



The management performance of marine protected areas in the North-east Atlantic Ocean



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ARTICLE INFO

Keywords:

Marine protected areas
Marine reserves
Management
Management plans
North-east Atlantic Ocean

ABSTRACT

In the North-east Atlantic Ocean there are 550 inshore and offshore MPAs established to accomplish a high diversity of objectives, which can be classified into 24 different types of MPA designations. Only 153 of these MPAs have a management plan (MgP) –the basic tool required for an effective management. Amongst these, only 66 are actually managed, i.e. they have the staff and resources required to operate the plan. A common characteristic of these MPAs is the lack of standardized indicators of their performance. In order to address this issue, an alternative approach was developed based on the assessment of management performance using the expert knowledge and perceptions of managers operating MPAs, a universal source of information that could allow overcoming the usual gaps due to the restrictions in coverage of scientific monitoring and assessments. MgPs showed differences among countries but were homogeneous within each country, reflecting the usual top-down approach in the establishment of MPAs. Compliance with the qualitative objectives present in MgPs was higher than compliance with quantitative ones (87% versus 50%), and the MPAs that most successfully achieved their objectives were those with regular monitoring. This analysis also shows that beyond these objectives, the establishment of an MPA and the activities developed as a consequence of its creation have a positive socio-economic impact on the local human community.

1. Introduction

Increasing evidence of the adverse impact of anthropogenic activities over marine systems has been reported in the last decades. Factors associated with this deterioration are overfishing, habitat loss and pollution at scales ranging from local to global [1,2]. Thus, the more natural resources are exploited, the more an ocean conservation strategy is needed. In this sense, the use of Marine Protected Areas (MPAs) has been at the centre of biodiversity conservation strategies and has been gaining leadership as a tool that, effectively implemented, can help to manage fisheries, protect marine ecosystems and reverse the degradation of aquatic habitats [3–6]. In 2015 more than 11,000 MPAs have been listed on the MPAtlas (<http://www.mpatlas.org>) (most of them established during the last 10 years), covering 2.12% of the world's oceans.

However, the concept of MPA currently encompasses several types of designation of marine and coastal protection, as explained below. Since these designations have been established in order to address different demands, with different objectives and in different institu-

tional settings, their implementation processes vary from one situation to another. For example, whereas stakeholders are sometimes involved in promoting the establishment of the MPA, in other cases they are only consulted or simply not involved at all [7]. Regarding their objectives, they could be focused on the conservation of marine biodiversity or on the sustainable exploitation of natural resources (including environmental protection), e.g. fisheries [8].

The 2008 International Union for Conservation of Nature (IUCN) - World Commission on Protected Areas (WCPA) definition of protected areas clearly states that these areas should have a secure conservation status over the long term, and this necessarily implies that they must have an effective management plan in place. This last point is a key aspect, since an MPA that is not effectively implemented and managed can become a useless tool. In this sense, the Convention for the Protection of the Marine Environment of the North-east Atlantic (OSPAR) established the objective of having a well-managed OSPAR MPA network by 2016. All this produced an increasingly large number of publications and reports in the peer-reviewed and grey literature directly related to management of marine protected areas [9 and

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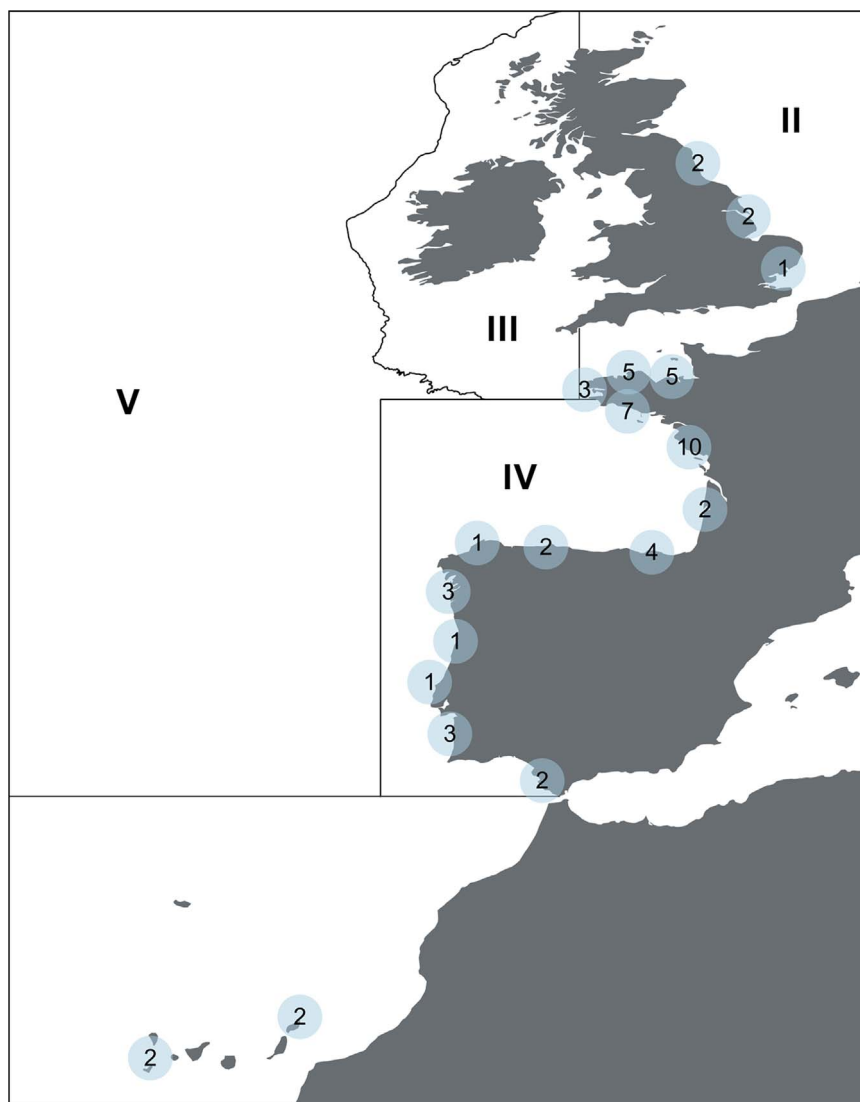


Fig. 1. Distribution of the studied MPAs along the study area, which comprises the Atlantic coast of the Iberian Peninsula, the French Atlantic coast (from the Spanish border to the Belgian border), the England coast of UK and the Canary Islands region (© ProtectedPlanet 2014–2015). Each grey circle represents the number of MPAs that are closer to each location.

references therein].

Management Plans (MgPs) are the required tool for effective protected area management. They should be concise documents that identify the key features of a marine protected area, clearly establish the management objectives to be met and indicate the actions to be implemented. They also need to be politically and economically feasible and flexible enough to provide for unforeseen events that might arise during the period of validity of the plan [10,11]. There is no standard format for an MgP. However, international guidelines identify several key components that have to be included in a ‘good’ MgP [11,12]: (a) a legal description of the area and how it relates to the system plan; (b) the authority in charge of the MPA and other important governance arrangements; (c) a basic description of the resources and conservation values for which the area is being designated and of the related human interactions intended to be permitted in the area; (d) the conservation objectives and management category for the area; (e) the main threats and management approaches for dealing with them; (f) a zoning plan as needed; (g) the types of activities permitted and prohibited in the area; (h) a monitoring plan; (i) performance criteria for assessing progress toward goals and objectives and effectiveness of specific management approaches; (j) the life of the plan and its basic cycle for review, revision and updating.

The process of developing an MgP may be more or less complex depending on the objectives of the MPA, the risks or threats to these objectives, the number of competing interests, the level of stakeholder involvement and issues arising from outside the protected area. Whether the plan is simple or complex, sound planning principles should be applied to guide the planning process and ensure that the completed MgP is a thorough and useful document [10,11]. Two key points for making an MgP successful in the long term are actively involving stakeholders from the development of the MgP to its daily management, and using adaptive management [10,12–14].

Once an MgP is developed, it must be launched and continued to achieve effective management. Management effectiveness is the way to achieve the goals and objectives of a protected area and to show accountability for its management as defined by IUCN [15] and the OSPAR Commission [16,17]. Guidelines to assess management effectiveness have been developed by international organisations such as IUCN [18,19], the World Bank [20] or the OSPAR Commission [16]. However, no standardized set of measures or global coordination mechanism for sharing and analysing comparable data exists [17,21]. Moreover, the assessment of management effectiveness through indicators requires a larger input in terms of time, resources and money [16,17].

Table 1
Number of studied MPA designations by country and type of designation.

| | Designation | FR | SP | PT | EN |
|----------------------|---|----|----|----|----|
| International | Biosphere reserve | | 1 | 1 | |
| | Ramsar site | | 3 | | 5 |
| | Ospar marine protected area | 4 | 1 | | |
| | Site of community importance (SCI)^a | 19 | 5 | 4 | |
| | Special area of conservation (SAC)^a | 2 | | | 4 |
| National | Special protection area (SPA)^a | 12 | 6 | 4 | 7 |
| | National nature reserve | 11 | | | |
| | Marine nature park | 1 | | | |
| | Marine reserve | | 3 | | |
| | National park | | 1 | | |
| | Natural park | | 3 | 3 | |
| | Nature reserve | | | 3 | |
| | Partial nature reserve | | 2 | | |
| | Marine reserve of fishing interest | | 3 | | |
| | Marine state property managed by conservatoire du littoral | 2 | | | |
| | Protected biotope | | 2 | | |
| | Regional nature reserve | 1 | | | |

^a Natura 2000 Network

Only in the North-east Atlantic Ocean there are 550 inshore and offshore MPAs with a high diversity of objectives, resulting in a large diversity of MPA designation types that are highly site- and country-specific. This complicates the adoption of common standards to measure the performance of these MPAs.

The objective of this study is to assess management performance in achieving the goals of MPAs of the North-east Atlantic Ocean, belonging to four countries in NW Europe (England, France, Spain and Portugal). Although the present study cannot claim to be an exhaustive synthesis, it does offer the first quantitative overall estimate of the magnitude of management performance of MPAs in the study area. This approach is based on the assessment of MgP performance using the expert knowledge and perceptions of managers operating MPAs, a universal source of information that could allow overcoming the usual gaps due to restrictions in the coverage of scientific monitoring and assessments.

2. Materials and methods

2.1. Study area, study cases and typology of MPAs

The Atlantic Ocean is dominated by deep ocean basins, with the exception of the Celtic Sea, the shelf along the Bay of Biscay and the Iberian coast. The formation of the North Atlantic Deep Water is one of the driving forces for the thermohaline circulation of the world's oceans [22]. The powerful forces of tides, wind and waves that act on a substrate alternating hard stones with soft sediments are primarily responsible for the North East Atlantic Ocean coast geomorphology and dynamics [23]. The degree of biodiversity is high, with more than 1,100 described species of fish [22]. It is also a highly populated area full of tourist destinations, which produces a high anthropogenic pressure on its environment. In addition, fisheries and maritime shipping are important economic activities in the area [24].

The study area ranges from the Atlantic coast of the Iberian Peninsula through the French Atlantic coast (from the Spanish border to the Belgian border) to the English coast of the UK. The study also includes the region of the Canary Islands. This area is a part of the marine regions of the Oslo Paris Convention (OSPAR): i) the English coast of Region II: Greater North Sea, ii) Region III: Celtic Sea, and iii) Region IV: Bay of Biscay and the Iberian Coast [Fig. 1]. One of the main goals of this Convention is to prevent, and eventually stop, further loss of biodiversity by 2020 in the OSPAR maritime area. The Convention

also focuses its efforts on conservation and protection of ecosystems and aims to restore, where practicable, marine areas that have been adversely affected. One way to reach those goals is to establish a well-managed network of marine protected areas in the OSPAR region by 2016 [25].

In order to conserve all the diversity of the marine protected areas (MPAs) established in the study area, all kinds of protected zones with local, national or international designation were included. In total, 550 inshore and offshore MPAs were identified based on a high diversity of objectives, which yielded 24 different MPA designations. A designation was defined as the legal name under which the different countries designate protected areas, grounded in law, for managing sites according to their objectives. It is important to note that a designation is established in a legal, formal manner and, even when the designation type is defined by international conventions or treaties and concerns more than one country (such as the sites designed under the OSPAR convention), it is transposed into national legislation. Moreover, sometimes several MPAs may overlap in the same area (within the same perimeter), even holding different designations (i.e. within one protected area there could be a sub-area with a more restrictive protection regime).

At an international level, the designations belonging to the Natura 2000 Network, centerpiece of EU's nature and biodiversity policy, were common to all studied countries. These are three designations: Site of Community Importance (SCI) and Special Areas of Conservation (SAC), designated by member states under the Habitats Directive, and Special Protection Areas (SPAs), designated under the 1979 Birds Directive. In the study cases, these international designations encompassed 33 protected areas in France (FR), 11 in Spain (ES), eight in Portugal (PT) and 11 in England (EN). There were also three other international designations: Biosphere Reserves (one in PT, and one in ES), Ramsar sites (three in ES, and five in EN) and OSPAR Marine Protected Areas (four in FR and one in ES) [Table 1].

At the national or local level, each country had its own designations, such as Réserve Naturelle Nationale (France) or Reserva Marina (Spain). In some cases, one designation name was common to two or more countries, but the objectives of the designation were different in each country (e.g. National Park was present in Portugal and Spain). A total of 11 national designations were identified in the study area [Table 1].

In several cases, some of these MPA designations coexist not only geographically but also within a single management unit, meaning that they are involved in the same MgP. For example, in England, Natura 2000 sites are grouped into management units called European Marine Sites (EMS), which include Special Areas of Conservation (SAC) under the EU Habitats Directive (92/43/EEC) and Special Protection Areas (SPA) under the EU Birds Directive (2009/147/EC).

2.2. Data collection

From the total 550 inshore and offshore MPAs identified, only 153 had an MgP and, amongst these, only 66 were actually managed, i.e. they had the staff and resources to operate the plan. Our study was focused on these 66 managed MPAs, corresponding to 87 MPA designations (as stated before, one MPA can include several designations).

Our methodology was based on three sequential structured questionnaires composed mostly of closed-ended questions and with a few open-ended questions (complete questionnaires can be found in Annex A). Precise criteria were provided to fill in the questionnaire in order to minimise biases due to different interpretations.

These questionnaires were sent to the individual MPA manager in charge of each of these 66 MPAs. For Spanish MPAs, these questionnaires were sent directly to be filled out by MPA managers. For the rest of the countries this was done through the main managing organisations for each MPA in the study area: Natural England (EN),

Agence des Aires Marines Protégées (FR) and Instituto da Conservação da Natureza e das Florestas (ICNF, PT). Returned questionnaires were received from 86% of the MPA managers, corresponding to 57 MPAs in the study area (by country, 31 MPAs in FR, 5 in EN, 6 in PT, and 15 in ES).

The first questionnaire (Q1) was aimed at recovering information about the description of the areas and MgP contents. It comprised 98 questions organised in seven groups: Site description, Management, Administration, Governance, Control and enforcement, Monitoring and Specific regulation of the MPA.

The second questionnaire (Q2) was focused on how the existing management plans were being implemented and, specifically, if there were any implemented actions or activities derived from the MgP. It comprised 56 questions organised in five groups: Site description, Management plan implementation assessment, Staff, Control and enforcement, and Monitoring and assessment of activities, habitats and species.

Finally, the third questionnaire (Q3) was aimed at collecting information on the socio-economic impact of the MPA on its stakeholder community. It comprised 34 questions organised in four groups: New income generated by activities developed due to the MPA implementation; Socio-economic impact related to the MPA implementation - Focus on fisheries; and Detailed description of one example of a new income-generating activity implemented in the MPA.

All questionnaires were completed between July 2011 and August 2012. Questionnaires were sent back by email and after revision, whenever a question arose about the answers, MPA managers were directly contacted again. Each dataset was finally sent to its corresponding provider for validation.

2.3. Data analysis

Information from questionnaires 1 and 2 was entered into a database and properly encoded. Boolean questions were coded as 1 (yes) or 0 (no). Some questions had their answers categorized from 0 to 3. The remaining questions, with an open answer, were analysed without encoding. The final database contains 353 encoded variables distributed as follows: 95 variables about Management Plan, 57 variables about Applied Regulations (both from Q1), 88 about Management Performance and 113 about Monitoring of Species, Habitats and Activities (both from Q2). Data from Q3 were not encoded. Data analysis was carried out in three consecutive stages, each one corresponding to data from one of the questionnaires, in order to answer three different sets of questions [Fig. 2]: What is the content of the management plan? , To what extent has the implemented management plan been accomplished? , and How do MPAs affect

the community? A descriptive approach was applied to study the distribution of the answers in the study cases globally and by country. Moreover, multiple correspondence analysis (MCA) [26] was applied for variables from Q1 and Q2. This analysis works like a factorial analysis but with categorical variables, decomposing the data in order to study their "structure" [27]. MCA analyses were carried out using FactoMineR [28,29] and factextra [30] libraries in statistical software R [31]. The last stage, corresponding to the information obtained from Q3, was only analysed descriptively to complement the results obtained in the previous stages. The three stages were as follows: i) Planning and Regulation: using all the study cases, the characteristics of the MgPs were studied, focusing on their objectives and regulations. MCA was performed using the complete database from Q1 (157 variables) in order to analyse systematic patterns in the variability of MgPs and thus look for patterns of association among management plans' features. Relationships among these groups and the different countries were also studied. ii) Management and Monitoring: MPAs where objectives were achieved were identified. MCA was performed using 201 encoded variables with the aim of identifying patterns of association among distinctive characteristics (understood as the analysed variables) and the 57 MPAs. Since two study cases were significantly different from the rest in 43 of the 201 variables (mainly associated with specific monitoring of habitats and species), these two cases were considered outliers and removed in order to improve the interpretation of the graphic results. The interpretation of these two study cases was previously performed independently in order to justify their removal.

iii) Social and economic impact. In this stage, the socio-economic impact on the community or/and stakeholders in 35 MPAs was analysed. The remaining 22 study cases did not provide any information about this subject. The information gathered from Q3 was summarized looking for key points in the data. Finally, by comparing the results obtained in the three stages, it was studied whether the influence of the MPA implementation on the income generated by activities was related to MPA management performance.

3. Results

3.1. Planning and regulation

Among the 57 study cases analysed, there were 16 different designations. In some cases, these designations coexisted in the same geographic area (perimeter) under a single MgP, e.g. Barayo Partial Nature Reserve and Peñaronda-Barayo SCI and SPA share a single MgP. In other cases, a single management plan was shared by a few adjoining MPAs. This was very common in England MPAs, e.g. Berwickshire & North Northumberland coast SAC and other associated designations [Table 1, see Annexe B].

According to the managers' information, only 26% of MPA designations and management plans established quantitative objectives. Meanwhile, 98% of them established qualitative ones. In order to observe the purpose for which MPAs were established, qualitative objectives of the MPAs were grouped in: objectives related to biological and ecological aspects, and objectives related to socio-economic interests. In the first group, objectives of restoration within MPA boundaries were the most common (above improvement), with "to maintain, conserve and restore biodiversity, natural heritage of habitats, species and landscapes under protection status" being present in 90% of all MPAs. It was the main objective in all countries except for Spain, where the main one was "management of exploited natural resources" [Fig. 3A]. Regarding socio-economic interest, the most frequent objectives in MgPs of all countries were: sustainable management and/or development or improvement of environmental education and awareness raising (80%) and scientific research (70%), which usually appeared together. Socio-economic activities (60%) were also common in all the countries [Fig. 3B]. Observing trends by countries, Portugal showed a higher number of objectives in their MPAs, while in

First - Planning and regulation

What is the management plan content?



Second - Management and monitoring

How is the management plan being accomplished?



Third - Social and economic impact

How do MPAs affect the community?

Fig. 2. Diagram of the three stages of data analysis.

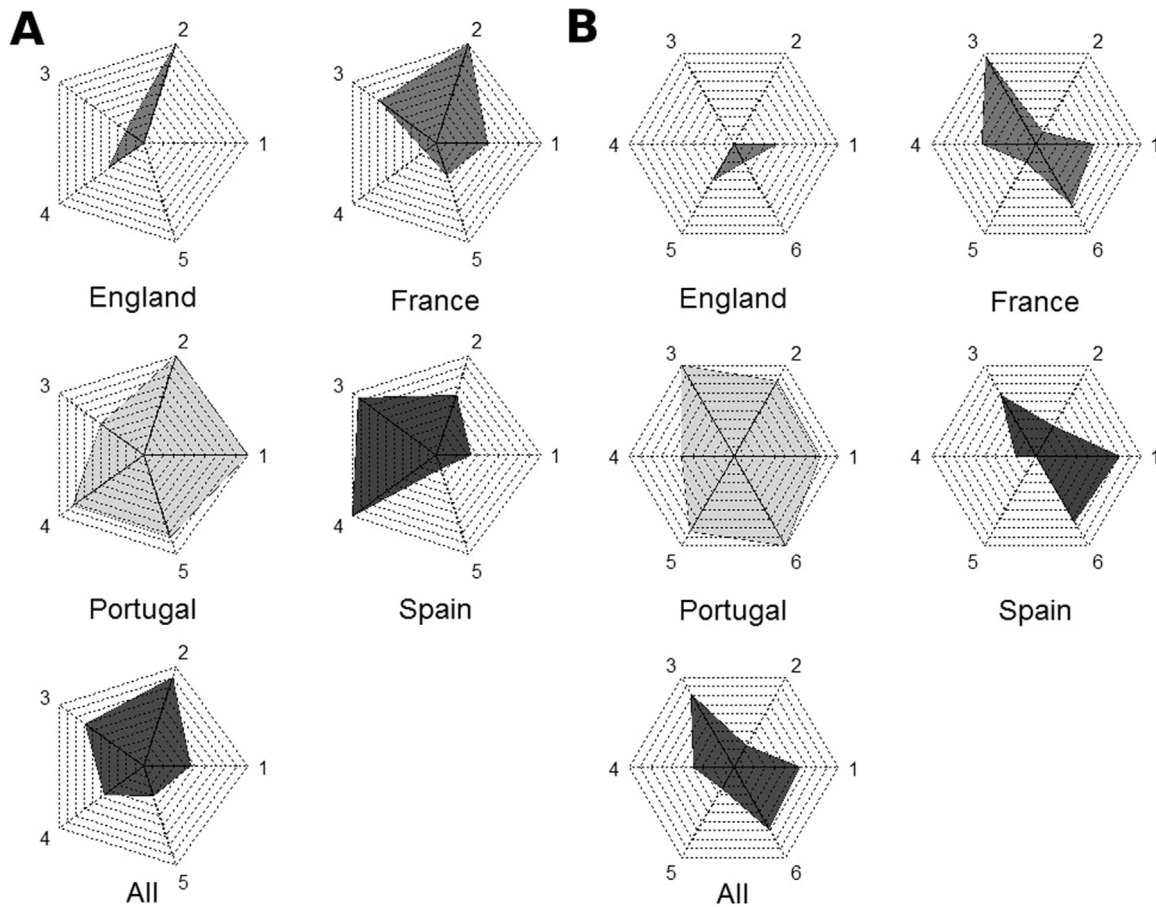


Fig. 3. Each vertex of the star plots represents one particular objective, either related to biological and ecological aspects (A) or to socio-economic aspects (B). The coloured area is the percentage of MgPs that has this particular objective over the total number of MgPs by country, from 0% in the centre of the star to 100% in the vertex; each dashed line corresponds to a 10% difference. Panel A: 1- To maintain/conservate/restore biodiversity, natural heritage of habitats, species or landscapes with no protection status; 2- To maintain/conservate/restore biodiversity, natural heritage of habitats, species or landscapes under protection status; 3- To maintain key ecological functions (spawning areas, nurseries, feeding zones, resting areas, productivity areas, etc.); 4- Management of exploited natural resources; 5- To improve water quality. Panel B: 1- Sustainable management/development of socio-economic activities; 2- To protect/conservate/restore cultural heritage; 3- To improve environmental education and raise public awareness; 4- To create socio-economic added value; 5- To improve governance of the MPA territory; 6- Scientific research.

England most MPAs had only one objective in their MgPs [Fig. 3].

The objectives were detailed in an action plan or operational plan (detailed information on how/when specific management actions are to be carried out) in 86% of MPAs and were linked to an agenda (72%) and bound to a budget for each action (63%) in the majority of MgPs. In contrast, only 35% of MgPs provided a global budget with detailed items for human resources, operational costs and equipment.

The results of the MCA analysis grouped the MPAs by country [Fig. 4]. In two countries, England and France, MPAs appeared very closely grouped, showing a high level of homogeneity among each country's MgPs. This result was expected in England, where all MPAs belong to the Nature 2000 Network, having very similar objectives focused on conservation and biodiversity restoration. In the case of France, although most of its MPAs had international designations (Nature 2000 and OSPAR), this country also had 15 MPAs with national designations that, like international ones, tend to have few objectives focusing on conservation.

Contrarily, Portugal and Spain showed a wider dispersion in their MPAs in the two first MCA dimensions, which means a higher variability in their MgPs. Regarding this variability, two aggregations of MPAs were observed in Spain: one formed by the Marine Reserves of Isla de la Palma (IP), Isla Graciosa e Islotes del Norte de Lanzarote (IG_IN) and Punta de la Restinga-Mar de las Calmas (PRMC), and another one formed by the Marine Reserves of Fishing Interest of Ría de Cedeira (RC) and Os Miñarzos (OM) [Fig. 5A]. MPAs from the first aggregation did not have a specific process for the MgP development

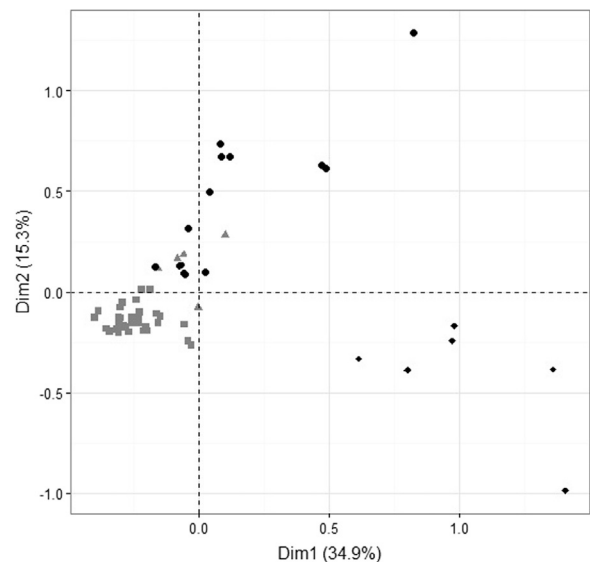


Fig. 4. Biplot of MCA carried out for planning and regulation data. The 57 MPAs, differentiated by country, were shown in the two first dimensions: England (▲), France (■), Portugal (◆) and Spain (●). Percentages for each axis correspond to the proportion of explained variance in each dimension.

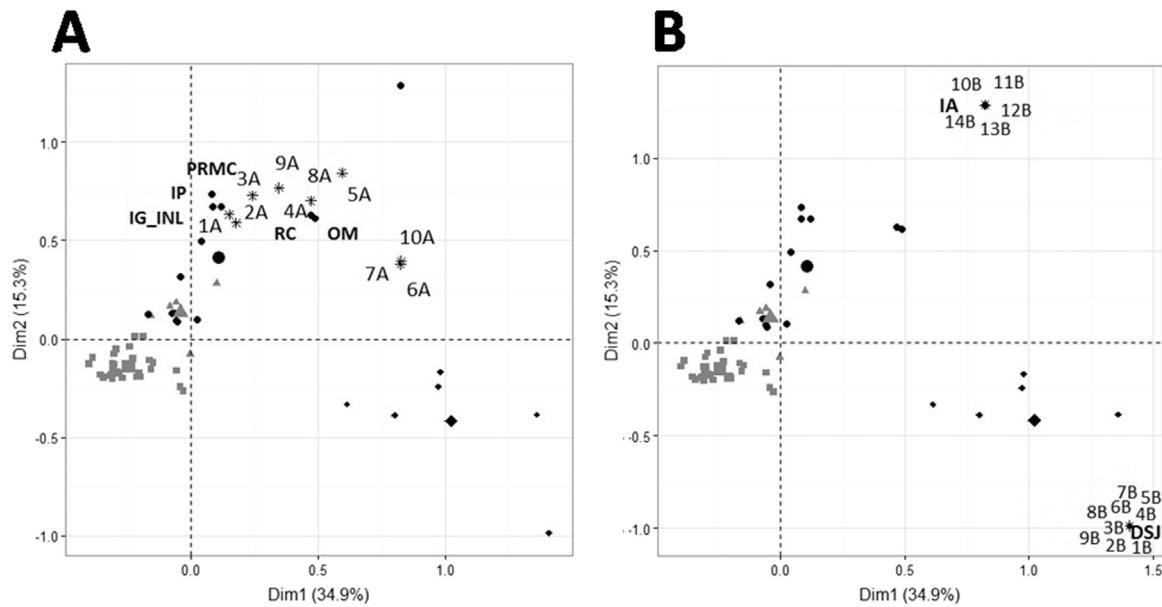


Fig. 5. Factor map of MCA carried out for planning and regulation data. The MPAs studied ($n=57$, England (▲), France (■), Portugal (◆) and Spain (●)) and categories of variables (MgP characteristics) are shown in the two first dimensions. (Fig. 5A) Spanish Marine Reserves group (PRMC, IP and IG_INL) and Marine Reserves of Fishing Interest group (RC and OM) were labelled as their closest categories (asterisk). (Fig. 5B) Dunas S. Jacinto Nature Reserve (DSJ) and Islas Atlánticas de Galicia National Park (IA) were labelled as well as their closest categories (asterisk). See Annex C for numbers of categories. Percentages for each axis correspond to the proportion of explained variance in each dimension, and the large symbol for each country corresponds to the centre.

and validation, and scuba diving activity was regulated in them. Meanwhile, in the MPAs from the second group, professional fishing with nets or hooks was regulated, and gathering activities were forbidden. In addition, in the two Spanish MPAs, professional pole and line fishing was regulated [Fig. 5A]. MPA designations of these two groups are also clearly different from the rest in their objectives, focused on the sustainable management of exploited natural resources, i.e. both were designed to contribute to the sustainable exploitation of fishing resources, establishing specific protection measures in limited areas within traditional fishing grounds. These two designations, Marine Reserves and Marine Reserves of Fishing Interest, are national and regional designations respectively, and both were designed following a bottom-up model. Currently, Marine Reserves are managed by the national government, while Marine Reserves of Fishing Interest are managed by Fishers' Associations and by the regional government. The rest of Spanish MPAs, located close to the axis centre in the MCA plot, were more similar to English MPAs, with a higher number of objectives and a focus on conservation, although those focused on management were still present.

Portugal, on the other hand, did not show any groups among their MPAs, although they showed some dispersion (higher than for English ones). The MgPs of Portuguese MPAs showed a trend towards having more objectives than the remaining countries. Moreover, these objectives were not only about conservation and management of exploited resources, but also about water quality. This last subject was only present in the objectives of some French MPAs.

In addition to the above mentioned, two MPAs were placed in the plot away from the rest, which means that they had unique characteristics that were not present in other MgPs. Thus, the Dunas S. Jacinto Nature Reserve (DSJ) forbade leisure activities outside authorized groups, anchoring or mooring in MPA waters and professional fishing, not only with unselective gears (trawling), as in other MPAs, but also with the majority of selective fishing gears. The Islas Atlánticas de Galicia National Park (IA) was characterised by regulating unselective fishing gears (trawling, bivalve dredging) and banning ship traffic and energy production activities [Fig. 5B].

3.2. Management and monitoring

Most of the studied MPAs (98%) presented qualitative objectives in their MgPs, and in 87% of the cases, these objectives were successfully achieved. Not so good were the results for quantitative objectives, which were present in 15 MPAs (26%) but were only achieved in seven of them. There were five MPAs where both types of objectives were accomplished: all the English FH MPAs, BNNC MPAs and WNNC MPAs (100%) and around half of Spanish E and RC MPAs. These three English MPAs were similar in terms of their designation (SAC) and of their objective "to maintain, conserve and restore biodiversity, natural heritage of habitats, species, and landscapes under protection status". These MPAs and the Spanish E MPA also had in common their regular monitoring of species, habitats and socio-economic activities. The RC MPA had occasional monitoring of socio-economic activities and fishing activities regulated. France only showed fulfilment of qualitative objectives in some MPAs, while Portugal was the country with a lower rate of objective achievement. Generally, Spain and England showed the highest rate of achieved objectives, both qualitative and quantitative.

Regarding the reasons for non-compliance with the objectives, 67% of the managers considered that the budget was insufficient to cover all actions of the MgP, and 65% thought that more staff was needed to pursue these actions. This opinion was common to the four countries. The lack of surveillance observed in 21% of the studied MPAs was also identified as a factor for non-compliance. Concerning monitoring, 63% of MPAs focused on species and 46% on habitats, while only in 21% of MPAs socio-economical activities were monitored. This pattern was similar in all the countries.

Multiple correspondence analysis (MCA) for the Management and Monitoring dataset allowed us to delve deeper into the causes for this patterns. This analysis did not show grouping by countries as observed in the previous stage [Fig. 6]. The clear differences observed respect to the characteristics of the MgPs by country and among some designations were not evident in terms of management and monitoring. In this case, there were general patterns that were common to most cases. Thus, MgPs in general did not provide indicators for the evaluation of actions or activities done in the MPA. Likewise, no specific training for

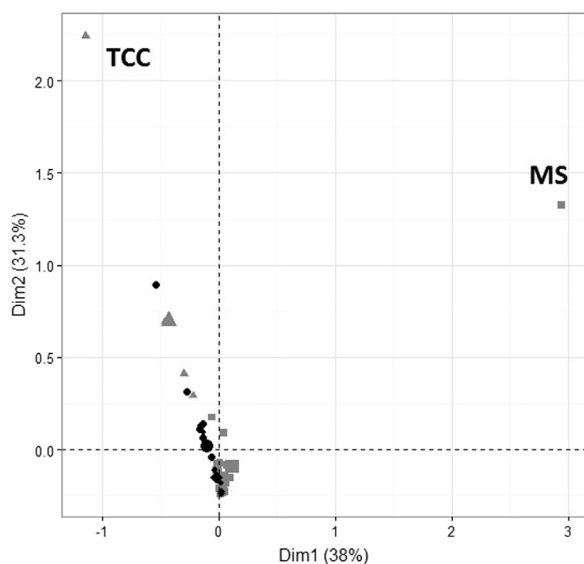


Fig. 6. Biplot of MCA carried out for management and monitoring data. The 57 MPAs, differentiated by country, were shown in the two first dimensions: England (▲), France (■), Portugal (◆) and Spain (●). The two outliers are Marais de Sene National Nature Reserve (MS) and Teasmouth and Cleveland coast SPA (TCC). Percentages on each axis correspond to the proportion of explained variance in each dimension, and the large symbol of or each country corresponds to the centre.

MPA staff was provided.

Regarding the MCA graphic [Fig. 6], two MPAs (located far away from the rest) showed unique characteristics: Marais de Sene National Nature Reserve (MS), in France, and Teasmouth and Cleveland coast SPA (TCC), in England. These two MPAs were unique because both monitored specific species (while monitoring in the rest of MPAs was performed over families) and habitats. In the MS MPA, several species of invertebrates were regularly monitored and, moreover, other species and habitats were occasionally monitored. In the TCC MPA, several habitats were regularly monitored (salt meadows, vegetated cliffs, halophilous, etc.). In these two MPAs with unique characteristics, qualitative objectives were achieved, whereas none of them had quantitative objectives. MCA analysis was repeated without these two outliers in order to visualise the patterns of the rest of MPAs.

While the MCA analysis on MgP characteristics showed a larger dispersion in Spanish and Portuguese MPAs (with the English and French ones being more homogeneous), more heterogeneity is observed in English and Spanish MPA's regarding management and monitoring characteristics, while Portugal and France remain closely together [Fig. 7]. This suggests that Portugal and France had a homogeneous management of their MPAs and therefore had more similarities between their MPAs than with MPAs in other countries. As an example, the budget for each MPA was not being spent according to the action plan in most of the Portuguese MPAs and in several of the French ones, while most of the Spanish and all English MPAs were using the budget as their MgP reflected. Moreover, European or international funds contributed to support the action plans implemented in most French MPAs and in all the Portuguese ones, while this was uncommon in the Spanish and English cases. On the other hand, regular monitoring of species, habitats and socio-economic activities was not common in the management of Portuguese and French MPAs. Only two MPAs from France (Iroise Marine Nature Park (I) and Banc D'Arguin National Nature Reserve (BDA)) and one from Portugal (Arrábida Natural Park (A)) diverged from this pattern, appearing closer to Spanish ones in the graph, probably because they presented regular or occasional monitoring on species, habitats and activities [Fig. 7].

The two Spanish MPA aggregations observed in the Planning and Regulation stage remained after this stage of the analysis [Fig. 7]. The

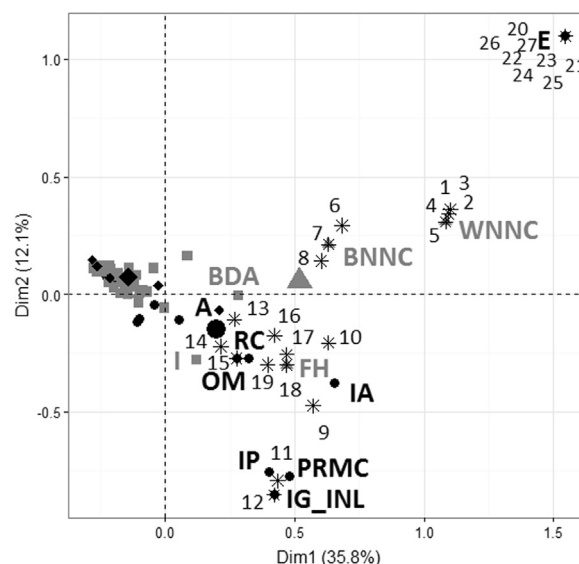


Fig. 7. Factor map of the second MCA carried out for management and monitoring data, without outliers. The MPAs studied (n=55) and variable categories (MgPs characteristics, labelled as numbers) associated to MPAs labelled are shown in the two first dimensions and differentiated by country: England (▲), France (■), Portugal (◆) and Spain (●). See Annex C for numbers and Annex B for abbreviations. Percentages on each axis correspond to the proportion of explained variance in each dimension, and the large symbol of each country corresponds to the centre.

Spanish Marine Reserves group (IP, IG_INL, PRMC) was characterised for having a website for environmental education and awareness raising. In addition, for all sub-perimeters with specific regulations/uses, boundaries were signposted in these reserves. The group formed by Marine Reserves of Fishing Interest (RC and OM) had in common that the MPA's government body was informed by the stakeholder community about the progresses through notifications on the reserve's notice board, while technical reports were used to improve management regulations. Navigation and sailing activities were also regularly monitored, and they had a monitoring program about socio-economic activities that took place occasionally [Fig. 7]. Both groups presented a high fulfilment of their qualitative objectives, being higher in Marine Reserves (which did not have quantitative objectives). The E Natural Park was isolated in the graph because it had the highest number of unique characteristics about regular monitoring of specific habitats classified by IUCN and OSPAR and about harassment and destruction of species with no protection. It was also characterised by achieving 75% of actions not included in its management plan [Fig. 7]. The last Spanish MPA with unique characteristics was the IA National Park. It appeared as having a different status in the previous stage as well. In this case, its government body informed the MPA stakeholder community about the progresses through memos, and scuba diving activities were regularly monitored [Fig. 7].

A similar dispersion to that observed in Spanish MPAs was also observed in English MPAs, although in this case no aggregations were shown. Two of them shared MCA space with most of the French and Portuguese MPAs [Fig. 7] around the axes' origin, showing similarities in their monitoring characteristics. The other three English MPAs (FH, BNNC and WNNC) appeared separated. The English FH MPA was characterised by performing regular monitoring of habitats classified by IUCN (1230: Vegetated sea cliffs of the Atlantic and Baltic Coasts) and OSPAR (Littoral chalk communities) and of seaweeds, algae and maerl. In addition, technical reports were produced by technical and scientific contractors. In the English BNNC MPA, there was regular monitoring of professional bivalve dredging activities and extraction of non-living resources (e.g. aggregates, oil and gas, etc.). 25% of actions not included in the management plan were achieved. The English WNNC MPA also monitored regular shipping traffic, shellfish gathering

and spearfishing activities, and extraction of living resources (other than professional fishing; e.g. algae, maerl). In addition, the staff attended local training [Fig. 7].

3.3. Socio-economic impact

The managers of the 35 MPAs analysed in this stage had a general perception (77%) of socio-economic benefits after the implementation of the MPA. The majority of managers (68%) confirmed eco-tourism as the new activity for generating new income, e.g. birds/nature watching. Other newly implemented income-generating activities (23%) were related to fishing activities, e.g. implementing a brand or quality certification for products linked to the MPA. In general, all these new activities were publicly funded, and the local population was trained for their implementation. Managers considered the newly implemented activities as economically sustainable, operational and long-term.

There was also the perception (31%) of a social impact by empowering fishers or shellfishers after implementation of the MPAs.

4. Discussion

This work assesses management performance in 57 MPAs in the European Atlantic coast. Firstly, the content of MPA management plans was studied, focusing on the similarities and particularities among those in the same or different countries. After that, the performance of MgPs was assessed regarding their management and the fulfilment of their objectives. Finally, both the positive and negative socio-economic effects of MPA implementation were studied.

According to their content, MgPs showed differences by country but were homogeneous within each country, particularly in England and France, and showed a maximum diversity in Spain. The intra-country similarities in MgPs seemed to be related to a top-down approach in the establishment of MPAs in most countries, since both MPA proposals and drafts of MgPs were led by state organisms (Natural England (EN) and Conservatoire du littoral (FR)). In this sense, the heterogeneities observed in Spain could be related to the more widespread promotion of MPAs, carried out by national organisms (Ministerio de Agricultura, Alimentación y Medio Ambiente (ES)) but also by regional ones, local stakeholders or NGOs, resulting in a variety of MgPs that reflects the diverse idiosyncrasies of these collectives.

Despite their heterogeneity, two groups can be identified in Spanish MPAs, corresponding to two different designations: Marine Reserves and Marine Reserves of Fishing Interest, the former being designated by a national organism (Ministerio de Agricultura, Alimentación y Medio Ambiente) and the latter by a regional government (Xunta de Galicia) [32,33].

In the case of Portugal, although the establishment of MPAs is done by a single national organism (Instituto da Conservação da Natureza e das Florestas) as in England and France, a greater heterogeneity was observed, perhaps due to a greater flexibility in MgP proposals by this regulatory organism in terms of MPA objectives and of regulations adapted to the site's characteristics.

Another item in the MgPs that explains the observed differences are their objectives. MPAs have been established with a wide range of goals (including protecting marine biodiversity and habitats from degradation, restoring depleted fish populations, regulating tourism and recreation or accommodating conflicting resource uses) [18,34], and these goals determine the objectives defined in the MgP, which can therefore be diverse as well. In this sense, the most usual objective in all countries, except for Spain, was the maintenance and restoration of biodiversity, habitats, species or landscapes under protection status within the protected area, following Europe's nature conservation policy (Habitats 92/43/EEC and Birds 2009/147/EC Directives) and the OSPAR Convention. It was commonly found in MPAs outside the boundaries of this study as well [10,35]. In Spanish MPAs, the management of exploited natural resources is the most frequent

objective, which is consistent with several of them being directly promoted by stakeholders [3,9,36]. Thus, in two special MPA groups (Marine Reserves and Marine Reserves of Fishing Interest), their creation was driven by stakeholders but with different aims and motivations (e.g. sustaining fishing activity) [3,9,36], which explains differences in their MgPs.

In the second part of this work, the fulfilment of the objectives present in MgPs was assessed to understand whether MPAs were effective at achieving their objectives, as well as the reasons of their failure if applicable [12,15,33]. First of all, differences in success by country were found to be small, success rates being much more homogeneous than their MgPs characteristics. This suggests that performance levels are similar regardless of the original MgP.

Assessing outcomes and achievement of management objectives in detail would require an independent evaluation or analytic assessment tools (such as the WCPA framework [15] or the IUCN 'How is your MPA doing?' guidebook [32]). These tools rely on indicators that measure the efficiency of management actions as the achievement of qualitative and quantitative objectives [18,33,37]. These indicators have been widely used, but that requires having access to a larger time span, resources and money [28]. In this work, an empirical approach was used to assess management performance based on the expert knowledge and perceptions of managers operating MPAs.

Compliance with qualitative objectives was higher than with quantitative ones, according to these results (87% versus 50%). This could be because quantitative objectives were more difficult to fulfil: both because their assessment was not subjective, leaving no room for a "benevolent" interpretation, and because quantitative objectives had been established wherever specific issues must be improved or preserved. In these cases, issues referred to particular risk situations often existed and, therefore, fulfilling the objectives involved a greater degree of difficulty. On the other hand, MPAs with the highest ratios of fulfilment of both types of objectives (all of them from Spain and England) showed stakeholder involvement in their MgP definition, in their management, or in both. MPAs designed following a bottom-up model also showed good levels of accomplishment of objectives.

In order to analyse these results in depth, key management actions aimed at achieving the objectives were studied: planning, design, implementation, monitoring, evaluation, communication and adaptation [18]. In this sense, the MPAs that most successfully fulfilled their objectives were those with regular monitoring, according to this study (FH MPA, BNNC MPA and WNNC MPA in England, and E MPA and RC MPA in Spain). This was in accordance with the importance of integrating monitoring together with the rest of management activities aimed at management effectiveness, as remarked by other authors [17,35]. The MPAs that fulfilled both types of objectives monitored specific species, habitats and/or activities that were characteristic of each MPA site. Therefore, monitoring adapted to the features and uses of the site seemed to help achieving the objectives. On the other hand, the lack of monitoring seemed to be linked to a lack of sufficient staff and budget.

In the third part, the analysis of questionnaires indicated that new socio-economic activities related to the MPAs appeared after their designation, as has been pointed out by other studies [38]. These activities had a positive socio-economic impact on the human community [35]. Among these new activities was, for instance, ecotourism, but MPAs were also considered beneficial for the fishers' communities, as other studies corroborate [38,39]. Some of the benefits were the creation of quality labels for fishery resources obtained in the reserves, reassessing their market prices.

5. Conclusions

In this work, a study of the European Atlantic MPAs was carried out from the point of view of their management plans, their efficiency and performance. This assessment has been addressed from the point of

view of the expert knowledge and perceptions of managers operating the MPAs. This methodology provided highly relevant information, and it constituted a cheap means of assessing management performance of multi-use MPAs in single or in wide areas such as the North-east Atlantic Ocean.

The study revealed that MgPs for MPAs showed differences between countries but were homogeneous within each country, reflecting the usual top-down approach in the establishment of MPAs. However, implementation of MgPs was similar in all the countries regardless of the original MgP, thus reducing the differences among them. This suggests that management worked similarly in all countries.

Compliance with qualitative objectives established in MgPs was higher than with quantitative ones (87% versus 50%). Moreover, the MPAs that successfully fulfilled their objectives were those with regular monitoring. This link between the achievement of objectives and regular monitoring suggests that a regular monitoring process is a key point for good MPA management practices. This study also revealed other key points for management, such as the necessity of sufficient staff and a budget linked to a regular monitoring program for the good management of an MPA.

Finally, the establishment of an MPA and the activities developed around it was found to have a positive socio-economic impact on the local human community.

These results suggest some considerations to be taken into account when developing an MgP, in order to improve the management of an MPA:

- Involving stakeholders contributes to the success of an MPA in the long term.
- Performing regular site-specific monitoring of species, habitats and activities is a key point for good MPA management practices.
- Having sufficient staff and budget to carry out the action plan will help achieve their objectives.

These results contribute to a better understanding of the differences and similarities among MPAs in the study area as part of the OSPAR network, and could improve their management in order to achieve OSPAR Commission's goal of a well-managed OSPAR network.

Acknowledgements

Funding for this study was granted by the European cross-border programme INTERREG IV B (Grant no. 2009-1/143) through the MAIA project and co-funded by the ERDF. The authors would like to extend their profound gratitude to all the MPA managers who answered the questionnaires, as well as to Miguel Henriques from Instituto da Conservação da Natureza e das Florestas, Jan MacLennan from Natural England, Fanny le Fur from Agence des Aires Marines Protégées, and Malú Lledó and Teresa Ortega from KV Consultores for their support. We are also grateful to Daniel Rodríguez-Pérez and Alicia Pallas for the English revision.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.marpol.2016.11.031](https://doi.org/10.1016/j.marpol.2016.11.031).

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