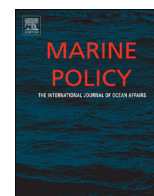




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Short Communication

Use of local knowledge in marine protected area management

Tiscar Mellado^{a,1}, Timothée Brochier^{b,*}, Julien Timor^c, Javier Vitancurt^d^a Sistema Nacional de Áreas Protegidas, Dirección Nacional de Medio Ambiente, Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente, Becaría MAEC-AECID, Spain^b Laboratoire d'Ecologie Marine (LEMAR), Institut de Recherche pour le Développement/Centre de Recherche Océanographique de Dakar-Thiaroye, BP 1386 Dakar, Senegal^c Museum National d'Histoire Naturelle, Paris, France^d Universidad de la República Uruguay, Centro Universitario Regional Este (CURE), Sistema, Nacional de Áreas Protegidas, Dirección Nacional de Medio Ambiente, Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente, Uruguay

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ABSTRACT

For decades, fishermen in most parts of the world have been experiencing a reduction in fish abundances. Overexploitation and increasing demands are the glaring visible causes, but weakness or absence of fishery management is the core problem. Faced with repeated failure of fishery management and the resulting overexploitation in fish stocks, new management plans are needed in order to preserve both fishermen's jobs and food security. A growing number of published sources have proposed marine protected areas (MPA) as a fishery management tool. The decision of MPA design requires close collaboration with local fishermen communities for it to be accepted and respected. This paper focuses on the case of a Uruguayan lagoon, the Rocha lagoon, which is exploited by two fishermen communities. The lagoon is located inside a national park. Park authorities are in the process of designing a management plan that defines a MPA inside the lagoon. The plan also sets out the rules to be upheld for the artificial opening of the sandbar that separates the lagoon from the ocean. It is shown that it is relevant to study the local ecological knowledge (LEK) in order (1) to understand the fishery related ecological issues within the lagoon and (2) to highlight an existing conflict between two fishermen communities. Studying the LEK allowed a clear representation of the factors that must be taken into account when defining the management plan. Furthermore, the LEK study in itself creates an appropriate place for inter-community debate and it enhances the acceptance of the future management plan.

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1. Introduction

Chronic overexploitation of the oceans threatens marine biodiversity at the global scale [1]. As advocated by the international research and conservation bodies, one of the counter-measures to palliate this problem is a drastic increase in the spatial protection of ecosystems in Marine Protected Areas (MPAs). This strategy has motivated a great research effort in developing scientific tools to help in the decision making process of MPA design [2,3].

Many publications have shown the importance of Local Ecological Knowledge (LEK) in designing and managing MPAs (e.g. [4–7]). However such knowledge is not always adequately integrated by scientists and resource managers. Indeed, numerous fisheries' management models have failed by not having taken LEK into account [8,9]. One of the main causes of this problem is the lack of dialog

between fishermen, scientists and decision-makers [10–12]. This lack of communication reduces the efficiency of stock assessment and management measures; it also generates skepticism toward scientific recommendations that are put forward [13]. As a result, conflicts can emerge and they can be piled on to those already present.

The objective of this paper is to describe an interdisciplinary initiative which attempted to integrate fishermen into the management process of one MPA in Uruguay (lagoon of Rocha) in order to provide recommendations for the MPAs' management design, and to value fishermen as source of management advices. Indeed, acknowledging fishermen's LEKs enhances their involvement in the management process and for the acceptance of management measures [4,6,14–16]. In addition, ignoring the existence of relevant LEKs, which could be constructively integrated into modern conservation programs, can lead to their loss [17,18].

1.1. Study area

The lagoon of Rocha is a 72 km² shallow body of inland coastal water, with an average depth of 0.55 m (max 1.4 m; [19]). It is

* Corresponding author. Tel.: +221 77 606 82 02.

E-mail address: timothee.brochier@gmail.com (T. Brochier).¹ Deceased.

separated from the ocean by a sandbar. It has the status of Biosphere Reserve (1976) and National Park Lagoon (1977). In 2010, it was included in the National System of Protected Areas (SNAP) of Uruguay with the category of Protected Landscape, according to Union Internationale pour la Conservation de la Nature (UICN).

Periodically, throughout the year, sea intrusions or river run offs (due to heavy rainfalls) open the sandbar, allowing communication of the lagoon with the coastal system [20]. The sandbar can stay open for several days to several months depending on weather conditions; it is estimated that it is open approximately half of the year [21]. During a flood period, if the sandbar does not open naturally, it is opened artificially by mechanical means. Artificial openings are expected to free the privately owned flooded fields. Currently, the decision for time and location of the artificial opening of the sand bar involves the stakeholders and competent authorities. It depends on water level inside the lagoon and weather conditions.

In the lagoon, there is a seasonal variability of fish assemblage determined by the dominant system of currents in the ocean. During summer, the warm Brazil current prevails and an associated tropical fauna is observed; while during winter, the cold Malvinas current dominates supporting cold water species (Fig. 1; [21,22]).

The towns of Rocha and La Paloma (25,500 and 4000 inhabitants respectively; 2004 Census from the Instituto Nacional de Estadística (INE)) are located near the MPA boundaries. There are two settlements of fishermen within the MPA: Puerto de los Botes (PB) with estimated population of 40 inhabitants, and Asentamiento de la Barra (AB) with estimated population of 100 inhabitants (Fig. 1). Although, in the past, fishermen used both sea and lagoons, today these fishing activities are separated. Fishermen of Puerto de los Botes and Asentamiento de la Barra focus their activities in the Rocha lagoon [23,24].

The artisanal fishery is an important source of income for permanent and seasonal fishermen. Fishermen generally use small boats (4–6 m long and 2–2.5 m wide) propelled by outboard motors (4–6 HP) that have replaced more traditional rowing and sailing. Each boat is operated by two or three fishermen [23]. The main commercial species fished in the studied area are listed in Table 1, along with their different ecological categories [25].

2. Methods

Diversity in ecosystems and in local cultures makes it difficult to develop a standardized method to use LEK in MPA management. However, participative approach may draw insights from the large panel of published and unpublished experiences. Drawing relevant information for management from LEK is a very different process than collecting biological data through academic methods. It is not straightforward because it involves skills both in ecology and in anthropology. In general, LEK studies require collaboration between researchers with interdisciplinary backgrounds, and/or specialists in ecology and in social science.

Fieldwork was conducted between January and August 2010 in the two above-mentioned artisanal fishing communities located inside the MPA. The fieldwork's scope was limited to permanent fishermen from both communities. A set of indicators was defined in order to characterize and to measure fishing activity in the lagoon for each community (Table 2). Total number of boats was estimated from direct field observation. Other statistics (total number of inhabitants, total number of fishermen and fishing effort) were determined through interviews. Total number of fishing licenses and total estimated fish catches were obtained from the local management team (Santana O., pers. com).

To bring forward fishermen knowledge on lagoon environment and to create a better dialog space, a spatial mapping tool was the preferred option [26–28]. This work started with semi-structured interviews as a first approach when seeking to understand the situation of the lagoon and to present the project. A total of 11 individual interviews were performed on MPA rangers; artisanal fisheries technicians; MPA managers; veteran and young fishermen; a local NGO; and owners of rural plots. According to the social organization of fishing activity, a total of four workshops were conducted in all communities: three in AB and one in PB. Each workshop involved four to five active fishermen who work together (Table 3). Workshops and individual interviews followed the same general semi-structured approach, although workshops had to be comparatively more structured because more people were involved in the process.

To start the interview, fishermen were asked to name and to describe the territory represented on maps. To minimize external suggestions, the maps contained only basic information: coastline, MPA boundary and main rivers. The intention was that only their spatial references would be used, so that fishermen were questioned about spatial and temporal distribution of fishing activities and of main harvested species. With our assistance, the respondents were asked to put this information on the maps. In addition, the gear used for each harvested species and the limit of fishing periods were defined. For commercial species, there was a period in which the fishermen concentrate their effort on a single one of those species. Such periods, referred to as *zafra* by fishermen, correspond to the time of maximum abundance and demand for one species.

To complete the mapping work, respondents were asked to highlight areas of interest: spawning sites, migration routes or fragile areas. The workshop finished with a discussion about past, present and future of fishery resources of the lagoon, its threats and its problems. That is when the respondents proposed themselves management strategies for fisheries. At that stage, in the different workshops, respondents themselves proposed management strategies for fisheries.

Lastly, the information collected during the workshops were discussed to reach a consensus, and to reach a general agreement on the management measures proposed by and in each working group, at a final meeting of all persons involved in the process.

3. Results

In the two communities studied there was a total of 140 residents, 22 permanent fishermen, 230 fishing licenses and 24 boats, 14 of which were motorized. The fishing effort ranges between 100 and 150 fishing days per year, and the estimated total fish catches was about 370 t per year (Table 2).

3.1. Fishing gear

Using the workshops' results, the fishing methods used in both communities were defined (Table 4). Two main types of fishing were identified: (1) encircling gillnets (called *remolino*); and (2) set gillnets (called *calada*). The beach net or drag net is also used, although to a lesser extent.

Fishing techniques vary throughout the year according to water level in the lagoon and target species' shape, mobility and habitat. For instance, during winter, the silverside has reduced power because of the development of its gonads, so it can be retained in the *calada*. Outside the reproduction period, on the contrary, it cannot be retained by the *calada* so fishermen use *remolino* or *arrastre*.

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