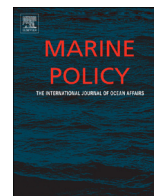




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Marine Policy

journal homepage: www.elsevier.com/locate/marpol

Each fisherman is different: Taking the environmental perception of small-scale fishermen into account to manage marine protected areas



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ARTICLE INFO

Article history:

Received 16 July 2014

Received in revised form

16 September 2014

Accepted 16 September 2014

Keywords:

Coastal management

Co-management

Human ecology

Resource management

Sustainable use of resources

Bayesian analyses

ABSTRACT

One of the reasons for the failure of some Marine Protected Areas (MPAs) is the lack of respect for their boundaries and regulations, which intensifies the need to assess the attitudes of stakeholders affected by MPAs. To this end, it is necessary to know the perception and behavior of resource users in these areas in relation to the management process. This study addressed the perception of different groups of fishermen in three MPAs that allow sustainable use of resources on the Brazilian northeastern coast. The perception analysis was based on four aspects: biodiversity conservation, flexibility and adaptability of fishermen, participation in management and opinions about the MPA. The interviewed fishermen ($n=100$) were classified into natives or immigrants, \geq than 40 years old or < 40 , predominant use of selective or nonselective fishing gear and part or full time fishermen. The results showed that younger fishermen and the ones who use selective fishing gear presented a more conservation prone perception; nonselective fishermen and part-time fishermen were more flexible and adaptable to changes; and younger fishermen tended to agree more with the establishment of the MPAs. Taking these differences in perceptions among fishermen into account could serve as a basis for improvements in the management and conservation of fishing resources, besides helping predict possible future behavior due to changes in management policies.

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1. Introduction

The maintenance of marine ecosystems and biodiversity has been threatened by overfishing, illegal fishing, use of predatory extraction methods and users conflicts over resource use [1,2]. As a result, there is an urgent call for sustainable management [3], and one of the most well regarded alternatives proposed for that is the establishment of Marine Protected Areas (MPAs) [4,5].

The implementation of an MPA is only the first step: its effective management is fundamental to ensure the protection, restoration or sustainable exploitation of natural ecosystems. Also, it should be considered that the successfulness of an MPA, similar to any other type of resource management initiative, is the outcome of the interplay between two main aspects: the local ecological characteristics (e.g. the carrying capacity of the area) and the institutions in place, which could assure a higher level of users' acceptance and compliance [6–8].

The poor performance of an area subjected to management rules may be the outcome of inadequate governance or management model [4], or lack of knowledge on resource users' behavior, their perception and attitudes [9–13]. Responses and adaptations of users to new rules imposed by MPAs are one of the determinants to achieve management goals [5,14,15]. Thus, understanding the perceptions and attitudes of resource users in socio-ecological systems could help predict possible behaviors that lead to the success or failure of management systems. This involves knowing the influences that act upon users and their likely responses, so that both the costs and benefits of such management strategies can be assessed.

MPAs will generally limit or forbid fishing, amongst other activities, affecting for example, fishing effort, time available for fishing activity, species that can be caught, catch limits and gear allowed [16]. Such restrictions imposed by these MPAs, along with local socioeconomic characteristics, create heterogeneity of preferences and attitudes among fishermen, increasing the diversity of perceptions and behaviors in the system. This, in turn, could increase conflicts over the resources [16]. Thus, knowing the perception of different groups of fishermen can generate subsidies that will help reduce conflicts among users, permitting the proposal

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of fisheries management more likely to be respected and the maintenance of protected areas [17].

Although there are studies that address the issue of perception and attitudes associated with different socioeconomic and management variables [18–22], little is known about how the perceptions and attitudes of users of natural resources can influence management of protected areas and the socio-ecological resilience of the people living in them. Differences in perception among groups of fishermen could potentially influence the promotion of resilience of social-ecological systems, defined as the capacity of self-organization of the system and the users' capacity for learning and adapting to a new state [23]. A more conservationist behavior, for example, could help an ecological system support a higher diversity of species, while adaptable and learning-prone fishermen could support and participate more in the decision-making process of an MPA.

In this study, the objective was to compare some aspects of the perception among groups of fishers according to some criteria that have already been demonstrated to be important in the construction of perception, such as birth place, age, fishing selectivity and degree of dependence on fishing [9,15,17,24–27].

The following questions were investigated: (1) whether selective fishermen born in a place subject to the limitations of an MPA show more conservationist attitudes; (2) if young fishermen, nonselective ones and those not exclusively dependent on fisheries (part-time fishermen) tend to be more flexible and adaptable to changes in the reserves; (3) whether fishers born in the community under the influence of an MPA and full-time fishermen have greater participation in the establishment of management; and (4) if fishermen born in the community under the influence of an MPA tend to have more positive opinions regarding the MPA than immigrant fishermen. The understanding of environmental perception of different groups of fishermen can help establish improvements in conservation practices. This can lead to identifying groups that can offer support and groups that need to be worked on for a better understanding of the need for MPAs, aiming, for example, to reduce local conflicts and improve compliance. Thus, studies of this nature can help improve the performance of MPAs where the use and extraction of natural resources is permitted.

2. Material and methods

2.1. Study area

In Brazil, MPAs can be managed under different categories of parks, with varying levels of access to the resources, from no-take areas to areas that allow the sustainable extraction of the resources, and anything in between [28]. This research was done in three MPAs that allow the sustainable use of resources, all located on the Brazilian northeastern coast (Fig. 1).

Such MPAs are in the states of Rio Grande do Norte (State Sustainable Development Reserve Ponta do Tubarão, established in 2003 – hereafter Ponta do Tubarão) and Ceará (Extractive Reserve Batoque, established in 2003 – hereafter Batoque; Extractive Reserve Prainha do Canto Verde, established in 2009 – hereafter Prainha) (Table 1). The three MPAs were established after intense local demand, but they still lack a management plan defining the access and use of natural resources. Also, these MPAs are based on co-management schemes, in which the communities are supposed to have input in the decision-making. However, in the absence of a management plan, the rules in place are vague or based on general federal laws, such as closed periods for lobsters. No specific rules devised for these MPAs themselves were in place by the time of this study.

Batoque and Prainha are exclusively marine and federally managed, while Ponta do Tubarão is a state MPA that includes terrestrial and marine area (Table 1). The fishing communities within the MPAs or subjected to the MPAs regulations depend mostly on fisheries and clam extraction. The infrastructure conditions and job options for the three MPAs are deficient, according to the interviewees, with severe socioeconomic problems related to health access, violence, drugs and unemployment.

2.2. Fishermen's profile

One hundred fishermen were interviewed in the three MPAs, and all of them were men between 21 and 77 years old (44 ± 12.4 years), with an average fishing experience of 29 (± 13) years. Most fishermen (81%) claim to own their house and have an average

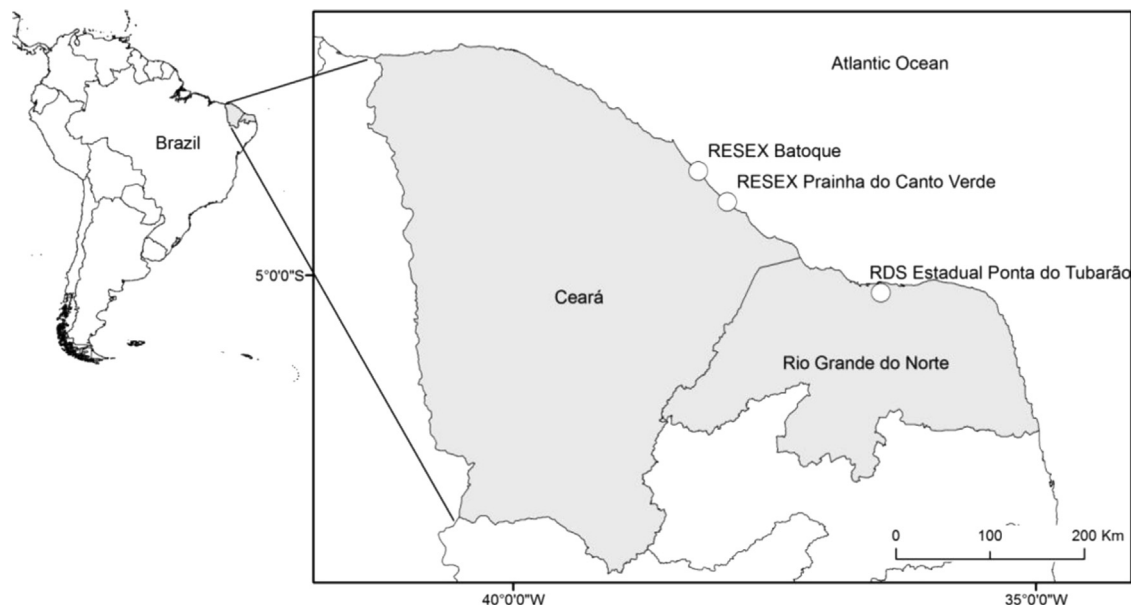


Fig. 1. Study area highlighting: State Sustainable Development Reserve Ponta do Tubarão ($5^{\circ}9'S$, $36^{\circ}27'W$), Extractive Reserve Batoque ($4^{\circ}0'6.13''S$, $38^{\circ}13'52.07''W$) and Extractive Reserve Prainha do Canto Verde ($4^{\circ}17'44.83''S$, $37^{\circ}57'20.22''O$), located on the northeastern Brazilian coast.

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