gender?

a) □ Male

b) □ Female

c) □ Other (please specify):_____

Attachment to fisheries

6) How old were you when you started fishing as an occupation? _____ years.

7) With whom did you start fishing/who taught you how to fish? _____.

8) Does your family fish too/ is involved in fisheries?

a) □ Yes (Kinship? _____)

b) □ No

9) Do you have children?

a) □ Yes (How many?_____)

b) □ No

10) Would you want your children be fishers like you? Why?

a) □ Yes, because

_____

b) □No, because

_____

c) □ Don't know/ No opinion

11) Why do you work in the fishery?

a) □ Family in the fishery

b) □ Like fishing

c) □ Make good money

d) □ Lack of alternative choices

e) □ Other:_____

12) In case you could have the same income in another occupation, would you change the activity?

a) □ Yes

b) □ No

Dependency on fisheries

13) What portion of your household income comes from the fishery?

a) □ Everything

b) □ More than half

c) □ Half

d) □ Less than half

e) □ Almost nothing

14) What are your sources of income? Check all that applies.

a) □ Fish all year round

b) □ Fish only during a certain season when the targeted species occur (Which one_____)

c) □ Fish as a crew member in industrial fisheries

d) □ Hire people to work on your boat

e) □ Buyer or middleman

f) □ Fix fishing nets

g) □ Processing (eg. filleting fish, peeling shrimp)

h) □ Agriculture

i) □ Take tourists to practice recreational fishing

j) □ Take tourists for boat tours

k) □ Work in other activities the city (formal employee)

l) □ Work in other activities without a formal contract

m) □ Receives a closed season insurance

n) □ Receives a retirement pension

o) □ Other:_____

15) Let's suppose that you've caught 100kg of fish today. How much of this fish goes to where?

____ % Your household consumption/give away to relatives and friends

____ % Sold directly by you/your family members at local markets

____ % Sold by you/your family members to any buyers/middlemen

____ % Sold to specific people as agreed upon prior to harvesting

____ % Others (please specify: _____)

100 % TOTAL

Comments:_____

_____

Fishing activities

16) What is your main fishing gear?

a) □ Bottom trawling

b) □ Gillnet

c) □ Spear fishing

d) □ Other: _____

17) Do you (Check all that applies):

a) □ Own the boat but does not work on it

b) □ Own and work on your boat

c) □ Work as a crew member

Perceived changes in the fisheries resources

18) Have you experienced changes in the catches?

a) □ Yes (please specify):

_____

b) □ No

c) □ Don't know/No opinion

19) In your opinion, what is causing these changes?

a) Please describe:

_____

b) □ Don't know/No opinion

20) How is it affecting your daily fishing activities (practices and places where you go fishing)?

a) Please describe:

_____

b) □ Don't know/No opinion

21) In your opinion, what is the future of fisheries in the region?

_____

Relation to the MPA

22) Have you ever heard about the National Marine Park of Currais Islands?

a) □ Yes

b) □ No

23) How did you hear about it?

a) □ At a public meetings

b) □ From governors

c) □ From managers

d) □ From NGO members

e) □ From researchers/students from the university

f) □ Through fishers organization/from other fishers

g) □ From members of the community (family or friends)

h) □ By visiting the area

i) □ From tourism agencies

j) □ Through media (radio, television, internet)

k) □ Other (please specify):_____

24) In your understanding, **what is the National Marine Park of Currais Islands for**?

Check all that applies.

a) □ Environmental conservation

b) □ Increase catches

c) □ Reduce anthropic pressure

d) □ Exclude some resource users

e) □ Empower local communities

f) □ Promote tourism

g) □ Conduct scientific research

h) □ Resolve conflicts between resource users

i) □ Achieve governmental goals on conservation

j) □ Other (please specify):_____

k) □ Don´t know/No opinion

25) In your opinion, the National Marine Park of Currais Islands is:

a) To the environment:

□Very good □ Good □ Neutral □ Bad □ Very bad

b) To the community:

□ Very good □ Good □ Neutral □ Bad □ Very bad

Comments:_____

26) Do you think you may be affected (positively or negatively) by the National Marine Park of Currais Islands? Why and in which way?

a) □Yes,

_____

_____

b) □No,

_____

_____

c) □ Don´t know/No opinion

27) In your opinion, **which activities should be allowed** in the National Marine Park of Currais Islands? Check all that applies.

a) □ Artisanal fisheries

b) □ Industrial fisheries

c) □ Recreational fisheries

d) □ Tourism activities

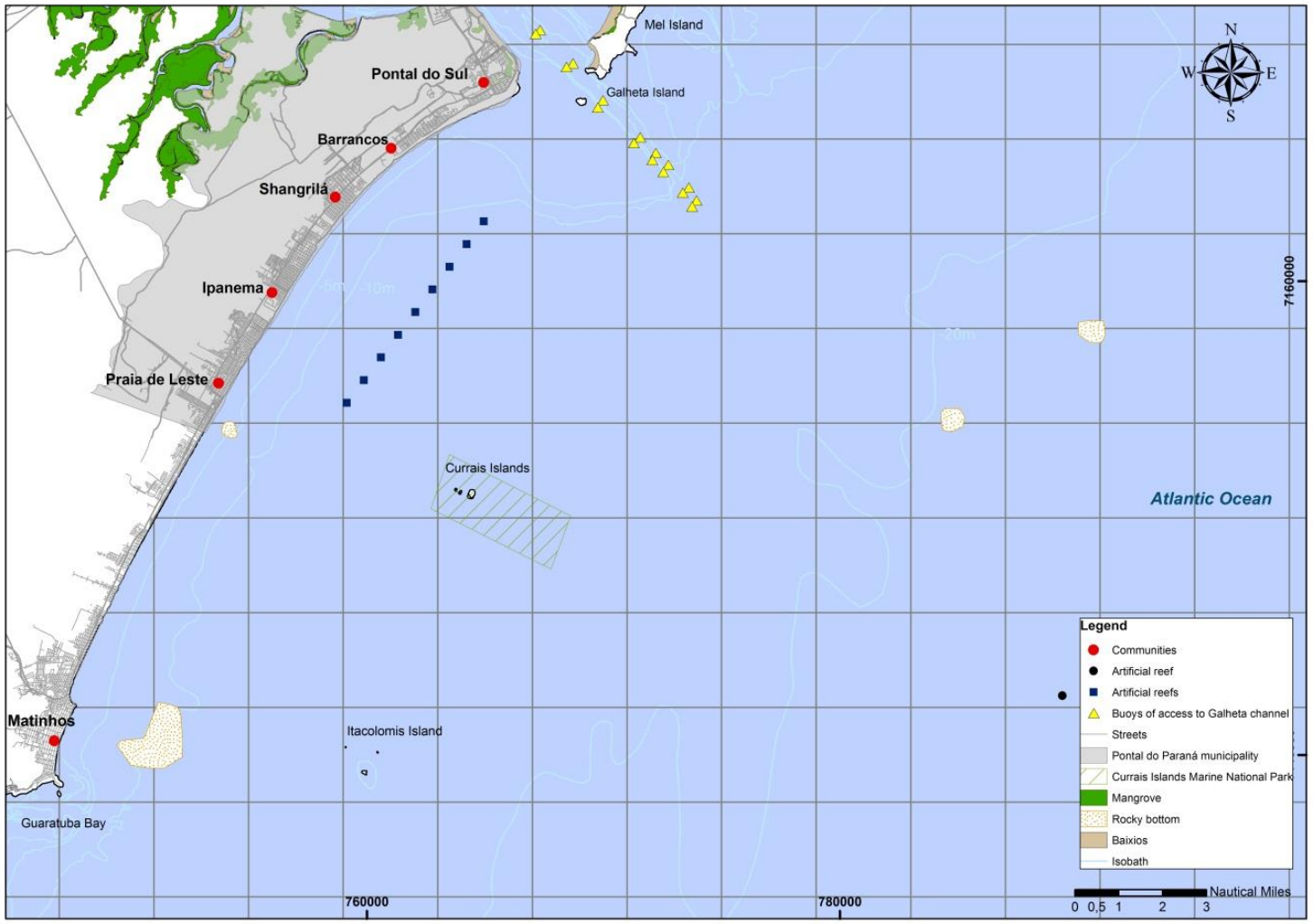
e) □ Research

f) □ Nothing should be allowed

g) □ Other (please specify):_____

h) □Don't know/No opinion

APPENDIX IV Map used for the exploratory mapping approach



APPENDIX V Original quotes from small-scale fishers in Portuguese

“[A área marinha protegida] não vai ajudar em nada. Nós não matamos os passarinhos, eles são os primeiros a visitar o pescador que chega ali. Ali nunca ninguém destruiu nada. Tá cuidado pelo pescador. Capaz que quando levarem o pescador de lá estraguem. Vai fazer sacanagem, botar fogo na ilha. Essa lei não vai proteger nada, ela [Ilhas dos Currais] fica mais cuidada sem a lei do que com a lei.” (p. 47)

“Eles criaram aquilo para proteger as gaivotas, os atobás. Mas quem sustenta elas é o pescador, que joga o resto do arrasto pra eles." (p. 47)

"Quem cuida da ilha somos nós, que estamos pescando sempre lá" (p.47)

"Não entendo porque fazer isso aí [a AMP]. Passarinho tem bastante. Maior besteira [a criação do parque], ali não tem nada para preservar, conheço aquela ilha ali como o quarto da minha casa". (p. 48)

"Tá ferindo a família do litoral. O que fere mais é saber que é por interesse político. Ninguém faz lei se não tiver algo atrás dele. Quem vai resolver o que é bom é nós mesmos. Quem tá em Curitiba não sabe disso. Nós sim." (p.48)

“A nossa renda dessa semana veio de lá [Ilhas dos Currais]. O primeiro lugar que os peixes de fora encostam é na ilha." (p. 49)

“[A área marinha protegida] vai me ajudar, porque vai ser um abrigo para os peixes: eles se criam ali, crescem, vêm para as beiradas.” (p. 49)