



Rapid assessment of protection and ecological effectiveness of the Spanish Fishing Reserve Network

David Rodríguez-Rodríguez^{a,b,*}

^a Institute of Economy, Geography and Demography, Spanish National Research Council (IEGD-CSIC), Associated Unit GEOLAB, C/Albasanz, 26-28, 28037 Madrid, Spain

^b University of Malaga, Andalucía Tech, European Topic Centre-Universidad of Malaga, Campus de Teatinos s/n, 29010 Malaga, Spain



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ABSTRACT

Fishing Reserves (FRs) are primarily designated for the enhancement of local fisheries and, secondarily, for biodiversity conservation. In Spain, FRs are considered marine protected areas (MPAs) and included in the country's MPA network. MPAs' ecological effectiveness is linked to a number of legal, managerial and biophysical factors. With the amount of MPA area rapidly rising and conservation funds largely stagnant or decreasing, rapid, cost-effective MPA assessment techniques are becoming increasingly useful to verify fulfillment of global conservation targets and ascertain potential conservation effectiveness. Here, a rapid MPA protection assessment framework and one MPA ecological effectiveness framework were applied to the Spanish Network of 10 FRs (FRN): the MaPAF and NEOLI frameworks. The FRN was moderately legally protected, with over 50.5% of its area having three or more overlapping legal designations, but only 3.8% of the FRN's area being no-take. All FRs had management plans and active surveillance. According to MaPAF, Columbretes FR was the most highly legally protected whereas Cabo de Palos was the FR with the greatest managerial effort. Both rank highest in protection. In contrast, Masía Blanca FR and Alborán FR were the least legally protected whereas Alborán FR and Graciosa FR were the least managerially protected FRs of the FRN and rank the lowest in protection, respectively. According to the NEOLI framework, Columbretes would also be the most effective FR whereas Masía Blanca FR would be the least ecologically effective. These results can help to spur and better allocate conservation efforts across the fastly growing Spanish MPA network.

1. Introduction

FRs are one type of spatial protection measure of the seas aimed at enhancing fishing resources for sustainable fishing activities. As a result of the legal and managerial protection FRs are afforded, they also act as *de facto* MPAs by helping to conserve valuable biodiversity within their borders. International guidelines recommend not considering FRs as MPAs because their main aim is not biodiversity conservation, but as Other Effective Area-Based Conservation Measures (OEABCMs; [1]). Both MPAs and OEABCMs should contribute to globally accepted targets to conserve at least 10% of coastal and marine areas through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures by 2020 [2]. Meeting that target on time seems challenging despite recent substantial rises in MPA coverage [3], as just three years ahead of the deadline, only 6.4% of the global ocean, including 15.9% of waters under national jurisdiction and 0.25% of

waters in areas beyond national jurisdiction are covered by MPAs [4]. Moreover, last year, the International Union for the Protection of Nature (IUCN) approved to call for '30% of each marine habitat' to be included in 'highly protected MPAs and OEABCMs' by 2030, with the ultimate aim of reaching 'a fully sustainable ocean, at least 30% of which has no extractive activities' [5].

Management is considered an essential factor for the ecological effectiveness of any protected area [3,6], more so in highly connected, heavily pressured and little enforced marine environments [7,8]. Nevertheless, proper assessment of the effects of protection measures on biodiversity is costly, effort-intensive and complex, as it very much depends on adequate semi-experimental designs that must account for natural populations' variability and a high number of confounders [9,10]. Therefore, effectively protecting such huge amount of marine area seems a daunting task given the important costs of MPA designation and essential management activities such as surveillance or monitoring [11,12] and chronic underfunding of marine conservation

* Correspondence address: Institute of Economy, Geography and Demography, Spanish National Research Council (IEGD-CSIC), Associated Unit GEOLAB, C/Albasanz, 26-28, 28037 Madrid, Spain.

E-mail addresses: david.rodriguez@csic.es, davidrr@uma.es, davidrg@yaho.es.

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Table 1
Main characteristics of the Spanish Fishing Reserve Network.

Fishing Reserve	Designation	Area (ha.)	No-take area (ha.)	Management	Marine ecoregion ^a
Tabarca	1986	1754	78	Joint	Western Mediterranean
Columbretes	1990	5493	3112	Spanish Ministry	Western Mediterranean
Graciosa	1995	70,439	1076	Joint	Azores, Canaries and Madeira
Cabo de Palos	1995	1931	267	Joint	Western Mediterranean
Cabo de Gata	1995	12,468	1665	Spanish Ministry	Alboran Sea
La Restinga	1996	1180	237	Joint	Azores, Canaries and Madeira
Alborán	1997	158,594	695	Spanish Ministry	Alboran Sea
Masía Blanca	1999	457	43	Spanish Ministry	Western Mediterranean
La Palma	2001	3455	837	Spanish Ministry	Azores, Canaries and Madeira
Cala Rajada	2007	11,285	2000	Joint	Western Mediterranean

^a Based on the classification by Spalding et al. [29].

activities [13,14] which currently result in most MPA area being insufficiently managed [15]. Moreover, there are little prospects that marine conservation funds are going to increase at all, let alone to keep pace with foreseen rapid MPA coverage growth [14]. Thus, scarce funds will have to render greater efficiency if some management is to be afforded to MPAs. As a result, rapid, cost-effective methods that are able to validly estimate conservation effectiveness are likely to become increasingly useful for the marine conservation community.

(M)PAs effective conservation and management is required by international policy [2] and, though a number of PA assessment techniques and evaluation frameworks have been developed [16], very few have been yet applied to the marine environment, thus remaining a pending research task [3]. The most broadly used systems in terrestrial PAs are opinion-based [17,18] and, although they are of some use to identify major pressures, strengths and weaknesses to PAs, they have not shown accurate or precise enough to assess ecological effects [19,20]. Thus, there is the need for rapid assessment systems based on official statistics rather than (or in addition to) informed opinions, so at least assessment precision can be ensured. Rodríguez-Rodríguez et al. [21] developed a Marine Protected Area Protection Framework (MaPAF) aimed at quickly and objectively assessing protection of (M) PAs based on indicators of legal and managerial protection and applied it to the Mediterranean MPA system. MPA protection was used as a surrogate for ecological effectiveness, although proper validation is needed.

In Spain, FRs were pioneering measures to improve the sustainability of the marine environment, with the first FR being designated in

1986 [22]. Though designated through the fisheries legislation and aimed at the enhancement of fishing resources and artisanal fisheries [23], Spanish FRs have been historically considered the only MPA network in the country and included in national [10,24] and international MPA publications [25]. Since 2010, they were officially included in the Spanish MPA Network [26]. They are generally considered ecologically effective, highly protected and well managed MPAs [27], although specific studies to assess their actual protection are scarce and opinion-based. Studies on FRs' ecological effects are more abundant, but they do not cover all FRs, are often site and feature-specific, and sometimes lack adequate controls [24].

In this study, the MaPAF [21] was applied to assess the protection afforded to the Spanish FRN in order to identify legal and managerial strengths and weaknesses. The results on protection were complemented with a quick assessment of the FRN's ecological effectiveness based on essential factors for the ecological effectiveness of MPAs [28].

2. Methods

2.1. Study area

The FRN includes ten FRs which are managed by the Spanish Ministry of Agriculture, Fisheries, Food and the Environment alone or jointly with regional governments. They cover approximately 266,900 ha of chiefly inshore area, distributed in zones of different legal stringency, and are located in three different marine ecoregions (Table 1).

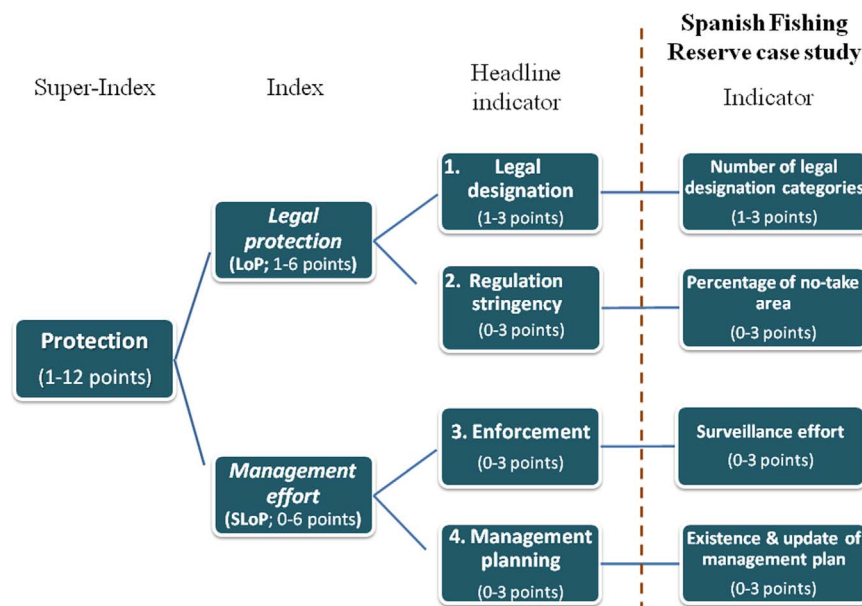


Fig. 1. Outline of the MaPAF and its application to the Spanish Fishing Reserve Network].

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