Using stakeholders' perspective of ecosystem services and biodiversity features to plan a marine protected area

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A R T I C L E   I N F O

A B S T R A C T

The definition of a common vision that includes social and environmental goals, ecosystem services and/or biodiversity features that people are interested in maintaining or restoring is a great challenge for marine protected areas (MPAs). Recent initiatives have promoted broadening the focus from biodiversity conservation alone to the conservation of both ecosystem services and biodiversity, indicating that this integration should improve support and compliance from stakeholders. Using a Multiple-Use Coastal Marine Protected Area recently proposed in northern Chile, we investigated (i) stakeholders' perceptions of the valuation of ecosystem services, threats to their provision, and the prioritization of ecosystem services, biodiversity features, and uses in a planning scenario, and (ii) stakeholders' expectations for the establishment of a new MPA. The perceptions of different groups of stakeholders were compared and statistically analyzed, and the relationships among prioritizations were studied using a network approach. Stakeholders identified and valued 13 ecosystem services, 28 biodiversity features, 20 uses and activities, and 22 threats. Significant differences among the valuations and prioritizations of different stakeholder groups were attributable principally to artisanal fishermen's perceptions of some components that are directly related to their activities and livelihoods. High expectations of benefits from a new MPA implementation were observed for all categories of stakeholders. To relate the different valuated components, we proposed a network-based conceptual model that reduces complexity, and also as a strategy to communicate relationships and

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trade-offs occurring in this particular social–ecological system to the several stakeholders. We strongly recommend early stakeholder engagement so as to understand the variability in environmental perceptions and then reflect that variation in the planning and management actions of MPAs, thus improving support for their implementation and achieving conservation and societal goals. Our findings indicate that stakeholders' perceptions and prioritizations of ecosystem services, biodiversity features and uses should be used as the basis for starting the MPA implementation and planning process.

1. Introduction

Marine Protected Areas (MPAs) are a widely used strategy with the principal aims of promoting fisheries management and biodiversity conservation (Roberts et al., 2005; Gaines et al., 2010). MPAs can also promote productive non-extractive activities such as ecotourism, thus playing an important role in diversifying local economies (Oracion et al., 2005; Charles and Wilson, 2009). In recent years, MPAs have been considered an essential tool for implementing ecosystem-based management (EBM) of the oceans and coasts (Hoelting et al., 2013; Halpern et al., 2010). MPAs are implemented in different forms depending, for example, on their size and shape, the desired levels of restriction and regulation of their uses, the legal and institutional framework in the region or country, and the conservation goals (Hind et al., 2010; Agardy et al., 2011). MPA design can vary widely from full no-take marine reserves to multiple-use MPAs (Mangi and Austen, 2008; Lester et al., 2009), but sometimes this variety of designs and nomenclatures can create unrealistic expectations regarding the level of and reasons for protection (Al-Abdulrazzak and Trombulak, 2012).

The design of a new MPA should be based not only on knowledge of the physical and ecological systems that affect it but also on the human dimensions, including governance, socio-economic, and cultural aspects (Charles and Wilson, 2009; McLeod and Leslie, 2009). The inclusion of the latter aspects can facilitate or hinder the implementation and success of a MPA (Rodríguez-Martínez, 2008; Pollnac et al., 2010; Lopes et al., 2013). Within the human dimensions of MPA design, the identification and understanding of stakeholders, including their perceptions, attitudes, interests and expectations, are essential under ecosystem- or place-based approaches to management (Gelcich et al., 2005; Mangi and Austen, 2008; Heck and Dearden, 2012). The involvement and early participation of stakeholders in MPA planning processes, including the expectations and perceptions of the performance of a new MPA and the definitions of goals and targets, are key for an effective implementation and can also reduce conflicts, improve the MPA's effectiveness, provide a measure of the success of management, and gain support and acceptance from stakeholders (Pomeroy and Douvere, 2008; Charles and Wilson, 2009; Heck and Dearden, 2012; Hoelting et al., 2013; Lopes et al., 2013; Pita et al., 2013). The definition of a common vision that includes social and environmental goals and ecosystem services or biodiversity features that people are interested in maintaining or restoring is a great challenge of

MPA and EBM implementation (Leslie and McLeod, 2007; Mangi and Austen, 2008).

Ecosystem goods and services (i.e., the benefits human populations obtain directly or indirectly from ecosystem functions (Costanza et al., 1997)) that are essential for our well-being are provided by coastal and marine ecosystems (Beaumont et al., 2007). However, various anthropogenic pressures directly or indirectly impact ecosystem functioning and its capacity to provide these services (Worm et al., 2006). Use of the ecosystem goods and services (hereafter ES) concept is promoted as an approach to integrate the ecological and socio-economic dimensions in a way that is useful for decision-making (Farber et al., 2006; Tallis et al., 2009). ES provides a common language to different stakeholders and can facilitate comparisons between management alternatives (Granek et al., 2010). Focusing management on ES rather than ecosystem functioning per se permits recognition and accounting for the physical, ecological, and social factors affecting the production and provision of these services (McLeod and Leslie, 2009). ES valuation may involve both qualitative and quantitative analysis, from a conceptual representation of how human activities affect and depend on ecosystems to quantification of the monetary value of particular services (Granek et al., 2010; Nahlik et al., 2012).

Qualitative assessments can be valuable for strategic decision-making processes, providing an overview and trends and identifying trade-offs between services, which subsequently requires an in-depth analysis (Busch et al., 2012). Ultimately, to achieve sustainable solutions and assist decision-makers in conservation planning and natural resource management, it is strongly recommended that a wide range of stakeholders and technical experts (e.g., in natural and social sciences) participate in the early stages of the assessment of the full range of benefits derived from an ecosystem, explicitly incorporating local human values and needs (Menzel and Teng, 2010; Maynard et al., 2011; Nahlik et al., 2012).

Recent initiatives have promoted broadening the focus from the conservation of biodiversity features alone to the conservation of ES as well as biodiversity, indicating that this integration should increase support and resources for the implementation of conservation programs (Egoh et al., 2010; Reyers et al., 2012). The results obtained by Egoh et al. (2010) show that by including data on the ES provided by a terrestrial system, conservation plans can be far more efficient in selecting areas for both biodiversity and ES without additional costs. For setting conservation priorities based on ES or biodiversity or both, first, we need to identify biodiversity features (or ecosystem features that supply ES) that need