



Research

Assessing the delivery of ecosystem services and benefits to human well-being of three contrasting MPAs in Spain

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ABSTRACT. Marine and coastal ecosystems are indispensable for life on Earth, providing vital functions and serving as a significant source of prosperity for humanity. These ecosystems contribute to the generation of Marine Ecosystem Services (MES), encompassing the benefits derived from marine environments, which are pivotal for economic prosperity and societal well-being. Nonetheless, these valuable ecosystems are facing severe degradation due to various human-induced pressures. In response to this challenge, Marine Protected Areas (MPAs) have emerged as crucial tools advocated by numerous international policies to counteract the adverse impacts of human activities on marine ecosystems. Despite the diverse array of MPAs characterized by varying levels of protection, there remains a dearth of understanding regarding their disparities in providing all forms of MES and their implications for human well-being. Through a comprehensive analysis involving scientific literature, gray literature, and press news, this research scrutinizes the role of MPAs in generating benefits and addressing conflicts arising from MES provision. The main disciplines involved, text orientation, methodologies, and key results of the publications were assessed. Moreover, benefits to people, conflicts between stakeholders, and emotions and sentiments related to MES supply in three selected Spanish MPAs (the Atlantic Islands of Galicia Maritime-Terrestrial National Park, the Os Miñarzos Marine Reserve of Fishing Interest, and the Cabo de Gata-Níjar Natural Park) were identified and analyzed. This allowed for comparisons with their respective levels of protection. The findings reveal that conservation efforts within MPAs contribute significantly to scientific knowledge generation while concurrently supporting human well-being through food security, economic growth, and employment opportunities, particularly in the tourism and fisheries sectors. However, these sectors also engender conflicts concerning conservation policies and resource utilization. The study underscores that the level of protection is a crucial feature, alongside the governance structure and proximity to population centers and tourism hotspots, in determining the delivery of MES by MPAs and their influence on human welfare. The adoption of co-management strategies and the promotion of ecotourism initiatives within MPAs emerge as viable approaches to mitigate conflicts and optimize the provision of high-quality MES, thereby enhancing human well-being. The insights gleaned from this research offer valuable guidance for scientists, managers, and policymakers in fostering the conservation of marine biodiversity through the strategic management and design of MPA networks geared towards maximizing the distribution of benefits for human well-being.

Key Words: *Marine Protected Areas; ecosystem services; well-being; conflicts; benefits; Spain*

INTRODUCTION

Marine biodiversity constitutes a key source of natural capital for the supply of Marine Ecosystem Services (MES), which play a crucial role in the economic development and the health and well-being of human communities worldwide (Deutsch et al. 2003, Guerry et al. 2015). Ensuring the delivery of MES depends directly on the status of marine ecosystems, which in turn are affected by the impacts of different human activities, including the overexploitation of natural resources (Jackson et al. 2001), the destruction of habitats (Duda and Sherman 2002), or marine pollution (Cabral et al. 2019), among others.

Throughout the last decade, different guidelines, agreements, and policies have been defined to establish roadmaps at different scales to improve the conservation of marine biodiversity and the derived supply of MES. For example, two international and European instruments are key in this process: the 2030 Agenda

for sustainable development of the United Nations Organization (UN; United Nations 2015), and the European Union (EU) Marine Strategy Framework Directive (MSFD; European Parliament and Council of the European Union 2008).

In 2015, UN member states endorsed a plan comprising 169 goals to achieve 17 Sustainable Development Goals (SDGs) by 2030, blending social, economic, and environmental dimensions. Rockström and Sukhdev (2016) identified SDGs 6, 13, 14, and 15 as foundational for other SDGs, focusing on clean water, climate action, life below water, and life on land. The 2030 Agenda acknowledges that economic development and societal well-being rely on ecosystem health. SDG 14 prioritizes marine ecosystem management, aiming to minimize negative impacts, enhance resilience, and conserve 10% of marine areas by 2020. The goal is to improve ocean health and align marine biodiversity with human development.

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The MSFD guides EU action on marine conservation, recognizing resource pressures and demand for MES. It advocates for new MPAs and sustainable sea use, aligning with EU maritime policy. Member states were expected to achieve a good environmental status of marine environments by 2020, but ongoing review is needed to address unmet objectives.

The establishment of the MPAs aimed to conserve biodiversity and mitigate human activities' impacts (Agardy 1994). However, effectively managing MPAs requires addressing the complex interactions between social and ecological systems (Berkes et al. 2000). This entails recognizing the interconnectedness of MPAs with their surrounding areas, as social-ecological systems (SES) interact across various spatial and temporal scales (Hilborn 2016). Although empirical evidence highlights the positive effects of MPAs on delivering various MES (Sardá 2013, Leenhardt et al. 2015, Marcos et al. 2021), realizing their full potential faces some challenges. Integrating biophysical and socioeconomic models is crucial for advancing MPA management (Liquete et al. 2016) and ensuring equitable protection by considering socioeconomic values in planning (Portman et al. 2016). Moreover, understanding how MES contribute to human well-being necessitates a comprehensive approach. MPAs vary in their protection levels, encompassing reserves, sanctuaries, parks, and no-take zones (Day et al. 2012). Although identifying MES from MPAs under different regulatory regimes is vital for sustainable ecosystem management (Barbier 2012, Guerry et al. 2012, Lau et al. 2020), the association between protection regimes and their impacts on human well-being remains underexplored (Palomo et al. 2014, Saunders et al. 2015, Driedger et al. 2023).

To investigate the interplay between social benefits to people through MES, conflicts between stakeholders, and regulatory mechanisms, a selection of MPAs was chosen in Spain. The chosen MPAs were deliberately diverse, encompassing variations in regulatory frameworks, creation modalities, and geographic locations within distinct marine basins.

The Atlantic Islands of Galicia Maritime-Terrestrial National Park and the Os Miñarzos Marine Reserve of Fishing Interest are both located in the Atlantic Ocean, whereas the Cabo de Gata-Níjar Natural Park is in the Mediterranean Sea (Fig. 1). The three MPAs include unique habitats and important species for marine biodiversity, and generate opportunities for commercial and recreational fishing, tourism, and cultural heritage.

To assess the contributions of each of the selected MPAs, a systematic review of scientific articles and books and gray literature was conducted, including not only doctoral, master, and bachelor theses but also technical reports and press news. Identification of the MES supplied by different types of MPAs will allow scientists, managers, and policymakers to have key information about the ecological and socioeconomic benefits they provide, to design networks of MPAs that better contribute to the international goals of marine biodiversity conservation (Fenberg et al. 2012), and also to improve marine governance by reconciling the interests of the different users of blue spaces, especially in the case of concurrent (and conflicting) uses (Pomeroy and Douvere 2008, Lester et al. 2013).

Fig. 1. Map of the Os Miñarzos Marine Reserve of Fishing Interest and the Atlantic Islands of Galicia Maritime-Terrestrial National Park in Galicia (upper left and lower left, respectively), and the Cabo de Gata-Níjar Natural Park in Andalucía (lower right).



METHODS

Study areas

Selection of Marine Protected Areas

The inclusion criteria for MPAs selection were based in three main reasons: (1) the marine area within the MPA had to account for over 25% of the total area to ensure a significant representation of marine features, (2) marine area exceeding 2000 ha to target sizable MPAs, and (3) a legal establishment dating back over 15 years to provide enough time for social and ecological influences to be discernible.

Currently in Spain there are 18 national-level designated MPAs that met the inclusion criteria, five in the Atlantic Ocean and 13 in the Mediterranean Sea (European Environment Agency 2023). According to the International Union for Conservation of Nature (IUCN) categorization, these MPAs exhibit varying degrees of protection, ranging from type II (national parks) to type VI (protected area with sustainable use of natural resources) (Day et al. 2012). From the most extreme classifications (types II and VI) that were available, two MPAs were selected so as not to be in the same ocean basin. In addition, a regionally designated MPA with an intermediate protection level (type IV: habitat or species management area) was chosen to improve the selection's representativeness (Table 1).

The selected MPAs cover a wide range of social-ecological characteristics and levels of protection, as recognized by the Spanish law on natural heritage and biodiversity (Gobierno de

Table 1. Marine Protected Areas designated by Spain at the national level that meet the following inclusion criteria: (1) marine area comprises over 25% of the total surface; (2) a minimum surface area of 2000 ha; and (3) established before 2009. The three selected MPAs with the broadest range of protection are highlighted in bold.

Name	Year	IUCN	Size (ha)	MPA (%)	Basin
Aiguamolls de l'Alt Empordà	1992	VI	10,896	54	Mediterranean
Alborán	2003	II	26,375	100	Mediterranean
Albufera des Grau	1995	IV	5114	34	Mediterranean
Atlantic Islands of Galicia Maritime-Terrestrial National Park	2002	II	8543	86	Atlantic
Begur Mountains	1992	V	2185	48	Mediterranean
Cabo de Gata-Níjar Natural Park	1995	VI	12,460	25	Mediterranean
Cabrera Archipelago	1991	II	91,420	100	Mediterranean
Chinijo Archipelago	1987	II	46,005	81	Atlantic
Coastal stretch of Deba-Zumaia	2009	V	4300	87	Atlantic
Coasts of the Garraf	1992	V	26,575	100	Mediterranean
Columbretes Islands Marine Reserve	1990	IV	5499	100	Mediterranean
Ebre Delta	1992	V	48,612	74	Mediterranean
Graciosa Island and the Northern Islets of Lanzarote Marine Reserve	1995	VI	70,769	100	Atlantic
Levante de Mallorca-Cala Ratjada Marine Reserve	2007	VI	11,384	100	Mediterranean
Os Miñarzos Marine Reserve of Fishing Interest	2007	IV	2074	100	Atlantic
Palma Island Marine Reserve	2001	VI	3565	100	Atlantic
Santes Creus Cape-Tarragona's southern coast	1992	V	4701	100	Mediterranean
Serra Gelada	2005	II	5710	87	Mediterranean
Strait of Gibraltar	1992	IV	19,177	49	Mediterranean

España 2007). The Atlantic Islands of Galicia MPA is a National Park with the second most restricted type of protection (type II; Bouzas et al. 2005), the Os Miñarzos MPA is a habitat and species management area with a medium level of protection (type IV; Villasante et al. 2021), whereas the Cabo de Gata-Níjar MPA is a protected area with sustainable, multiple uses of natural resources, with the lightest level of protection (type VI; Pisonero and Han 2017).

Regarding the type of governance, both the Atlantic Islands of Galicia (González-Gómez et al. 2001) and the Cabo de Gata-Níjar (Hogg et al. 2021) are top-down government-ruled MPAs, whereas Os Miñarzos is under a shared governance regimen between regional government and fisheries sector (Pita et al. 2018). The governance of Os Miñarzos MPA supposed the introduction for the first time in Spain of a decentralized and community-managed exploitation space, which included co-legislation and social experimentation within an adaptive management regime (Seijo-Villamizar 2022).

Atlantic Islands of Galicia Maritime-Terrestrial National Park

Located in the Autonomous Community of Galicia (northwest Spain), this national park, established in 2002, includes several islands covering 1195 ha of land and 7285 ha of sea surface (Munoz Sobrino et al. 2016; Fig. 1). This study focuses on the Cíes Islands Archipelago (2658 marine ha and 433 land ha), situated near Vigo, Galicia's largest population center, with a multitude of concurrent uses, configuring an extraordinarily complex SES (Fernández et al. 2022). The Cíes Archipelago is home of the Playa de Rodas, a popular tourist beach destination (Costas et al. 2009), along with eight other beaches (Gómez-Pazo et al. 2019).

In 2007, the islands were integrated into the OSPAR Convention to enhance marine environment protection. By 2014, they were also included in the EU's Natura 2000 Network (Fig. 2). Conservation reserves within the park include marine areas around the Cíes Islands, where all activities except scientific

research are prohibited to protect sensitive habitats and species. Generally, human activities that could harm the ecosystems are banned in the MPA, whereas traditional activities that shape the landscape and align with conservation, such as sustainable artisanal fishing and shellfishing, are encouraged. Recreational fishing, however, is not allowed (Cambìe et al. 2012, Ouréns et al. 2015).

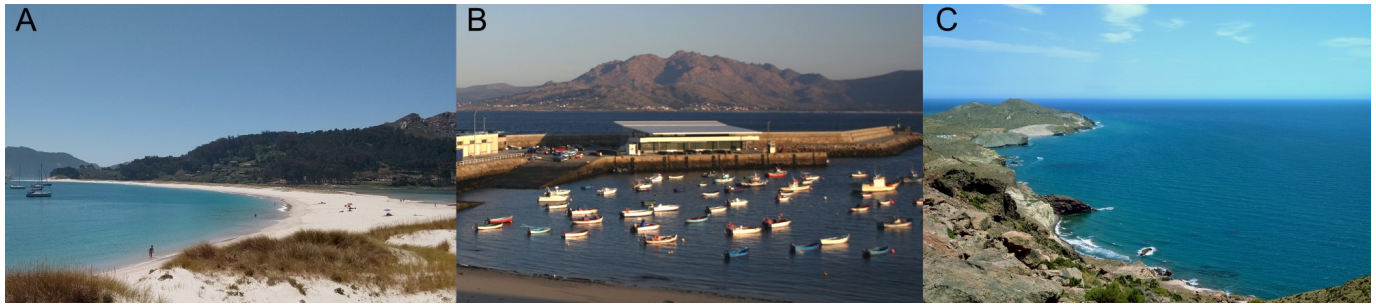
The proximity to the urban area of Vigo (~600,000 people) exerts significant human pressure, leading to controlled visitor numbers in recent years (González-Gómez et al. 2001). The underwater area around the Cíes Islands is rich in biodiversity, supported by seasonal coastal upwelling that enhances nutrient concentration, sustaining a complex food web (Fraga 1981, Bode et al. 2009). This biodiversity, found in various habitats like cliffs, rocky reefs, and beaches, attracts both national and international recreational divers (da Costa et al. 2022).

Cabo de Gata-Níjar Natural Park

The Cabo de Gata-Níjar Natural Park, declared in 1987 by the Autonomous Community of Andalusia in Southern Spain, is the region's first maritime-terrestrial protected area. Because of its unique ecological, geological, historical, and landscape richness (Mooser et al. 2018), it has been recognized as a UNESCO Biosphere Reserve since 1997 and a World Geopark since 2015. Located in Europe's driest region, much of the park's ecological distinctiveness stems from its lack of winter and diverse volcanic geology (Escribano et al. 2015). The MPA spans 63 km of coastline, extending one nautical mile into the Mediterranean Sea, making it the largest MPA on the European continental coast (García-Charton et al. 2004).

The park features 50 km of well-preserved cliff coastlines, natural beaches like Mónsul and Los Genoveses, and urban beaches such as San José and Aguamarga, all of which are significant tourist attractions (Mooser et al. 2018; Fig. 2). The Natural Resources Management Plan divides the park into areas with varying protection levels to manage the use of its spaces and resources.

Fig. 2. Seascapes of the Atlantic Islands of Galicia Maritime-Terrestrial National Park (A), of the Os Miñarzos Marine Reserve of Fishing Interest (B), and of the Cabo de Gata-Níjar Natural Park (C).



Reserve Zones, covering 18% of the park, include well-preserved terrestrial and marine ecosystems with high ecological value (Hogg et al. 2021). These areas have minimal human impact, except for the salt pans, which support bird diversity (Castro-Nogueira et al. 1998). Only activities related to conservation, research, and environmental education are permitted here (Hogg et al. 2021).

Special Regulation Zones make up 74% of the park and allow sustainable human activities, including artisanal fishing, recreational fishing, navigation, diving, and beach tourism, while maintaining biodiversity and preventing erosion. Common Regulation Zones, comprising 7% of the park, aim to ensure sustainable use and restore degraded areas, including agricultural and urban lands (Hogg et al. 2021).

Os Miñarzos Marine Reserve of Fishing Interest

The Os Miñarzos Marine Reserve of Fishing Interest, located in the coastal waters of Galicia in the northwest Iberian Peninsula (Fig. 1), was established in 2007 to recover coastal resources, support sustainable artisanal fishing, and conserve marine ecosystems (Jentoft et al. 2012). It was the eighteenth MPA in Spain but the first initiated by local fishers, who played an active role in its design, creation, and implementation. The reserve's management and monitoring body, jointly overseen by representatives of the Regional Fisheries Administration and the fishing sector (Pita et al. 2018, Villasante et al. 2023), is based in the Port of Lira (Fig. 2).

Covering 2074 ha, the MPA includes two integral reserves and a buffer zone. The two integral reserves (79 and 61 ha) are designated for scientific activities only, chosen for their importance as nursery habitats for commercially valuable species like common octopus (*Octopus vulgaris*) (Sánchez-Carnero et al. 2016). These areas, previously hotspots for fishing (Fernández-Márquez 2015), are located near the Port of Lira to facilitate control and surveillance.

The buffer zone, encompassing 1934 ha, permits traditional artisanal fishing, along with shellfishing, recreational angling, and diving. This zone operates under more restrictive measures than general fisheries regulations, fostering the sustainability of local marine resources (Fernández-Márquez 2015).

Data collection and analysis of the information

We followed the Common International Classification of Ecosystem Services (CICES), in which MES are classified into three categories: (1) provisioning, such as food, biofuels, and

medicines; (2) regulating, such as waste treatment or protection against storms; and (3) cultural, such as the leisure use of beaches and recreational and scientific activities (Haines-Young and Potschin-Young 2018).

Identification of delivered Marine Ecosystem Services

The MES derived from the selected MPAs were identified by searching in Web of Science and Scopus scientific databases for peer-reviewed articles published in English, Galician, or Spanish until the end of 2019. The final search strings used (in the title, abstract, and keywords) were selected to maximize the number of articles published on each of the MPAs:

1. In the case of the Atlantic Islands of Galicia MPA it was: “Parque Nacional Marítimo-Terrestre de las Islas Atlánticas de Galicia” OR “Islas Cíes”;
2. In the case of the Cabo de Gata-Níjar MPA it was: “Cabo de Gata Natural Park” OR “Cabo de Gata”; and
3. In the case of Os Miñarzos MPA it was: “miñarzos” OR (“community” OR “cofradía” OR “reserve” OR “marine area” OR “marine reserve” OR “MPA” OR “fishermen”) AND “lira”.

Moreover, the search included the following string in the three cases: AND (“benefit*” OR “ecosystem service*” OR “environmental service*” OR “good*” OR “contribution*” OR “fish*”).

Expert knowledge of the co-authors involved in this study was used to identify additional sources of information to be included in the analysis. Thus, scientific publications undetected in Web of Science and Scopus, contributions to scientific meetings, master and doctoral academic theses, books and book chapters, and gray literature (e.g., technical reports) were also captured and included in a database. Therefore, the database was integrated with information on a wide range of publications related to MES supplied by the MPAs.

In the subsequent analyses the following was identified: (1) context of the publications, i.e., year of publication and geographical location; (2) academic discipline of the first author; (3) the methods used; (4) orientation, i.e., the key topics covered, grouped in ecological, economic, governance, social, and legal; (5) results, i.e., the main findings reported in the publications, including ecological results, catches and/or fishing effort estimations, socioeconomic and legal aspects, etc.; (6) specific studied MES in each of the three main categories (provisioning, regulating, and cultural); and (7) the main studied species.

Benefits and conflicts

Contributions of MES to human well-being were studied, encompassing various aspects such as employment, income generation, population stabilization, human health promotion, and tourism development, among others. To assess these contributions, the benefits accruing to people from MES within each MPA were systematically evaluated in the review. Ratings were determined according to the observed degree of benefits, ranging from 1 (reflecting modest improvements, such as brief quotation within the publication text) to 2 (indicating significant changes, particularly when the topic was specifically addressed and elaborated upon in the text). To ensure consistency, a single investigator conducted the categorization of these changes across all three MPAs, mitigating potential discrepancies. Additionally, conflicts among different users of the MPAs were identified in the reviewed literature.

Generalized linear models (GLMs) were used to test the relationship between the benefits and conflicts identified within each MPA and the level of protection. This analysis was conducted by using the statistical software R (R Core Team 2023). Poisson distributions, suitable for handling discrete count outcomes such as the level of protection, were utilized to model each benefit as continuous predictors, whereas a binomial distribution was applied to model the presence or absence of conflicts, represented as a categorical factor (yes or no). During the model selection process, we compared the fit of numeric and factor variables as well as different error structures and link functions. The selection of the best models was based on criteria including Akaike's Information Criterion (Akaike 1998), goodness of fit (R^2), and ensuring appropriate residual structure.

Social magnitude

Because press news are widely used by scientists to communicate findings (Woloshin and Schwartz 2002), we assessed the degree of interest for the general population in the benefits of the MPAs by estimating the ratio between the number of press news published until 2019 and the number of publications included in the database. The press news were obtained by using the names of the MPAs and the following search string in Google news: *hábitats OR marinos OR especies OR conservación OR biodiversidad OR pesca OR profesional OR artesanal OR capturas OR amenazas OR conflictos OR pescadores OR turismo OR actividades OR acuáticas OR identidad OR local OR patrimonio OR cultural OR natural OR gobernanza OR gestion*.

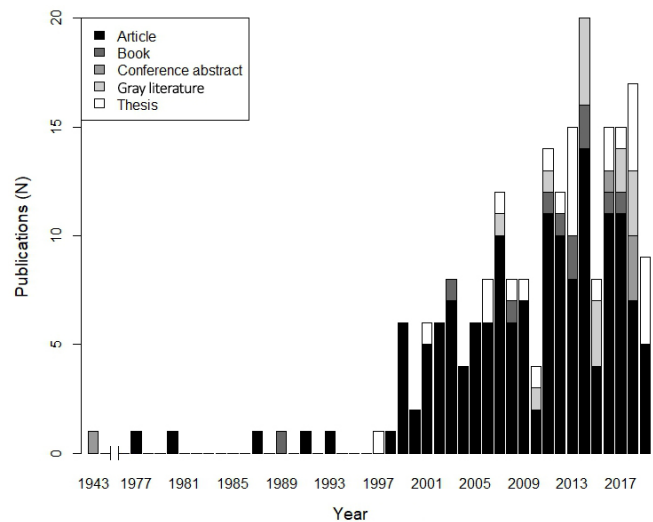
Even though journalists do not always express opinions explicitly, press news are more permeable to them than scientific texts, which systematically exclude emotions. That is why press news have been used as a proxy of social position on various topics (Balahur and Steinberger 2009). Thus, in addition to the orientation (ecological, economic, governance, social, and legal) and the identification of MES covered by the news, headlines were analyzed for their emotional content by using an automated procedure that assigns sentiment scores to individual words implemented in the *syuzhet* package (Jockers 2015) of the statistical program R. Using the Spanish emotion lexicon provided in the package, which contains words annotated with their associated emotion, the headlines pertaining to each MPA were classified into eight emotions (anger, fear, anticipation, trust, surprise, sadness, joy, and disgust).

RESULTS

Scientific publications on the three Marine Protected Areas

Up to 212 scientific publications and gray literature about the three MPAs were published between 1943 and 2019, showing a growing trend over time. Most of the publications were focused on the Atlantic Islands of Galicia MPA (122), followed by the Cabo de Gata-Níjar MPA (77), and the Os Miñarzos MPA (13). The most frequent publications were scientific articles (73% of the total), followed by academic theses (13%), gray literature (7%), books (5%), and communications in conferences (2%) (Fig. 3).

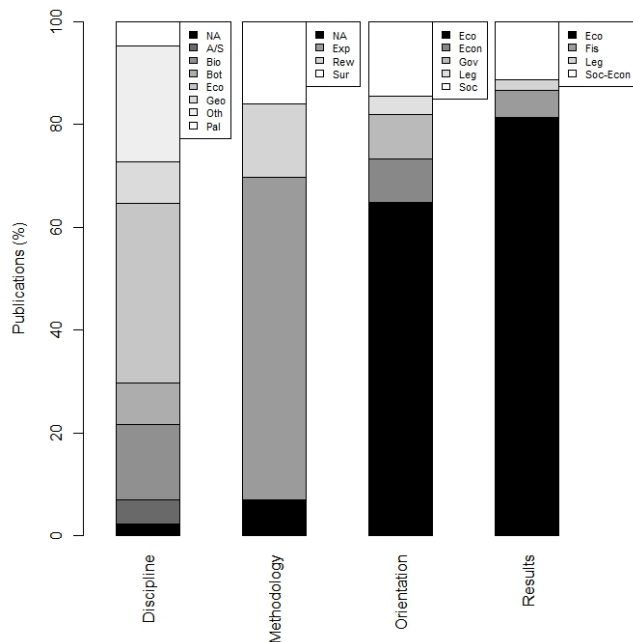
Fig. 3. Number of publications by year up to 2019 ($n = 212$) about Marine Ecosystem Services supplied by the three selected Marine Protected Areas in Spain, grouped by category.



Most first authors of the analyzed publications were ecologists (74 publications) and biologists (31), which accounted for more than half (51%) of the reported academic disciplines. This is why the key topics most covered (i.e., the orientation of the publications) were ecological (65%). Other important disciplines were botany (8%), geology (8%), paleontology (5%), and anthropology and sociology, which together accounted for 5% of the academic disciplines. Economics (2%) and fisheries (1%) were among the least frequent disciplines (Fig. 4).

Ecology and biology were also the main disciplines of the first authors in the publications about each of the studied Spanish MPAs, accounting for 57%, 54%, and 41% of total in the Atlantic Islands of Galicia, Os Miñarzos, and the Cabo de Gata-Níjar, respectively. Accordingly, the most frequent orientation of scientific literature about the Atlantic Islands of Galicia (89%) and the Cabo de Gata-Níjar (87%) was ecological. However, the main orientation in publications about Os Miñarzos was governance (61%), whereas an ecological orientation was included in 46% of the publications on this MPA. Governance-oriented publications were also relatively important in the Cabo de Gata-Níjar (12%), but they were quite unimportant in the Atlantic Islands of Galicia (4%) (Fig. 4).

Fig. 4. Main characteristics of research publications published up to 2019 (n = 212) about Marine Ecosystem Services supplied by the three selected Marine Protected Areas in Spain. It is shown the discipline of the first author (NA= Not available; A/ S= Anthropology or Sociology; Bio= Biology; Bot= Botany; Eco= Ecology; Geo= Geology; Oth= Other; Pal= Paleontology); methodology (NA= Not available; Exp= Experiment; Rew= Review; Sur= Survey), orientation (Eco= Ecological; Econ= Economic; Gov= Governance; Leg= Legal; Soc= Social) and results (Eco= Ecological; Fis= Fisheries; Leg= Legal; Soc-Econ= Socioeconomic).



Although geology and sociology were disciplines absent from the academic background of the first authors in publications about the Atlantic Islands of Galicia, they were important in the other MPAs. Geology was the second discipline in the Cabo de Gata-Níjar (22% of the total), whereas sociology was the second discipline in Os Miñarzos (15%). In fact, social sciences were an important orientation in publications about Os Miñarzos MPA (31%), and on the Cabo de Gata-Níjar (27%), while relatively unimportant in the Atlantic Islands of Galicia (13%) (Fig. 4).

Finally, the discipline of economics had a greater representation in the publications of Os Miñarzos (8%), than in the Cabo de Gata-Níjar (3%) or the Atlantic Islands of Galicia (2%). Thus, the economic-oriented publications were more important in Os Miñarzos (15%) than in the Atlantic Islands of Galicia (13%) and the Cabo de Gata-Níjar (8%) (Fig. 4).

Regarding the methodology used in the publications, most of them were based on either field or laboratory experiments (68% of the total), followed by different surveys (17%) and reviews (15%) (Fig. 4). However, whereas in the Atlantic Islands of Galicia (83%) and the Cabo de Gata-Níjar (52%) experiments were the most frequent methodology, surveys were more used in Os Miñarzos (77%). Publications based on reviews were the second-

most used methodology in the Atlantic Islands of Galicia (13%) and Os Miñarzos (15%), whereas in the Cabo de Gata-Níjar this was the case of the surveys (29%) (Fig. 4).

In relation to the results reported in the publications about the three MPAs, ecological outcomes were the most important (81% of the total), followed by socioeconomic (11%), fisheries (5%), and legal (2%) (Fig. 4). Ecological results were the main outcome included in publications about the Atlantic Islands of Galicia (98%), the Cabo de Gata-Níjar (82%), and Os Miñarzos (54%). Socioeconomic aspects were also relevant in Os Miñarzos and the Cabo de Gata-Níjar, because they were the second-most important reported result included in the publications (46% and 25%, respectively). However, socioeconomic results were of low importance in the Atlantic Islands of Galicia (1%). Fisheries and legal aspects were also important in the publications that studied the MPA of Os Miñarzos (31% and 23%, respectively), but less important in the Cabo de Gata-Níjar (7% and 1%) and the Atlantic Islands of Galicia (3% and 1%) (Fig. 4).

Publications on the Atlantic Islands of Galicia MPA included the largest list of studied taxa (32 species or groups of species), followed by the Cabo de Gata-Níjar (17), and Os Miñarzos (3). Birds were the most frequent taxonomic group in the publications about the Atlantic Islands of Galicia, since different bird species were included in nearly half of the texts (45% of the total), with European shag (*Phalacrocorax aristotelis*) and yellow-legged gull (*Larus michahellis*) being the most studied species (they were included in 22% and 10% of the publications, respectively). Fishes were the next most studied taxa (16%), especially the Syngnathidae family (10%). Plants (11%), especially calcareous algae (Maërl), and cephalopods (8%), especially common octopus, were also relatively well studied in this MPA (Table 2).

In the Cabo de Gata-Níjar MPA plants were the most studied taxa, since different plant species were studied in 41% of the publications, especially macroalgae and eelgrass species, which together were included in 18% of the publications. In the same way as in the Atlantic Islands of Galicia, fishes were the second most studied group (23%), including blennies like black-faced blenny (*Tripterygion delaisi*) and rusty blenny (*Parablennius sanguinolentus*), and commercially relevant species like European hake (*Merluccius merluccius*), European pilchard (*Sardina pilchardus*), and pearly razorfish (*Xyrichtys novacula*) (Table 2).

Finally, in the case of Os Miñarzos MPA, research focused mainly on commercial fish stocks, included in half of the publications (50%). It should be noted that a single species of cephalopod, the common octopus, was very well studied, as was the invasive macroalga Japanese wireweed (*Sargassum muticum*), with each species included in 25% of the publications (Table 2).

Marine Ecosystem Services derived from Marine Protected Areas, benefits, and conflicts

Publications on the Cabo de Gata-Níjar included the longest list of MES identified in the three MPAs (up to 15 MES), whereas 10 were reported in publications on the Atlantic Islands of Galicia and only 5 in Os Miñarzos. Cultural MES were included in more publications than regulating and provisioning. Thus, publications on the Atlantic Islands of Galicia MPA included different cultural MES as the main category (49% of identified MES), especially those related to knowledge systems, which accounted for 43% of

Table 2. Frequency of taxa studied in publications released up to 2019 (n = 212) about Marine Ecosystem Services supplied by the three selected Marine Protected Areas in Spain.

Taxon	Species	Atlantic Islands of Galicia (n = 122)	Cabo de Gata-Níjar (n = 77)	Os Miñarzos (n = 13)
Amphibians	Amphibians	1	0	0
Benthic communities	Benthic communities	0	3	0
Birds	Birds	6	0	0
	Common guillemot	1	0	0
	Eurasian spoonbill	1	0	0
	European shag	18	0	0
	Lesser black-backed gull	1	0	0
	Oceanic puffer	1	0	0
	Scopoli's shearwater	2	0	0
	Seagulls	1	0	0
	Yellow-legged gull	8	0	0
Bivalves	Mussel	2	0	0
Cephalopods	Cephalopods	2	0	0
	Common squid	1	0	0
	Cuttlefish	2	0	0
	Octopus	3	0	1
Fishes	Ballan wrasse	1	0	0
	Black-faced blenny	0	1	0
	Blue shark	1	0	0
	European hake	0	1	0
	European pilchard	0	1	0
	Gilt-head bream	1	0	0
	Pearly razorfish	0	1	0
	Rusty blenny	0	1	0
	Syngnathidae	8	0	0
	Fish stocks	2	0	2
Insects	Insects	1	0	0
Mammals	American mink	1	0	0
Microbes and plankton	<i>Halomonas almeriensis</i>	0	1	0
	<i>Halomonas indalutina</i>	0	1	0
	Microbial populations	0	1	0
	Phytoplankton	0	1	0
Plants	<i>Asteriscus maritimus</i>	0	3	0
	Common water hyacinth	1	0	0
	<i>Cystoseira tamariscifolia</i>	0	1	0
	Eelgrass	1	0	0
	Japanese wireweed	0	0	1
	Lichens	1	0	0
	Little Neptune grass	0	1	0
	Maerl	3	0	0
	Neptune grass	0	2	0
	Plant communities	1	1	0
	Portuguese crowberry	4	0	0
	Red date	0	1	0
Reptiles	Iberian wall lizard	1	0	0
	Loggerhead sea turtle	0	1	0
	Ocellated lizard	2	0	0
	Viperine snake	1	0	0
Ribbon worms	Ribbon worms	2	0	0

identified MES in this MPA. Tourism (3%), landscape (2%), and cultural capital (0.4%) were other reported cultural MES in the publications (Table 3).

Regulating MES was the second category in the Atlantic Islands of Galicia (48% of the total MES), with natural capital as the most important regulating MES (37%), followed by nutrient recycling, protection against erosion, seed dispersion, and coastal protection (all together accounting for 10%). Moreover, food (3%) was the only provisioning MES that was identified in the publications on this MPA (Table 3).

As in the Atlantic Islands of Galicia, the most important MES in the Cabo de Gata-Níjar MPA were cultural services (56%), followed by regulating (33%) and provisioning (10%). Knowledge systems were also the main cultural MES (39%), followed by tourism (9%), whereas cultural capital, landscape, and local identity together summed up to 8% of the total. Natural capital

Table 3. Frequency of Marine Ecosystem Services identified in publications released up to 2019 (n = 212) about the three selected Marine Protected Areas in Spain.

Category	Marine Ecosystem Service	Atlantic Islands of Galicia (n = 122)	Cabo de Gata-Níjar (n = 77)	Os Miñarzos (n = 13)
Provisioning	Food	9	11	5
	Water supply	0	3	0
	Wind energy	0	1	0
Regulating	Biodiversity	0	0	1
	Biological control	0	1	0
	Climate regulation	0	7	0
	Coastal protection	1	2	0
	Genetic diversity	0	1	0
	Natural capital	103	27	0
	Nutrient recycling	13	6	0
Cultural	Protection against erosion	9	5	0
	Seed dispersion	6	0	0
	Cultural capital	1	5	0
	Knowledge systems	120	58	2
	Landscape	6	5	0
	Local identity	0	2	1
	Tourism	9	13	1

was also the main regulating MES (18%) in the Cabo de Gata-Níjar, followed by climate regulation, nutrient recycling, protection against erosion, coastal protection, biological control, and genetic diversity (altogether accounted for 15%). Finally, in addition to food, which was the most important provisioning service (accounting for 7% in the publications on this MPA), water supply and wind energy were also present (aggregated representing up to 3%) (Table 3).

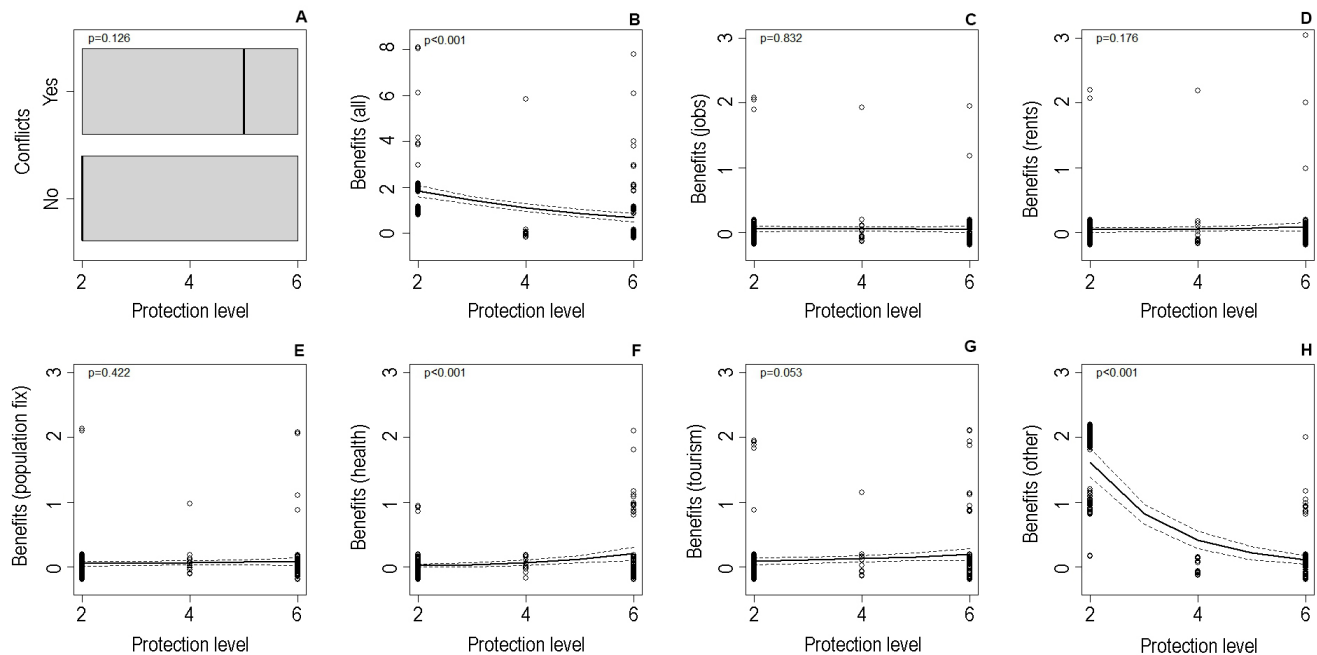
In a different way to the Atlantic Islands of Galicia and the Cabo de Gata-Níjar MPAs, in Os Miñarzos the main MES included in the publications were provisioning MES (50%), followed by cultural (40%), and regulating (10%). Food (50%) and biodiversity (10%) were the only provisioning and regulating services, respectively, whereas cultural services included knowledge systems (20%), local identity (10%), and tourism (10%) (Table 3).

Various benefits to local communities stemming from MES were identified across the studied MPAs, encompassing job opportunities, increased rental income, incentives for local population retention, improved public health, and enhanced tourism development. Generally, a higher level of MPA protection correlated with greater benefits to people ($p < 0.001$; see Fig. 5).

Notably, the Atlantic Islands of Galicia demonstrated significant benefits beyond the aforementioned categories, with an average score of 1.63 ± 0.52 (SD) in the review, compared to MPAs with lower protection levels ($p < 0.001$). Additionally, the Cabo de Gata-Níjar exhibited a considerable positive impact on public health (0.21 ± 0.47) compared to MPAs with higher protection levels ($p < 0.001$). However, other benefits did not exhibit significant differences among the MPAs (see Fig. 5).

In the Atlantic Islands of Galicia, tourism development emerged as an important benefit (0.09 ± 0.41), followed by job opportunities and population stabilization (0.05 ± 0.31 each), and rent increases (0.03 ± 0.26) (Fig. 5).

Fig. 5. Effect of Marine Protected Areas in Spain (IUCN types II to VI) on user and stakeholder conflicts, and on the benefits derived from Marine Ecosystem Services, estimated using Generalized linear models (GLMs). Conflicts and benefits were assessed in research publications up to 2019 ($n = 212$) for the Atlantic Islands of Galicia Maritime-Terrestrial National Park (Atl. Is.), Cabo de Gata-Níjar Natural Park (C. Gat.-Níj.), and Os Miñarzos Marine Reserve of Fishing Interest (Os Miñ.). The median value for conflicts, showing either their presence or absence, is represented by a thick horizontal line (A). Predicted grouped benefits (B) and of each component (C: jobs, D: people's rents, E: population fix, F health, G: tourism, H: other benefits), are shown with lines and dashed lines indicating the 95% confidence intervals. Dots represent individual observations. Benefit scores range from 1 (indicating some benefits with minor improvements) to 2 (indicating high benefits with significant changes). GLM p-values are also displayed.



In Os Miñarzos, both job opportunities and rental income showed notable improvements, with mean scores of 0.15 ± 0.55 each. Additionally, it positively contributed to population stabilization (0.08 ± 0.35) and tourism development (0.08 ± 0.28) (Fig. 5).

Finally, the Cabo de Gata-Níjar MPA also contributed positively to tourism development (0.19 ± 0.51), population stabilization (0.08 ± 0.35), rent increases (0.08 ± 0.42), and job opportunities (0.04 ± 0.25) (Fig. 5).

Although the correlation between conflict and the level of protection did not reach statistical significance ($p = 0.126$; Fig. 5), various conflicts among stakeholder groups concerning access to benefits provided by MES were noted. The MPA exhibiting the highest incidence of conflicts was Cabo de Gata-Níjar, where as many as 13 conflicts between pairs of stakeholders were identified in 13% of the reviewed publications. Following this, the Atlantic Islands of Galicia presented four conflicts in 7% of publications, whereas in Os Miñarzos it was reported one conflict in 15% of publications (Table 4).

In the Cabo de Gata-Níjar MPA commercial fishers, conservationists, and managers were the stakeholders showing more conflicts (5 conflicts each). Thus, commercial fishers operating in this MPA showed conflicts related to conservation policies with conservationists, managers, and scientists. Poaching was a specific source of conflict with managers of this MPA. They

also came into conflict over the use of common resources and/or areas with recreational fishers and tourists (Table 4).

In addition to the commercial fishers, conservationist groups had conflicts related to conservation policies with all stakeholders except scientists, i.e., with local population, managers, recreational fishers, and tourists. In a similar way, MPA managers entered conflict because of conservation policies with all other stakeholders except with scientists, i.e., with commercial fishers, conservationists, local population, recreational fishers, and tourists. Finally, recreational fishers and tourists engaged in conflicts because of the use of common resources and/or areas (Table 4).

In the Atlantic Islands of Galicia MPA, the stakeholder group that showed more conflicts were the conservationist organizations (3), followed by commercial fishers (2), and MPA managers (1). Conservationists evidenced conflicts with commercial fishers because of conservation policies, with managers because of disagreements related to the MPA creation procedure, and with tourists because of the use of resources and/or areas. In addition to the conflicts with conservationists, commercial fishers also conflicted with tourists derived from the use of resources and/or areas. Finally, the only conflict identified in the Os Miñarzos MPA was evidenced between commercial and recreational fishers because of disagreements related to the MPA creation procedure (Table 4).

Table 4. Conflicts between stakeholders identified from information included in publications released up to 2019 (n = 212) about Marine Ecosystem Services supplied by the three selected Marine Protected Areas in Spain (Atl. Is. = Atlantic Islands of Galicia; C. Gat.-Nij. = Cabo de Gata-Níjar; Os Miñ. = Os Miñarzos; X = not found).

	MPA	Conservationists	Local population	Managers	Recreational fishers	Scientists	Tourists
Commercial fishers	Atl. Is.	Uses	X	X	X	X	Uses
	C. Gat.-Nij.	Conservation policies, uses	X	Conservation policies, poaching, uses	Conservation policies, uses	Conservation policies	Conservation policies, uses
Conservationists	Os Miñ.	X	X	X	MPA creation	X	X
	Atl. Is.		X	MPA creation	X	X	Uses
	C. Gat.-Nij.		Conservation policies	Conservation policies, uses	Conservation policies, uses	X	Conservation policies, uses
Local population	Os Miñ.		X	X	X	X	X
	Atl. Is.			X	X	X	X
	C. Gat.-Nij.			Conservation policies	X	X	X
Managers	Os Miñ.			X	X	X	X
	Atl. Is.			X	X	X	X
	C. Gat.-Nij.				Conservation policies, uses	X	Conservation policies, uses
Recreational fishers	Os Miñ.				X	X	X
	Atl. Is.					X	X
	C. Gat.-Nij.					X	Conservation policies, uses
Scientists	Os Miñ.					X	X
	Atl. Is.						X
	C. Gat.-Nij.						X
	Os Miñ.						X

Press news about the three Spanish Marine Protected Areas

Most of the collected press news focused on the Atlantic Islands of Galicia MPA (157 news since 2008), followed by the Cabo de Gata-Níjar MPA (109 news since 2005), and the Os Miñarzos MPA (20 news since 2008). However, the ratio between the number of newspaper articles and the number of academic and technical publications was higher in the case of Os Miñarzos MPA ($1.5 \frac{N_{news}}{N_{academic}}$), followed by the Cabo de Gata-Níjar MPA ($1.4 \frac{N_{news}}{N_{academic}}$), and the Atlantic Islands of Galicia MPA ($1.3 \frac{N_{news}}{N_{academic}}$).

The news about the Atlantic Islands of Galicia and the Cabo de Gata-Níjar MPAs focused mainly on social aspects (78% and 62% of total news, respectively), whereas in Os Miñarzos the main orientations were both governance and ecological (45% in each case). Ecological aspects were also highly covered by press news on the Atlantic Islands of Galicia (49%) and the Cabo de Gata-Níjar (23%), whereas governance was not a relevant topic in these MPAs. The economic (35%), social (25%), and legal aspects (20%) were also relevant in Os Miñarzos, whereas in the Cabo de Gata-Níjar the news that included legal aspects also stood out (22%) (Table 4).

In relation to the MES covered by the news about the different MPAs, in both the Atlantic Islands of Galicia and the Cabo de Gata-Níjar cultural MES were dominant, since different cultural MES, tourism especially, were covered by 89% of the total news and 79%, respectively. However, the main MES in Os Miñarzos were provisioning, especially food provision (75% of total news) (Table 5).

Roughly half (47%) of the words linked to any of the eight emotions examined in the press news regarding the Atlantic Islands of Galicia were associated with negative emotions.

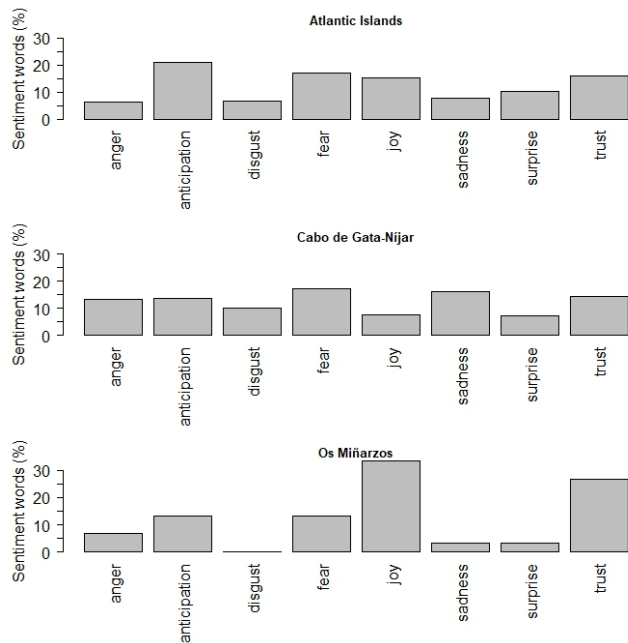
Table 5. Frequency of different Marine Ecosystem Services reported by press news published up to 2019 (n = 286) about the three selected Marine Protected Areas in Spain. It also identifies the orientation of the press article.

Category	Marine Ecosystem Service	Atlantic Islands of Galicia (n = 157)	Cabo de Gata-Níjar (n = 109)	Os Miñarzos (n = 20)
Provisioning	Food	4	32	15
	Water supply	0	0	1
Regulating	Air quality	0	1	0
	Biodiversity	0	0	2
	Climate regulation	0	1	1
	Natural capital	47	38	0
	Nutrient recycling	1	0	0
	Water purification	0	1	0
Cultural	Cultural capital	0	11	0
	Knowledge systems	47	14	2
	Landscape	5	17	0
	Tourism	88	44	3
Orientation	Governance	6	12	9
	Social	123	68	5
	Ecological	77	25	9
	Economic	2	12	7
	Legal	2	24	4

Notably, fear, comprising up to 17% of emotional vocabulary, stood out prominently in the media coverage of this MPA. Conversely, positive emotions like anticipation (21%) and trust (16%) also held significant relevance (Fig. 6).

The press coverage included a higher proportion of words associated with positive emotions in Cabo de Gata-Níjar (60%), with an even greater prevalence in Os Miñarzos, where positive emotional terms reached up to 79%. Although negative emotions like fear and sadness exhibited relatively high frequencies in Cabo de Gata-Níjar (17% each), positive emotions such as anticipation

Fig. 6. Emotional classification of press news published up to 2019 (n = 286) about Marine Ecosystem Services supplied by the three selected Marine Protected Areas in Spain. The percentage of words correlated with any of the eight emotions assessed (anger, fear, anticipation, trust, surprise, sadness, joy, and disgust) is presented relative to the total number of words associated with an emotion.



and trust also held significance (14% each). Trust (27%) and joy (33%) emerged as the predominant emotions identified in Os Miñarzos (Fig. 6).

DISCUSSION

This research explored the benefits and trade-offs of MES in selected Spanish MPAs. We reviewed scientific publications, gray literature, and press news to assess their focus, methods, and key findings. We also analyzed the benefits, conflicts, and emotions related to MES in the three MPAs, comparing them with their protection levels.

Even though the selection of MPAs included in this study covers a wide range of social-ecological features, generalization of the results to other marine spaces should be performed with some care. A theoretical framework has not yet been developed to consistently measure benefits and conflicts in MPAs and how they impact the well-being of the population (Palomo et al. 2014), which limits the comparison of our results with others carried out in the same or other MPAs (Rasheed 2020). Although evaluating the benefits and conflicts related to MES by integrating scientific articles and gray literature, including press news, has proven valuable, it would be advantageous to incorporate uncertainty into future socioeconomic assessments. In addition, it is possible that other factors independent of MPAs could have influenced to some extent the benefits and conflicts related to the supplied MES (García-Charton et al. 2004, Claudet et al. 2011, Liqueste et al.

2016). Even so, our conclusions are relevant to help scientists, managers, and policymakers on how to contribute to the conservation of marine biodiversity by managing and designing better MPA networks that maximize the distribution of benefits to people's well-being.

Marine Ecosystem Services supplied by Marine Protected Areas

Most of the publications reviewed in this study focused on the Atlantic Islands of Galicia MPA, followed by publications on the Cabo de Gata-Níjar MPA and the Os Miñarzos MPA (Fig. 3). However, the degree of coverage of the MPAs in the media was the opposite, showing higher performance relative to the scientific production the news about Os Miñarzos, followed by the Cabo de Gata-Níjar, and the Atlantic Islands of Galicia (Table 5).

Press journalists and editors tend to highlight the positive outcomes of scientific communications (Tichenor et al. 1970). Therefore, positive news about research carried out in MPAs would be more easily published in the press than negative ones. In fact, our results about human emotions associated with press news concluded that news about the Os Miñarzos MPA were especially positive, many associated with the emotion of trust and joy (e.g., Pena 2010, Barral 2013). News about the Cabo de Gata-Níjar MPA were also relatively positive, several of them associated with the emotion of anticipation (e.g., Oubernel 2018, Unknown 2018). Otherwise, news about the Atlantic Islands of Galicia MPA were negative in many cases, including several associated with fear (e.g., Huete 2015, Pérez 2017), so they could have been less likely to be disclosed in the press (Fig. 6).

In the literature review, we found that the MPA with fewest conflicts was Os Miñarzos (Table 4). The only source of conflict we identified in this MPA was related to the exclusion of recreational spear fishers and boat anglers during the creation process, an issue that seems to have been overcome with time, to the point that commercial recreational fishing initiatives have been successfully developed in the area (see, e.g., Pita et al. 2022a). In the other two MPAs, the identified conflicts were greater, especially those related to conservation policies and the use of space and shared resources, issues that involve frequent and sustained interactions over time between different users and stakeholders, which favors their presence in the public narrative about both spaces (Table 4). It is not surprising that social conflicts have been highly covered by the press in the two MPAs, whereas in Os Miñarzos many news focused on the benefits we showed in the results, derived from its co-governance system (Perez de Oliveira 2013), and on the improvement of fishers' revenues, in line with the results of cost-benefit analyses recently developed in this MPA (Chai et al. 2022).

However, not all of the news about the Atlantic Islands of Galicia and Cabo de Gata-Níjar MPAs were negative, since many of them covered important positive aspects related to economic benefits we identified in the results (Fig. 5), including job opportunities to different sectors (e.g., Unknown 2016, Balch 2018). For example, the high diversity of habitats and species of the Atlantic Islands of Galicia MPA (Table 2) offers opportunities to develop environmental education, volunteering, and green tourism business initiatives that include star-gazing and fish-, bird-, and whale-watching (da Costa et al. 2022). Although beach tourism is the most important recreational activity in the Atlantic Islands of Galicia, alternative recreational activities are highly valued by

visitors, such as snorkeling and scuba diving (Piñeiro-Corbeira et al. 2020). Beach tourism is also the most popular activity in the Cabo de Gata-Níjar MPA (Soto et al. 2008), but green geotourism initiatives are relatively important (Lorenc and Janusz 2019), which was reflected in our press review (Fig. 5).

The academic articles, gray literature, and newspaper articles analyzed agreed in identifying that the most important MES supplied by both the Atlantic Islands of Galicia and Cabo de Gata-Níjar MPAs were knowledge systems and tourism opportunities, followed by natural capital (Tables 3 and 5). Therefore, it is not surprising that biologists and ecologists have extensively studied their habitats and communities of organisms (e.g., Peña and Bárbara 2008, Bourillot et al. 2009), to the point that the Atlantic Islands of Galicia are considered a “natural laboratory” (Fernández et al. 2022). Although different fish species were well investigated in the two MPAs (e.g., García-Charton et al. 2004, Villegas-Ríos et al. 2013), seabirds were especially studied in the Atlantic Islands of Galicia (e.g., Velando and Freire 2002, Munilla et al. 2016), whereas marine plants stood out the Cabo de Gata-Níjar (e.g., Figueroa et al. 2002, Celis-Plá et al. 2017) (Table 2). The paucity of investigations concerning marine mammals is notable, potentially attributable to the wide distribution of these species, surpassing the coverage of the studied coastal MPAs. The limited research on these animals exacerbates the challenge of devising effective conservation policies, particularly given the intensive utilization of unprotected crucial hotspots by various human activities (Coll et al. 2012).

On the contrary, food provision was the main MES supplied by the Os Miñarzos MPA (Tables 3 and 5). For this reason, academic publications about the fisheries developed in this MPA were the most frequently published, especially about socioeconomic and governance issues related to the exploitation of different fish stocks (e.g., Jentoft et al. 2012, Fernández-Vidal and Muiño 2014).

Benefits and conflicts in different types of Marine Protected Areas

We found that important benefits in the three MPAs were labor opportunities and economic improvement of the population's income (Fig. 5). These socioeconomic benefits were largely derived from the tourism sector in the Atlantic Islands of Galicia (Piñeiro-Chousa et al. 2021) and in Cabo de Gata-Níjar (Mooser et al. 2018), where the opportunities for tourism development were also considered an important MES with positive outcomes (Tables 3 and 5). The tourism sector has probably contributed to fixing the population in the Atlantic Islands of Galicia and Cabo de Gata-Níjar, another relevant benefit derived from both MPAs (Fig. 5, Tables 3 and 5). The proximity of important urban centers close to the Atlantic Islands of Galicia and the diversity of traditional terrestrial and marine uses developed in the Cabo de Gata-Níjar have probably strengthened their capacity to settle local population (Alló et al. 2010, Palomo et al. 2011). The contribution of the marine area to the establishment of the local population in the Cabo de Gata-Níjar is particularly important, since there is a declining trend of the population in Spanish terrestrial Protected Areas of similar protection category (Rodríguez-Rodríguez et al. 2021).

The remote location of Os Miñarzos, situated distantly from major tourist destinations and communication networks, coupled with its protection strategy primarily focused on sustainable fish

stock exploitation to ensure food security, likely diminishes the significance of tourism in driving local economies. Nonetheless, despite the absence of industrial infrastructure and urban hubs conducive to service sector growth—particularly in the hospitality and catering (HORECA) domains—the enhanced exploitation of marine resources within the Os Miñarzos MPA (Chai et al. 2022) likely plays a role in mitigating depopulation, a prevailing challenge in rural Galician areas (Lois-González 2002).

The fact that MPAs widely located along the spectrum of protection figures of the IUCN classification provided socioeconomic benefits for the population supports the idea that spatial conservation policies can be compatible with economic and social development (Badalamenti et al. 2000, Christie et al. 2003, De Santo 2013). However, as explained above (see Table 4), this success has not been without conflicts between different users and stakeholders, especially in the Cabo de Gata-Níjar, the MPA with the least rigid conservation policies (see Cortes-Vazquez 2014). The formulation, implementation, and oversight of conservation policies emerged as significant sources of conflict in the Cabo de Gata-Níjar, particularly among commercial fishers, conservationists, and managers, as corroborated by previous research in the area (Hogg et al. 2021). It seems that although multiple-use areas can foster economic development, they tend to cause conflicts related to the demand of MES that are less directly monetizable, such as knowledge systems, the most important MES identified in this MPA. On the other hand, although there were also important conflicts between commercial and recreational fishers and tourists for the use of common space and shared resources, benefits for people's health were very important in the Cabo de Gata-Níjar, which could be related to the practice of outdoor leisure activities, such as recreational fishing (Pita et al. 2022b) or nautical activities and diving, as found in other MPAs in the Mediterranean Sea (Lloret et al. 2021).

On the other side of protection policies is the MPA of the Atlantic Islands of Galicia, which, as a National Park, imposes strict regulations aimed at conservation. It also enforces regular monitoring of fisheries (Ouréns et al. 2015) and other significant human activities, such as tourism (Velando and Munilla 2011). It would be expected that an MPA devoted to the conservation of ecosystems with virtually no residents would exhibit fewer conflicts than less protectionist MPAs hosting more and varied users (Stamieszkin et al. 2009, Stevenson and Tissot 2013). However, the level of conflict demonstrated by the Atlantic Islands of Galicia is relatively high, especially in the case of conservationist organizations, which maintain conflicts with different users and stakeholders in relation to wildlife conservation policies (Table 4). The maintenance of a significant fishing pressure in the MPA (Cambiè et al. 2012, Ouréns et al. 2015), an exception included within traditional activities allowed in Spanish National Parks (Voth 2007), and the high tourist pressure (Navalpotro et al. 2012) could explain this important level of conflict, as also shown in other MPAs (Davis et al. 1995, Lopes et al. 2017, Villasante et al. 2021).

The low access of other users who compete with the main activity in the MPA, commercial fishing and shellfishing, would explain the low level of conflict in Os Miñarzos (Table 4), despite the medium level of protection on the MPA (Fernández-Márquez 2015). The low tourist pressure in the area and the existence of a co-management system for fisheries (Pita et al. 2018, Villasante

et al. 2021, Seijo-Villamizar 2022) would also reduce conflicts, as turned out in other MPAs created through similar bottom-up processes (Singleton 2009).

CONCLUSION

Different international policies are promoting the creation or extension of MPAs in the coming years, but the positive and negative impacts of the diverse types of protection regimes currently available are hardly known. In this study, we examine three MPAs in Spain spanning a broad spectrum of protection levels. Our findings reveal that the level of protection assigned to an MPA significantly shapes the nature of MES provided, along with the associated benefits. Nevertheless, attributes such as the proximity to major population centers and tourist destinations as well as the governance structure may also be pertinent factors to understanding the dynamics of MES derived from MPAs, including conflicts among users and stakeholders.

In our study, the two most stringent protection categories, represented by IUCN type II (the Atlantic Islands of Galicia MPA) and type IV (the Cabo de Gata-Níjar MPA), underscore the significance of tourism as a primary MES provided by both MPAs. The tourism sector has played a pivotal role in enhancing social well-being in these MPAs by augmenting income levels, creating employment opportunities, and fostering local population stability.

However, the remote location of the Os Miñarzos MPA (type IV), situated away from major urban centers and popular tourist hubs, has posed challenges in leveraging tourism as a driver of local economic development. Nevertheless, the success of this MPA in bolstering fishing yields has positively impacted the well-being of the local community. By generating employment opportunities and increasing fishermen's incomes, the Os Miñarzos MPA has contributed to countering depopulation trends in the region.

On the other hand, the absence of mass tourism has significantly reduced conflicts in Os Miñarzos, contrary to what has happened in the other two MPAs, where this sector is one of the main sources of tension. The existence of a co-management system and the low concurrence of different uses in Os Miñarzos may also have contributed to improving social peace in this MPA.

Therefore, it is imperative to include tourism and fishing in the analysis before creating new MPAs and enhancing the management of those that already exist. Both industries contribute to the betterment of MPA populations, but if they are not properly controlled and regulated, they may also become a cause of conflict. Under any category of protection, MPAs should value the development of fisheries co-management policies and activities that promote ecotourism rather than mass tourism.

Author Contributions:

Conceptualization: SV; *Methodology:* SV, PP, AC, GMM, AGA; *Data curation:* PP, JDS, JM, JS; *Analysis of data:* PP, SV, JDS, JM, ME; *Writing draft paper:* SV, PP, JSD, JS; *Review and editing:* PP, SV, AC, JM, GMM, JM, AT, AGA, JS; *Funding acquisition:* PP, SV.

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Data Availability:

The data that support the findings of this study are available on request from the corresponding author [PP].

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