Ocean and Coastal Management 152 (2018) 37–47

Contents lists available at ScienceDirect

Ocean and Coastal Management

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

A co-designed, transdisciplinary adaptive management framework for artisanal fisheries of Pehuen Co and Monte Hermoso (Argentina)

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ARTICLE INFO

Keywords:
Artisanal fishing
SAF framework
DPSIR framework
Fishery management
Community based natural resource management

ABSTRACT

The artisanal fishers from the Pehuen Co and Monte Hermoso (Argentina) are aiming for sustainable use of the common pool resource of their socio-ecological system (SES). However, complex interactions between the artisanal fishers and other actors (the industrial fisheries, natural reserve managers, fish traders, conservationists and governance authorities) are putting the fishing activity at risk. An adaptive management plan has been developed to analyse this SES based on the results of combining the analysis-orientated Systems Approach Framework with the action- oriented multi-Driver-Pressure-System-Impact-Response framework. The overarching issue is the sustainability of the fishery, although there are a number of sub-issues affecting the fishing activities including: restricted access to the sea, damage to the seabed integrity, fishing legislation, distribution of the product, and conflict of conservation with fishing. The most important pressures are overfishing and bottom damage, resulting in habitat deterioration and depletion of the stock. The main impacts on human welfare are the loss of income, the loss of jobs and the loss of biodiversity. A transdisciplinary management plan has been formulated based on common responses to these impacts, such as the organisation of the fishers into local associations, and the creation of a fishing terminal through the synergy of the community with researchers and the governance authorities. The long-term objective is to promote community based management of the natural resources of Pehuen Co and Monte Hermoso.

1. Introduction

Socio-ecological systems (SES) are not isolated and there is a complex interdependence with economic and political systems (Redman et al., 2004). Ostrom (1990) provided several examples of Common Pool Resources (CPR) where the natural resource is the basis of the economy for the SES. The ecological aspects of the SES are often only considered once there is a decline in the abundance of the resource and hence, when the economy of the society is threatened (Newcome et al., 2005). Achieving a sustainable development of natural resources is not only protecting the environment but also ensuring livelihoods and a source of income in the short term as well as for future generations (James et al., 2015).

Artisanal fishing is a good example of a CPR where the SES has both a cultural and a professional activity that is inherited through generations with strong community roots. Fishing has always been the main activity of fishers, requiring a large effort and a strong bond with the sea. It is a dangerous, unstable job that is not always well paid, but as there are limited alternative activities, it is difficult for them to convert to other occupations (Daw et al., 2012). This situation is worse when the fishers are the senior members of the community, as is often the case in fishing villages. Therefore, the loss of artisanal fishers represents a major problem for the community (Zilio et al., 2013). Supporting artisanal fisheries is a way of reducing poverty by providing a source of protein and jobs, as well as of preserving cultural traditions (FAO, 2005). Increasingly, artisanal fishers are replaced by industrial fishers, who have access to larger areas and highly mechanized techniques, for extracting large catches in the short term with limited regard to local sustainability (Pauly, 2006; James et al., 2015). Indeed, the stronger lobbies and economic interests of industrial fishers, generally ensure that governments support industrial fisheries (Ponte et al., 2007).

The long-term protection of the local resource is fundamental for allowing the responsible and sustainable exploitation by artisanal fishers. This requires a relationship between representatives of the

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https://doi.org/10.1016/j.ocecoaman.2017.11.002
Received 1 November 2016; Received in revised form 6 November 2017; Accepted 7 November 2017
Available online 22 November 2017
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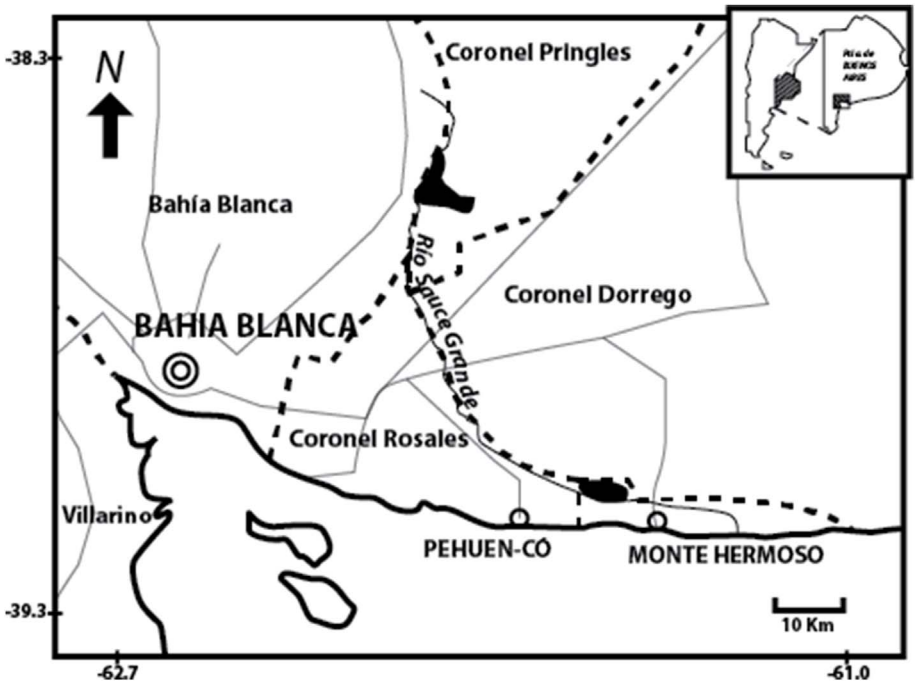

Fig. 1. Map showing the study site: Bahía Blanca to Monte Hermoso region. Municipal boundaries are represented by dashed black lines and main roads are shown with continuous grey lines (Adapted from Semeoshenkova et al., 2016).

community, researchers and government to develop appropriate management plans. An Adaptive Management Framework is a way of linking these three types of actors so that short and long-term management decisions may be based on scientific knowledge. There are many frameworks that have been used for analysing SESs. Binder et al. (2013) have compared 10 established frameworks and have suggested that some frameworks might be better for dealing with some issues rather than others. Analysis-orientated frameworks, such as System Approach Framework (SAF; Hopkins et al., 2011), are better for conceptualizing the SES for formulating and approaching different research questions, whereas action-orientated frameworks, such as Driver-Pressure-State-Impact-Response (DPSIR; OECD, 1993) have a more anthropocentric view of the SES which makes them better for addressing management issues. In this sense, both types of frameworks complement each other and used together provide a better understanding of the SES.

The SAF developed by the Science Policy Interaction in the Coastal System project (SPICOSA: Hopkins et al., 2011) is a methodology for providing multidisciplinary and transdisciplinary advice to decision makers by following systematic steps. The SAF has been used to achieve sustainable development while implementing European environmental policies (Newton, 2012). There are five basic steps that are needed for performing a SAF: Issue identification, System design, System formulation, System appraisal and System output (http://www.coastal-saf.eu/).

The Organisation of Economic Cooperation and Development (OECD) along with the European Environment Agency (EEA) have developed the DPSIR framework as a tool for the analysis of SESs (OECD, 1993; EEA, 1995; Gari et al., 2015; Lewison et al., 2016; Patrício et al., 2016; Elliott et al., 2017). DPSIR considers the links between *driving* forces that impose *pressures* on a SES leading to a *state* change in the ecosystem that then *impacts* on human welfare. Thus, human activities linked to economic drivers lead to *pressures* on the environment and the ecosystem (Gray and Elliott, 2009; Atkins et al., 2011). Physical and chemical variables, biodiversity, biological features and environmental functions are *state* changes that can be observed and measured. The ecosystem integrity is reflected by these changes that are indicators of the quality of the ecosystem. A change in the *state* of the ecosystem may compromise the flow of ecosystem services (ES); these are the benefits people obtain from ecosystems (Millennium Ecosystem Assessment, 2005). ES include provisioning services (food, water, timber, and fuel), regulating services (climate, floods, disease, wastes, water quality) that affect cultural services (recreational, aesthetic, spiritual), and supporting services (soil formation, photosynthesis, nutrient cycling). Impacts are mainly related to ES (Atkins et al., 2011) and can result in loss of life, jobs, infrastructure, income, property, as well as affecting socially important activities and public health (Elliott, 2014). *Responses* are policy actions and management actions including education and awareness raising, public information, governance, technology, infrastructure, social constructs and conflict management. In summary, this analysis provides a snapshot of a specific issue affecting an SES, thereby allowing for *Responses* to address the *Drivers, Pressures, States* and *Impacts* affecting the issue.

This combined SAF and DPSIR study is focused on the artisanal fishing activity in Pehuen Co and Monte Hermoso, Argentina. The DPSIR approach is not only a problem structuring method, but can provide possible solutions for local stakeholders and issues identified with the SAF (Bell, 2012; Patrício et al., 2016). As this artisanal fishery is affected by multiple issues (and sub-issues), a multi-DPSIR has been used through a transdisciplinary participatory process with the stakeholders to co-design and develop a management plan for the sustainability of the artisanal fishery at Pehuen Co and Monte Hermoso, with the long-term prospect for community based management of the natural resources (CBMNR) for this region of Argentina.

2. Methodology

2.1. Study site: Bahía Blanca estuary – Monte Hermoso

The geographical scope of this work includes the northern part of the Bahía Blanca Estuary, Pehuen Co and Monte Hermoso. This estuary (Fig. 1) is situated on the southwestern coast of the province of Buenos Aires and is one of the largest coastal wetlands in Argentina (2300 km^2) (Perillo and Piccolo, 1999; Perillo et al., 2004).

Within the estuary, a large channel (Canal Principal) links to the largest, deep water harbour system in Argentina (Piccolo and Perillo, 1990). This channel has been recently dredged down to 15 m to improve the accessibility of shipping to the port, as Bahía Blanca is an

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