Marine Policy 52 (2015) 11–18

Contents lists available at ScienceDirect

Marine Policy

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

Balancing extractive and non-extractive uses in marine conservation plans

Ana Ruiz-Frau [a,*], Michel J. Kaiser [a], Gareth Edwards-Jones [b,1], Carissa J. Klein [c], Daniel Segan [c], Hugh P. Possingham [c]

[a] School of Ocean Sciences, College of Natural Sciences, Bangor University, Bangor, United Kingdom
[b] School of the Environment, Natural Resources and Geography, College of Natural Sciences, Bangor University, Bangor, United Kingdom
[c] School of Biological Sciences, The University of Queensland, Brisbane, QLD, Australia

ARTICLE INFO

Article history:
Received 20 June 2014
Received in revised form
21 October 2014
Accepted 21 October 2014

Keywords:
Fisheries
Recreation
Marine zoning
Stakeholders
Marxan
Socioeconomic data

ABSTRACT

Socioeconomic considerations are crucial in the design process of marine protected areas (MPAs). Most systematic planning processes that incorporate socioeconomic aspects mainly concentrate on extractive user interests by integrating spatial data on fisheries thus overlooking other interests such as non-extractive recreational uses of the marine environment such as wildlife observation, diving or kayaking. Additionally, most theory on systematic spatial conservation planning is focused on the design of single zone reserves. The present study, focused in Wales (UK), uses the systematic conservation software Marxan with Zones to quantify the benefits of integrating extractive and non-extractive interests in the planning process of MPAs and assesses whether the impacts on affected users differs between single vs. multiple zones MPAs. Results indicate that MPAs designed with consideration of non-extractive interests reduced the potential economic impacts on this sector by approximately 50% more than MPAs designed without that consideration, without extra cost to the extractive sector. The design of a multiple-zone MPA outperformed that of a single-zone MPA by reducing and generating more equitable impacts for both extractive and non-extractive interests. This study highlights the importance of including the interests of any groups that might be impacted by the designation of an MPA.

1. Introduction

The positive ecological effects of marine protected areas (MPAs) are well documented [1–3]. However, their designation is often controversial as their implementation usually entails the removal of certain human activities from specific areas, which may have negative socioeconomic impacts for affected user groups [4,5]. The success of MPAs in achieving their conservation goals depends on two main factors; firstly, MPAs need to be designed with biological principles as the primary design criteria to ensure biodiversity conservation [6] and secondly, their success is dependent on user compliance [7,8]. However, stakeholders' needs are not always included in the MPA design process or are sometimes considered *a posteriori* [9], which can lead to unanticipated socioeconomic impacts on certain stakeholder groups.

In order to minimize socioeconomic impacts and to achieve conservation objectives efficiently and equitably, the socioeconomic costs associated with the establishment of protected areas should be integrated at the onset of the planning process [10]. The incorporation of spatially resolved socioeconomic costs into conservation planning can minimize impacts on resource users [11,12], and thereby reduce the potential conflicts between stakeholders and managers [13], resulting in a cost-effective implementation of protected areas through reduced costs to society [14].

A review by Ban and Klein [15] indicated that most published studies (77%) that accounted for socioeconomic costs in MPA systematic design focused on the opportunity costs for fisheries (i.e. the foregone revenues or value to fisheries). In all these studies the integration of fisheries socioeconomic data into the marine reserve design significantly reduced unnecessary socioeconomic impacts for the commercial fishing sectors. For instance, Richardson et al. [12] showed that the incorporation of fine-scale fisheries economic data into the design of protected areas considerably decreased the losses incurred by the fishing industry when compared with reserves designed using coarse-scale resolution data (between 76% and $>300\%$). Although these studies have shown the importance of including socioeconomic data into marine reserve planning they remained limited in scope, as the marine environment is used by a much wider collective of stakeholders with commercial and non-commercial interests that are seldom taken into account in the planning process of protected

* Corresponding author.
E-mail address: aina.ruiz@gmail.com (A. Ruiz-Frau).
[1] Deceased.

http://dx.doi.org/10.1016/j.marpol.2014.10.017
0308-597X/

areas. Attempts have been made to incorporate a wider range of users of the marine environment in systematic MPA planning by using proxies for non-extractive interests [11]; however, the effectiveness of socioeconomic data surrogates remains an issue of debate [16]. Furthermore, most of the studies published on the cost-effective systematic planning of MPAs have focused on the design of protected areas at the two extremes of management options (closed vs. open areas) with no consideration for different use-zones within the planning area. The release of a new multizone optimization tool software, Marxan with Zones [17], enables the definition of areas with a range of different management constraints. Although it has been shown that the establishment of zones with different uses in systems of MPAs can be used to reduce and obtain a more equitable socioeconomic impact on the different fishing sectors operating within an area (e.g. [18,19]), no studies have assessed the potential effects of incorporating fine resolution data on recreational interests in the planning process of a multi-zoned MPA.

The present study assessed the socioeconomic effects of integrating fine scale resolution data of non-extractive recreational uses and extractive uses of the marine environment in the design of an MPA network that balances conservation needs with multiple stakeholder interests. It also considered whether the socioeconomic impacts on extractive and non-extractive uses of an MPA network with zonation are different to those of a MPA network with two zones, a highly protected area where no activities are allowed and an open area with no restrictions. The results of the study provide a quantification of the value of considering non-extractive uses and multi-purpose zones in the design of MPAs and how the incorporation of spatial socioeconomic information for a wider range of stakeholders produces more equitable solutions.

1.1. Policy context and area of study

In Wales, the Marine and Coastal Access Act (MCAA) commits the Welsh Government (UK) to "establishing an ecologically coherent, representative and well-managed network of marine protected areas" taking into account "environmental, social and economic criteria" [20]. The Government will consider social and economic issues to ensure that MPA sites are, as far as possible, chosen to maximize ecological, social and economic benefits while minimizing any unnecessary conflicts with the different uses of the sea. Currently, 36% of Welsh territorial waters are protected under a range of European designations (Marine Nature Reserve, Special Area of Conservation, Special Protection Area and Site of Special Scientific Interest). However, existing designations are limited in terms of the species, habitats or areas that are afforded protection and also the level of protection they offer. The Welsh Government is considering extending the current network of protected sites through the MCAA in order to strengthen and complement the existing European network through the designation of highly protected sites, these are sites that are generally protected from extraction and deposition of living and non-living resources, and all other damaging or disturbing activities.

The coastal area of Wales is a popular domestic tourist destination where commercial and recreational marine activities are widespread. Recreational activities such as diving, kayaking and wildlife watching are popular and represent an important source financial influx into local economies [21].

The planning region of this study was defined by the Territorial Sea around the coastline of Wales. This area extends 12 nautical miles (nm) offshore from the midline of the Dee Estuary in the northeast and the midline of the Severn Estuary in the south. The area lying to the east of Worm's Head was excluded from the planning exercise as not enough biological data were available for the region (Fig. 1). A 5×5 km grid covering the entire planning region was created, this process delineated 779 square cells or

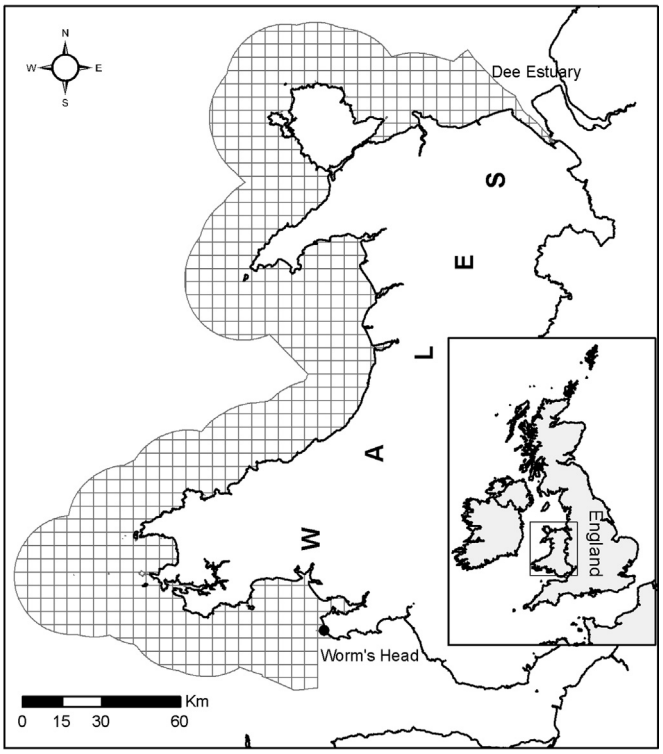

Fig. 1. Overview map of the planning region showing the distribution of the 5×5 km planning units.

"planning units", each which could be selected as part of an MPA. This particular size of planning unit has been suggested to be adequate for coastal management [22] and has been used previously in other planning exercises [23]. Due to the irregular shape of the study area, a number of planning units were truncated at the coastline and near shore islands, creating some size variation across the planning region. Each planning unit contained spatial information on the biological and socioeconomic aspects considered in the design of the MPA network (Sections 2.2 and 2.3). ArcGIS v 9.2 (ESRI, Redlands, California) was used to calculate the amount of each biological and socioeconomic feature contained in each of the planning units.

2. Methods

2.1. Biodiversity considerations

Natural Resources Wales, NRW (formerly Countryside Council for Wales), which is the statutory nature conservation agency that advises the Welsh Government in environmental matters, has recommended the inclusion of both representative habitats and special conservation features within the future network of Welsh MPAs [24].

A network of MPAs that encompasses representative proportions of all ecologically relevant habitats is considered to have the greatest chance of including all species, life stages and ecological linkages that exist in a particular area [6]. International (OSPAR[2]) and national (JNCC[3]) guidance suggests that level 3 of the EUNIS classification (European Nature Information System, a pan-European habitat classification system) is an appropriate level at which to represent

[2] Administrator of the Oslo and Paris Conventions for the protection of the marine environment of the North-East Atlantic.

[3] Joint Nature Conservation Committee, UK's Government wildlife advisor.