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Turning the tide on protection illusions: The underprotected MPAs of the 'OSPAR Regional Sea Convention'

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ABSTRACT

Contracting Parties of the Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention') have agreed to establish an effective network of marine protected areas (MPAs). While the network is currently covering approximately 7% of the North-East Atlantic, the extent to which existing MPAs appropriately harbour protection remains unknown. Using the regulation-based classification system, we assessed the levels of protection of 946 zones belonging to 476 strictly marine OSPAR MPAs. We show that only 0.03% of the OSPAR MPA network is covered with full or high protection levels, which are the protection levels exhibiting significant conservation benefits. According to this study, more than 60% of MPAs are unprotected, leading to uncertainties about their potential to deliver positive conservation outcomes. MPA coverage alone should not be used as an indicator for MPA performance, but when presented with the actual protection levels, a light can be shed on MPA quality. To be able to reach the 2030 ocean targets agreed under the European Biodiversity Strategy, to which most OSPAR Contracting Parties are committed, substantial efforts are required not only to strategically enlarge the MPA network coverage to 30% but mostly to reach the EU sub-target of 10% of strict protection. Enhancing effective protection by increasing the coverage of fully and highly protected areas to safeguard marine ecosystems is urgently needed to sustainably support human well-being.

1. Introduction

Effective biodiversity conservation is needed to support resilient ecosystems and ecosystem services, including food production. Marine protected areas (MPAs) are broadly accepted as an effective tool for marine conservation [1] and are widely used to enhance biodiversity conservation. Member State Parties of the United Nations Convention on Biological Diversity (CBD) have agreed to protect 10% of their coastal and marine waters with MPAs by 2020 [2] but that remains mostly unachieved [3]. CBD member states are currently debating to raise that target to 30% coverage by 2030 [4]. Additionally, the European Union, with its recent Biodiversity Strategy and the Green Deal, have committed to protect at least 30% of European seas, of which one third (i.e. 10% of European seas) shall be under "strict protection" [5]. This criterion was defined on the basis that different protection levels confer distinct protection quality, and that strict protection is needed to reach significant conservation outcomes.

However, most existing MPAs are partially protected. Partially protected MPAs can show positive effects on conservation, especially when adjacent to a fully protected area [6], when showing high connectivity levels and when established for a long time [7] if threats are reduced significantly. Nonetheless, they allow extractive uses that can have serious detrimental impacts on biodiversity [8–12]. For instance, 94% of global MPAs allow fishing [10]. Moreover, 59% of MPAs in EU waters are commercially fished by destructive bottom trawling, with average trawling intensity 1.4 times higher than in non-protected areas [11]. Fully protected areas, where no fishing or other extractive uses are allowed, show not only efficient ecological effectiveness [13–16], fisheries benefits [17,18] but also socio-economic and cultural benefits [19–21]. Yet, only 2.8% of all global MPAs are fully or highly protected [22]. Quantity seems to be the common rule in MPA nomination processes rather than quality, at the expense of the marine environment [23–26].

European Regional Sea Conventions play a major role in establishing MPAs and MPA networks on a cross-boundary level to protect marine biodiversity. Their Contracting Parties are encouraged to regularly

Abbreviations: MPAs, marine protected areas; RBCS, regulation-based classification system.

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report MPAs into their regional MPA databases. However, these international databases witness shortages in reporting, leading to a lack of transparency to assess protection levels and assess MPA effectiveness [27]. The Convention for the Protection of the Marine Environment of the North-East Atlantic ('OSPAR Convention') aims at establishing a network of well-managed and ecologically coherent MPAs within the network [28–30]. The OSPAR Commission works on implementing the 'OSPAR Convention'. Its Contracting Parties nominate new MPAs according to ecological and practical criteria (e.g., threatened or declining species and habitats; potential for success of management measures). In the past years, meaningful progress in MPA designation procedures has been made in some regions of the North-East Atlantic Ocean. Notably, large MPAs in the high seas have been designated by OSPAR Contracting Parties collectively, demonstrating OSPAR's leading role in implementing MPAs in the high seas [31–33]. Yet, protection levels remain largely unknown, despite being indicators of potential ecological and social effectiveness [6,20,34,35].

Here, using the regulation-based classification system (RBCS) for MPAs [36] we assess the levels of protection of the OSPAR MPA network, not only to set the status of current protection efforts but also as a way to build the baseline, against which future progress of EU member states and neighbouring countries can be assessed.

2. Material and methods

We extracted information on all MPAs belonging to the OSPAR MPA network (n = 551) from the OSPAR MPA database [37]. For nearly 80% of the OSPAR MPAs, no regulation data is provided on the database. We compiled information on prohibited and allowed uses (such as fishing, mining, aquaculture, or anchoring [36]) by means of various data sources: the OSPAR MPA database (n = 90) [37], an online survey conducted with MPA managers in 2020 (n = 17), the ProtectedSea's Marine Activity MPA database (n = 27) [38], regulatory documents associated to specific MPAs (n = 325; e.g., management plans or byelaws), and a Portuguese (n = 13) [39], as well as a French national assessment (n = 4) [9].

When MPAs consisted of multiple zones (n = 103), we assessed those MPAs at the zone level as most fully and highly protected areas are part of multi-zone MPAs [8,9]. If an MPA is regulated by more than one legal text, for instance at a regional or national level, we considered regulations collectively.

We extracted georeferenced data of all MPAs from the OSPAR Commission's map tool [40]. In cases where MPAs were not strictly marine, we kept only the marine part and considered for further analyses only strictly marine MPAs, using the terrestrial facing line of the internal water zone (n = 541 strictly marine MPAs) [41]. Sizes of strictly marine MPAs varied between 0,01 and 178,093,92 km^2 (median size: 77,81 km^2; average size: 1863,07 km^2 ± 520,21). We assigned MPAs and their zones to "territorial seas" (< 12 nm), "EEZs" (12–200 nm, exclusive economic zone), and "high seas" (> 200 nm). In case of areas overlapping between two categories, we assigned the MPA, or zone, to the category covering more than 50%. If some uses such as aquaculture and commercial activities with bottom impact were not specified in legislation, we used georeferenced marine activity data to obtain such information and subsequently intersected it with OSPAR MPAs [42–56].

We classified all MPAs and their zones according to the regulation-based classification system by following the approach defined by Horta e Costa et al. [36] (Appendix A). To assign a protection level, a straightforward and objective decision tree is followed. The decision tree has four steps, each assessing the allowed uses within a given activity. The path followed in the tree depends on the allowed uses within each activity type: the first activity to consider is fisheries, which is double-assessed, namely by the number of distinct fishing gears allowed in the MPA, and by the potential impact of the most damaging fishing gear (i.e., fishing scores are assigned, corresponding to low, moderate or high impact, based on literature review and expert knowledge, as defined by Horta e Costa et al. [36]); then, the third step of the tree considers the occurrence of aquaculture and/or bottom impacting activities (e.g. mining; aggregated in a common index); and, finally, the fourth step of the tree is dedicated only to distinguish fully protected areas, according to the regulation of access and non-extractive recreational activities. Here, the RBCS was adapted, with additional details being considered for the steps related to aquaculture and bottom activities (and their associated potential impact index). For instance, aquaculture activities, such as algae and shellfish farming are considered low impacting, while fish farming is considered moderately impacting. Mining or oil platforms are considered highly impacting, whereas wind farms or other structures can be considered moderately impacting (further details in Appendix A). If information for the aquaculture and bottom impact index was not complete or was not available in regulation data, or in georeferenced data, we conducted a sensitivity analysis on the zone level to guide decisions about presence/absence of particular activities (Appendix B). Here we conducted two types of sensitivity analyses: (i) One was conducted to investigate the potential occurrence of finfish aquaculture in English and Welsh MPAs (n = 157), as such information was lacking and precluded the assignment of an accurate index. We based this sensitivity analysis on the Scottish MPAs where all relevant information was acquirable and consistently obtained using spatial data (n = 184); (ii) For certain MPAs (n = 12), where the information about the fishing gears was available, but not the aquaculture or bottom impacting activities (required to assign the respective index), another sensitivity analysis was performed, based on all MPAs for which the number of gears, the gear score and the aquaculture and bottom impact index were assigned (n = 934). For both analyses, we assumed the unknown activities allowed or forbidden by mimicking the respective activities of the MPAs where all activities were known; we guided assumptions for the unknown activities by the examples of the majority of cases (> 50% MPA).

The decision tree leads to a final MPA class [36], which ranges between five protection levels: fully protected, where no extractive uses are permitted, highly protected, moderately protected, weakly protected and unprotected, where no further protection (according to the allowed uses) is offered compared to adjacent outside areas. These protection levels are based on the number and type of activities allowed and not on the density of users [36], as such information is not available, despite their relevance for MPA effectiveness.

Due to the UK differing from all other Contracting Parties in the way that they regulate and manage their MPAs, a slightly different approach was used for British MPAs belonging to the OSPAR network (n = 360). In the UK, the restriction of fishing gear in MPAs is regulated through byelaws and orders, which are declared in several acts [57–63]. The MPA's location, either inshore or offshore of 6 NM, will define which institution has the power to state byelaws. Around the UK, waters inshore of 6 NM are managed by ten different Inshore Fisheries and Conservation Authorities in England, through Marine Scotland in Scotland, through Natural Resources Wales in Wales and through the Department of Agriculture, Environment and Rural Affairs in Northern Ireland. Waters offshore of 6 NM are managed through the Marine Management Organisation. In this study, we were able to compile all byelaws and orders of the OSPAR MPAs in the UK issued until May 2021, except for the ones declared by Natural Resources Wales which access was not available. All MPAs not exhibiting any gear restricting byelaws in the UK, excluding Welsh waters, are therefore determined as unprotected in our study.

We could determine the protection levels of 476 MPAs which corresponds to 946 zones. Due to the lack of available regulatory data or due to the lack of dedicated management plans or equivalent regulatory documents, some MPAs (n = 65, ~12%); could not be assigned a zone class, corresponding to 1.65% of the network's area, and are allocated to an additional "unclassified" category (Fig. 1 B).

We then assessed the coverage of protection levels per OSPAR Contracting Parties (i.e., sovereign states; n = 12), OSPAR regions (n = 5),

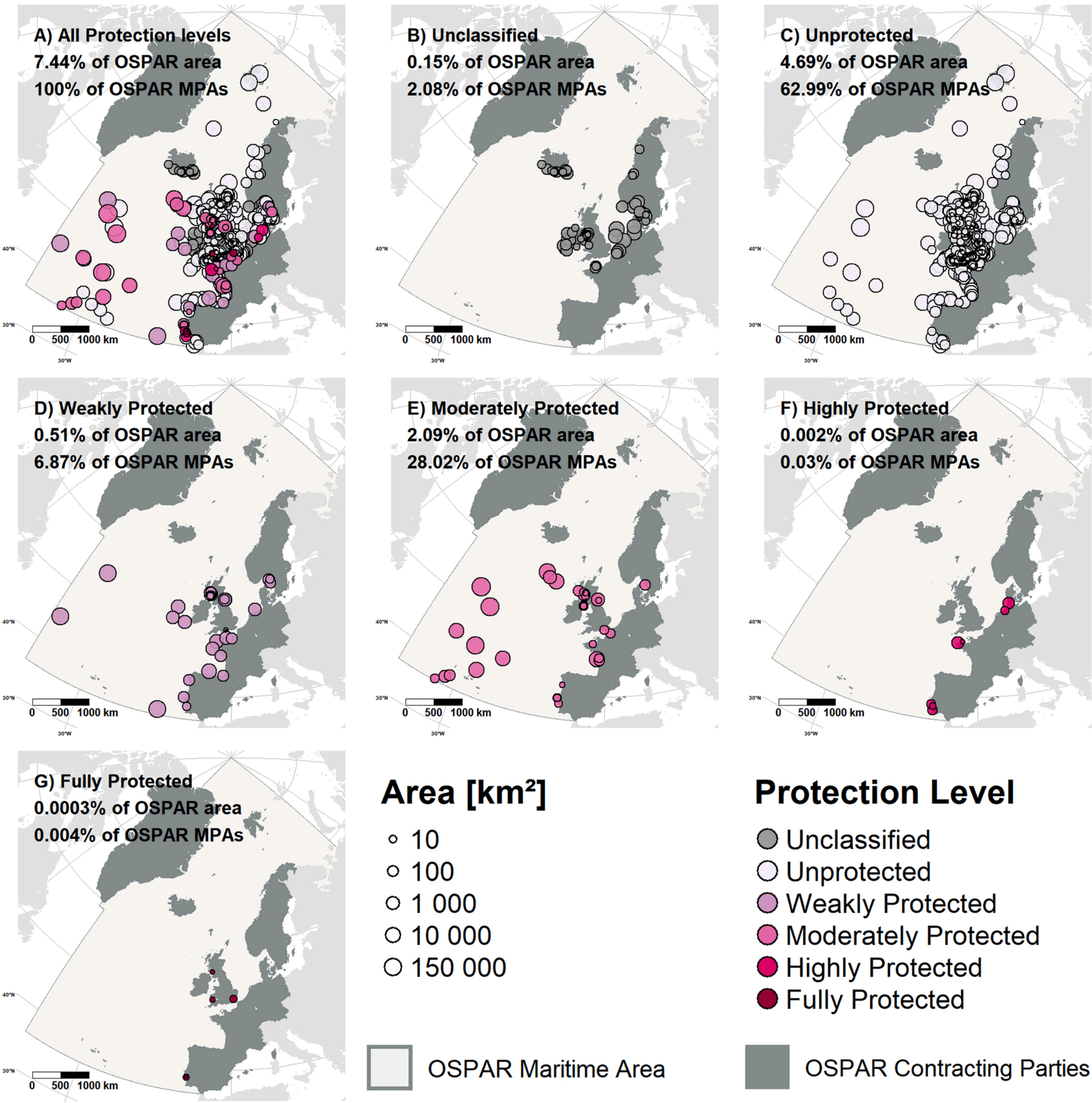

Fig. 1. Protection levels in the OSPAR marine protected area (MPA) network. Each MPA or its zone (in case of a multi-zone MPA) is illustrated by a single dot. The size of each dot is proportional to the size of the represented MPA or zone. Protection levels are presented in panels A-G. The first percentage in each panel corresponds to the OSPAR MPA cover when compared to the overall OSPAR Maritime Area. The second percentage of each panel indicates the protection level coverage in relation to only the OSPAR MPA covered area. The OSPAR Maritime Area is shown in creme and Contracting Parties in darker grey.

and maritime zones (i.e., territorial seas, EEZ, and the high seas; n = 3) [41]. When national MPAs are located in the high seas (n = 2) we excluded them when calculating the MPA area cover across sovereign states. Additionally, territorial seas and EEZ of the Faroe Islands and Greenland, which do not contain any OSPAR MPAs in their waters and which are under Danish sovereignty, were not included when analysing the protection levels across the sovereign states and across the maritime zones.

We conducted all analyses using QGIS v. 3.16.3 [64] and R v. 3.6.1 [65]. Maps and plots were created by means of scatterpie [66], sf [67], tidyverse [68], and tmap [69] packages.

3. Results and discussion

MPAs cover 7.4% of the OSPAR Maritime Area (Fig. 1A; Appendix C), which is below the 10% CBD target due by 2020 [2] and is roughly equivalent to the global MPA coverage of 7.7% [22] or the Mediterranean MPA cover of 6% [8]. According to the European Environment Agency, 10.8% of European waters under national jurisdiction had been covered by MPAs in 2016, showing a slightly higher expansion when compared to the OSPAR Maritime area [70]. The MPA cover of certain countries, such as the United States (26%), France (22%), or the United Kingdom (67%) [22], show striking elevated ranges, mostly due

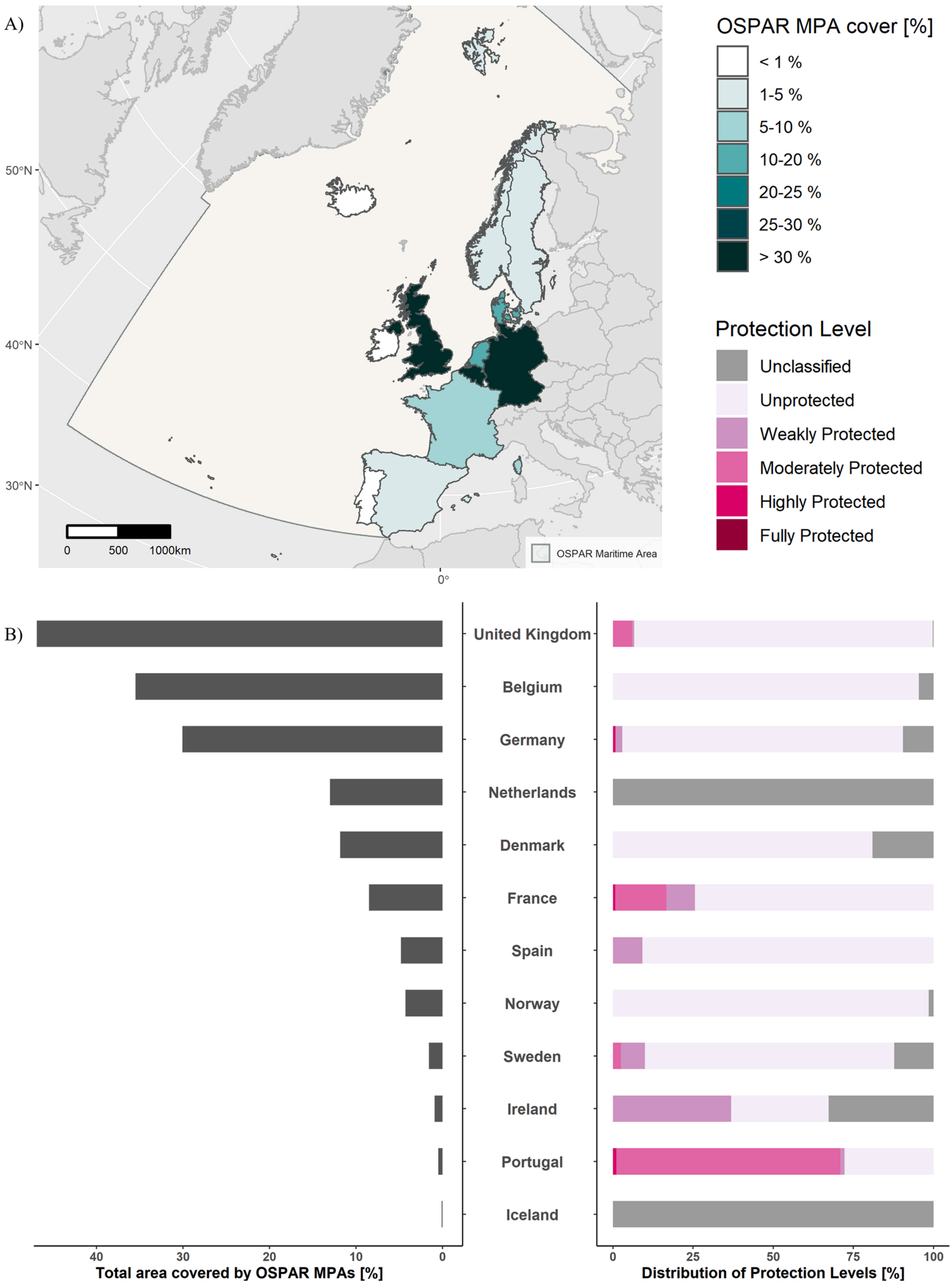

Fig. 2. Marine protected area (MPA) coverage and protection levels across the OSPAR Contracting Parties. A. The turquoise colour scale indicates the OSPAR MPA coverage in per cent for each Contracting Party. The OSPAR Maritime Area is illustrated in creme. B. The left bar diagram shows the percentage of each Contracting Party's coastal waters covered by OSPAR MPAs. The bar diagram on the right side illustrates how the MPA covered area, shown on the left side, is qualitatively protected, by indicating the cover of protection levels in per cent, illustrated by a pink colour scale for each Contracting Party.

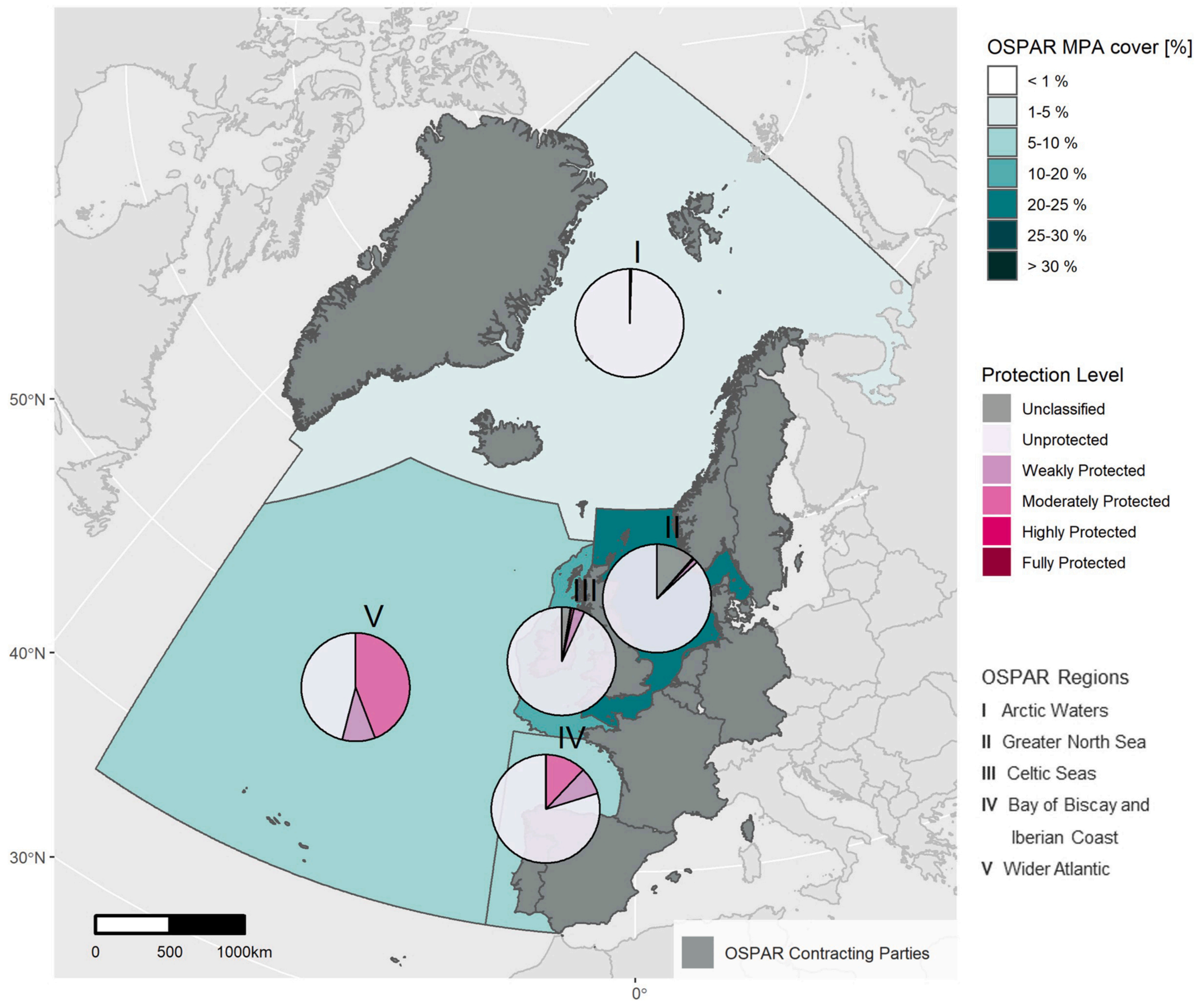

Fig. 3. The coverage of marine protected areas (MPAs) and their protection levels in the five OSPAR regions. The turquoise colour scale indicates the percentage of OSPAR MPA coverage for each region. The pie charts display the percentage of protection levels of the MPA covered area for each region in a pink colour scale. Contracting Parties are shown in darker grey.

to large remote marine protected areas in overseas [9,23]. Most of the OSPAR MPAs are partially protected (97.9% of the network; Fig. 1C-E). This pattern is similar in other regions (e.g. the Mediterranean Sea [8]) or even countries (e.g., France, [9], or Portugal [39]). However, by distinguishing among the partial protection levels, we show that more than in other regions or countries, 63% of the MPAs are unprotected (Fig. 1C) and 7% weakly protected (Fig. 1D). A recent study has shown that fish abundance and biomass in weakly protected areas do not differ from outside areas [6]. Therefore, 70% of the OSPAR MPA network has levels of protection that are unlikely to show any conservation benefits as regulations are inexistent or too weak [20,34]. Approximately 30% of the OSPAR MPA network offers moderate protection levels (Fig. 1E), whereas fully and highly protected areas, those levels of protection providing the largest range and magnitude of benefits [6,20,35,71,72], cover only 0.004% and 0.03%, respectively (Fig. 1F-G; Appendix C). In summary, more than two-third of OSPAR MPAs are unlikely to provide any sort of conservation benefits while they can be expected with confidence from only 0.034% of the network.

The five Contracting Parties with the largest OSPAR MPA coverage show predominantly unprotected and unclassified protection levels, reaching from 93% to up to 100% of their OSPAR MPA covered area (Fig. 2A and B; Appendix C). This can raise questions about those countries' ambition to reach effective conservation outcomes with their MPAs and can only reinforce the need for not only coverage but outcome-based targets. Among all Contracting Parties, Portugal and the UK are the only nations to show the presence of fully protected areas within their OSPAR MPAs, albeit at small proportions (0.11% and 0.01% of their respective overall OSPAR MPA coverage). Highly protected areas were only found in Portugal, Germany, and France, exhibiting proportions of 0.93%, 0.79% and 0.71%, respectively, of their overall OSPAR MPA coverage (Fig. 2B). This pattern is similar to those found on national scales in Portugal [39] or in France [9] and is being pointed out throughout Europe [27,73].

The OSPAR biogeographic regions are unevenly protected, with coverage ranging from 1.9% in 'Arctic waters' to 20% in the 'Celtic Sea' and 21.3% in the 'Greater North Sea' (Fig. 3; Appendix C). 'Arctic waters' not only show the lowest coverage but also the poorest protection levels, all MPAs being either unprotected (99.4%) or unclassified (0.6%). The 'Celtic Sea', together with the 'Bay of Biscay and Iberian Coast', exhibits the largest coverage of fully protected areas (0.02%

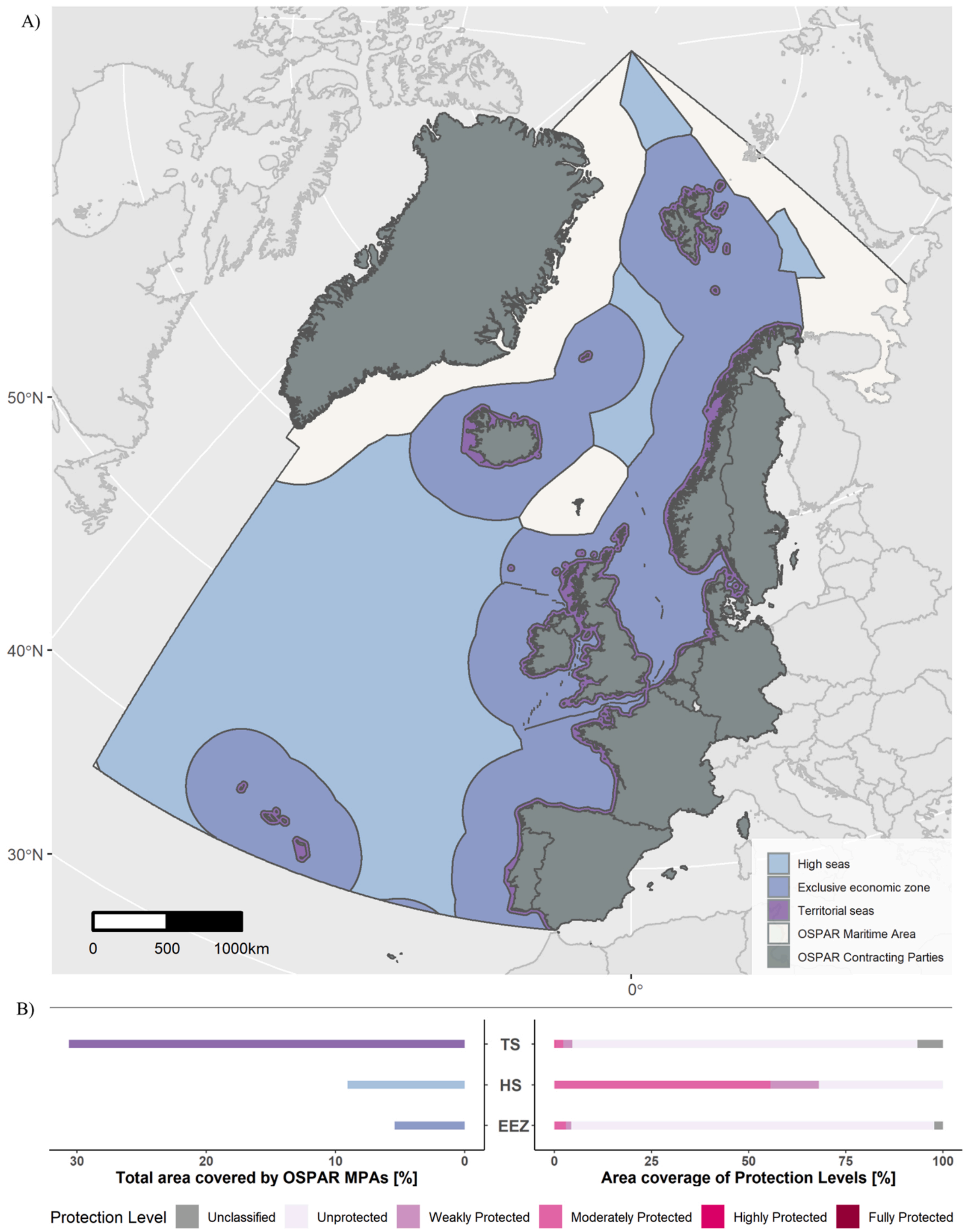

Fig. 4. The coverage of marine protected areas (MPAs) and their protection levels across maritime zones. A. Maritime zones are represented in blue-purple colour scale, those being the high seas, the exclusive economic zone and territorial seas of all Contracting Parties combined. Maritime zones belonging to the Faroe Islands and Greenland were excluded, illustrated in white. Contracting Parties are shown in darker grey. B. The left bar diagram illustrates the OSPAR MPA coverage in per cent of the total area of each maritime zone, being territorial seas (TS), high seas (HS), and exclusive economic zone (EEZ). The protection level distribution [%] of the OSPAR MPA covered area of each maritime zone is shown on the right bar diagram.

each) and highly protected areas (0.15% and 0.27%, respectively; Fig. 3; Appendix C). While OSPAR's Contracting Parties agreed on establishing an ecologically coherent network of MPAs their efforts are insufficient in protecting adequately representative proportions of OSPAR's biogeographic regions.

Fully and highly protected MPAs can only be found in territorial seas (in proportion of 0.02% and 0.13%, respectively; Fig. 4A and B; Appendix C). Although territorial seas harbour the strongest protection levels and highlight more MPAs than the other maritime zones (more than 30%), the large majority is unprotected (88.8%). The high seas within the OSPAR Maritime Area exhibit the second largest MPA coverage (9.05%), with more than 55% being moderately protected (Fig. 4A and B; Appendix C). This is mainly due to very large MPAs implemented collectively by OSPAR's Contracting Parties and regional fisheries management organisations, such as NEAFC. The exclusive economic zones (EEZ) of all Contracting Parties combined show the lowest MPA coverage with less than 6%, of which more than 93% are unprotected (Fig. 4A and B; Appendix C), thus not offering any better protection than areas outside MPAs. Under the United Nations Convention on the Law of the Sea, each coastal state is granted the sovereign right to govern its respective EEZ in cooperation with regional fisheries management organisations when agreed. However, in the EU, under the Common Fisheries Policy, member states agreed to share the access of their EEZ's fisheries resources with other member states, as opposed to the exclusive access to the territorial seas. Implementing fully protected areas by the sovereign states in their own EEZ is thus challenging and it requires joint recommendations, which can include complex and lengthy negotiation processes [73]. OSPAR's joint MPA implementation efforts in the high seas show that it is possible to achieve some protection even outside countries' full jurisdiction and that those mechanisms can be adopted by the European Common Fisheries Policy in EEZs. While EEZs deliver the majority of global catch, they are also reported to contain most of the world's overexploited fisheries [74]. A recent study show that forbidding destructive fishing practices within EEZs can restore and protect marine biodiversity [75]. Similarly, fish populations can be also restored in the EEZs if fisheries are closed in the high seas, resulting in large socioeconomic benefits [75–77]. Further, unprohibited dredging or trawling in large areas in the EEZ is likely to remineralize sedimental carbon, potentially leading to increased ocean acidification, reducing the ocean's buffering capacity and ultimately leading to higher atmospheric CO_2 concentrations [76]. Such studies reinforce the potential role of large fully or highly protected MPAs in the EEZs and high seas and the need to effectively implement them. Restricting or banning destructive uses has a high potential to contribute to marine biodiversity conservation, whether in the high seas or the EEZs, yet only little and weak protection is in place so far in the North-East Atlantic.

The OSPAR MPA network coverage across all assessed domains is far from achieving the 10% target, except for a few countries such as the UK, Belgium, and Germany (Fig. 2A), as well as the combined territorial seas (Fig. 4B). Besides, as some MPAs overlay one with the other (estimated overlap of 5%), this coverage might even be overestimated. Nonetheless, results presented here provide consistent evidence that most MPAs are unprotected. Regardless of the MPA coverage, across all analysed domains full and high protection levels are on the verge of being non-existent, covering only 0.002% of the North-East Atlantic (Appendix C). In order to reach the EU target of 30% with one third in strict protection [5], OSPAR will be required to increase the overall network cover by more than four times, and full and high protection, in particular, by more than 5000 times.

A large majority of MPAs (as those in the UK) do not display a management plan but rather overlapping regulatory documents managed by independent national agencies. MPAs should have their regulations defined and compiled in a single plan and independently from external mechanisms that can be changed without conservation objectives in mind but with direct impacts inside the MPA. Evidence suggests that the existence of complete and clear management plans, including proper and precise regulations, is one of the key features for successful MPAs, besides other elements such as enforcement and monitoring [24,35,39,71,77–79]. In the North-East Atlantic EU waters, 11% is covered with designated MPAs, yet only 2% is covered by MPAs having a management plan [27]. To increase transparency and to guarantee an adequate MPA assessment, correct reporting, and access to MPA regulations are needed, namely in the OSPAR MPA database.

In the framework of this study, we focus on the quality of protection, by highlighting the different types of protection conferred by regulations. Other aspects such as connectivity or species vulnerability to threats, enforcement or effective management are key for MPA effectiveness and should be evaluated [19,80]. However, if detrimental human activities are not restricted nor evaluated in the OSPAR network of MPAs, it is unlikely that ecological benefits are accrued, precluding other aspects such as ecological coherence or connectivity to be achieved [81–83]. Evidence suggests that when MPA implementation processes are coordinated strategically on a transboundary or even global level, biodiversity conservation benefits can be achieved with vastly enhanced efficiency than if purely based on national strategies [84]. The OSPAR Commission, which is a key player in implementing MPAs collectively in the high seas, is in a perfect position to create an effective network by strategically implementing strictly protected MPAs on a transboundary level across its Contracting Parties to start the pathway towards sustainability [85]. Policymakers and all involved stakeholders have the next eight years to turn the tides of aligning quantitative coverage with quality indicators to overcome the illusion of protection that many MPAs currently provide.

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CRediT authorship contribution statement

B.H.C conceived the idea and designed the study and the analyses with J.R. and J.C.; J.R., J.C. and B.H.C. provided the data; J.R. compiled, collected, and analysed the data, J.R. produced the figures; J.R. wrote the manuscript with B.H.C. and J.C. All authors approved the manuscript.

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Competing interests

The authors have no competing interests to declare.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2022.105109.

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