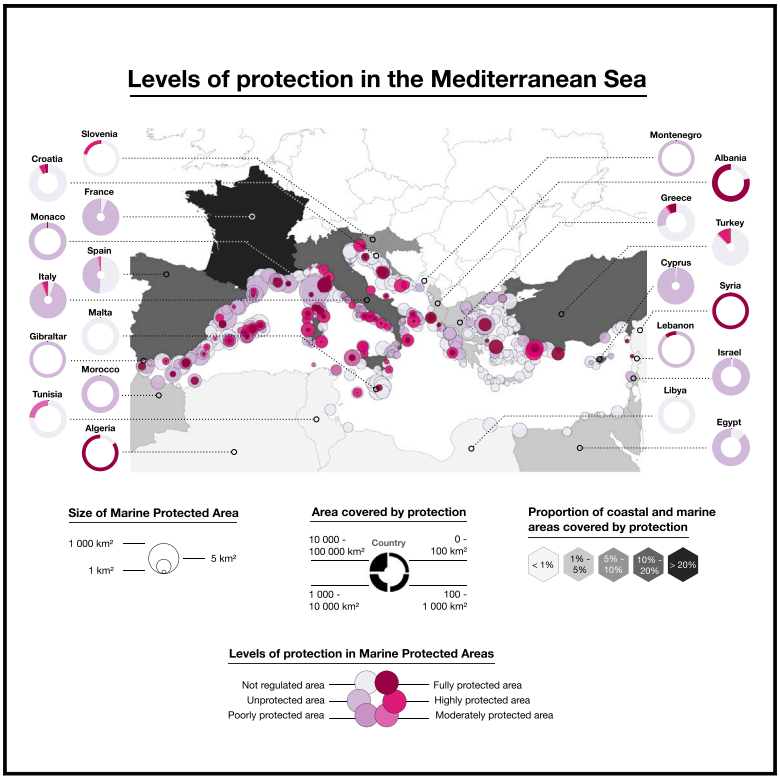
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Article

Underprotected Marine Protected Areas in a Global Biodiversity Hotspot

Graphical Abstract



Highlights

- 6.01% of the Mediterranean is covered by protection
- In 95% of this area, regulations are not stronger inside than outside MPAs
- Only 0.23% of the Mediterranean is fully or highly protected
- Protection is unevenly distributed across political boundaries and eco-regions

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In Brief

While the ocean is central to human well-being, an expanding human footprint is placing it at risk. Among the 1,062 marine protected areas in the Mediterranean Sea, 72% of the protected areas lack regulations that can reduce human impacts on biodiversity. The most effective levels of protection represent only 0.23% of the basin. Protection levels should be increased and more evenly distributed across political boundaries and eco-regions to deliver tangible benefits for biodiversity conservation.

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Underprotected Marine Protected Areas in a Global Biodiversity Hotspot

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SCIENCE FOR SOCIETY The ocean is central to human well-being. It regulates climate and provides food, energy, minerals, and genetic resources as well as cultural and recreational services. Even though the United Nations Sustainable Development Goals cannot be met without a healthy ocean, an expanding human footprint is placing it at risk. To help protect the ocean, 193 Member States of the United Nations agreed to protect 10% of their waters following the Convention on Biological Diversity. The target year for completion was 2020. This year.

This work investigates how successfully the introduction of marine protected areas (MPAs) has been in the Mediterranean Sea. We show that 1,062 MPAs currently cover 6% of the basin, short of the 10% target. However, of greater concern is that 95% of the area covered by these 1,062 MPAs lack sufficient regulations to reduce human impacts on biodiversity and protect ocean health. Only 0.23% of the basin is effectively protected, and these MPAs are unevenly distributed across political boundaries and eco-regions. More efforts are needed if we are to protect our oceans and safeguard environmental and human well-being.

SUMMARY

Ocean health is critical for human well-being but is threatened by multiple stressors. Parties to the Convention on Biological Diversity agreed to protect 10% of their waters by 2020. The scientific evidence supporting the use of marine protected areas (MPAs) to conserve biodiversity stems primarily from knowledge on fully protected areas, but most of what is being established is partially protected. Here, we assess the protection levels of the 1,062 Mediterranean MPAs. While 6.01% of the Mediterranean is covered by protection, 95% of this area shows no difference between the regulations imposed inside the MPAs compared with those outside. Full and high levels of protection, the most effective for biodiversity conservation, represent only 0.23% of the basin and are unevenly distributed across political boundaries and eco-regions. Our current efforts are insufficient at managing human uses of nature at sea, and protection levels should be increased to deliver tangible benefits for biodiversity conservation.

INTRODUCTION

A healthy ocean is critical for human well-being. Many Sustainable Development Goals (SDGs) may not be met without achieving SDG 14 for ocean conservation and sustainable use.[1] However, oceans are threatened by multiple stressors, with fishing as the most important driver.[2] While there is an urgent need to modify human behavior to allow sustainable development pathways,[3,4] mitigation strategies still need to be put into practice. Within this context, marine protected areas (MPAs) are an effective spatial, ecosystem-based management tool,[5] and Member States Parties to the Convention on Biological Diversity (CBD) agreed to cover 10% of their coastal and marine areas with MPAs by 2020 (CBD Aïchi target 11).[6] This areal target is shared by target 5 of SDG 14 and should only be considered a milestone, because current research suggests that at least 30% of the ocean should be protected to meet global conservation goals.[7] Here, we ask whether CBD Aïchi target 11 led to effective conservation strategies or if the endeavors of Member States deviated from the original aim of the target, which is to deliver conservation outcomes.

Most of the science in support of MPAs has been based on fully protected areas,[8,9] where all extractive activities are forbidden, yet in order to meet the CBD Aïchi target 11, most of the recently established MPAs are only partially protected.[10,11] Although partially protected areas can be effective in some instances,

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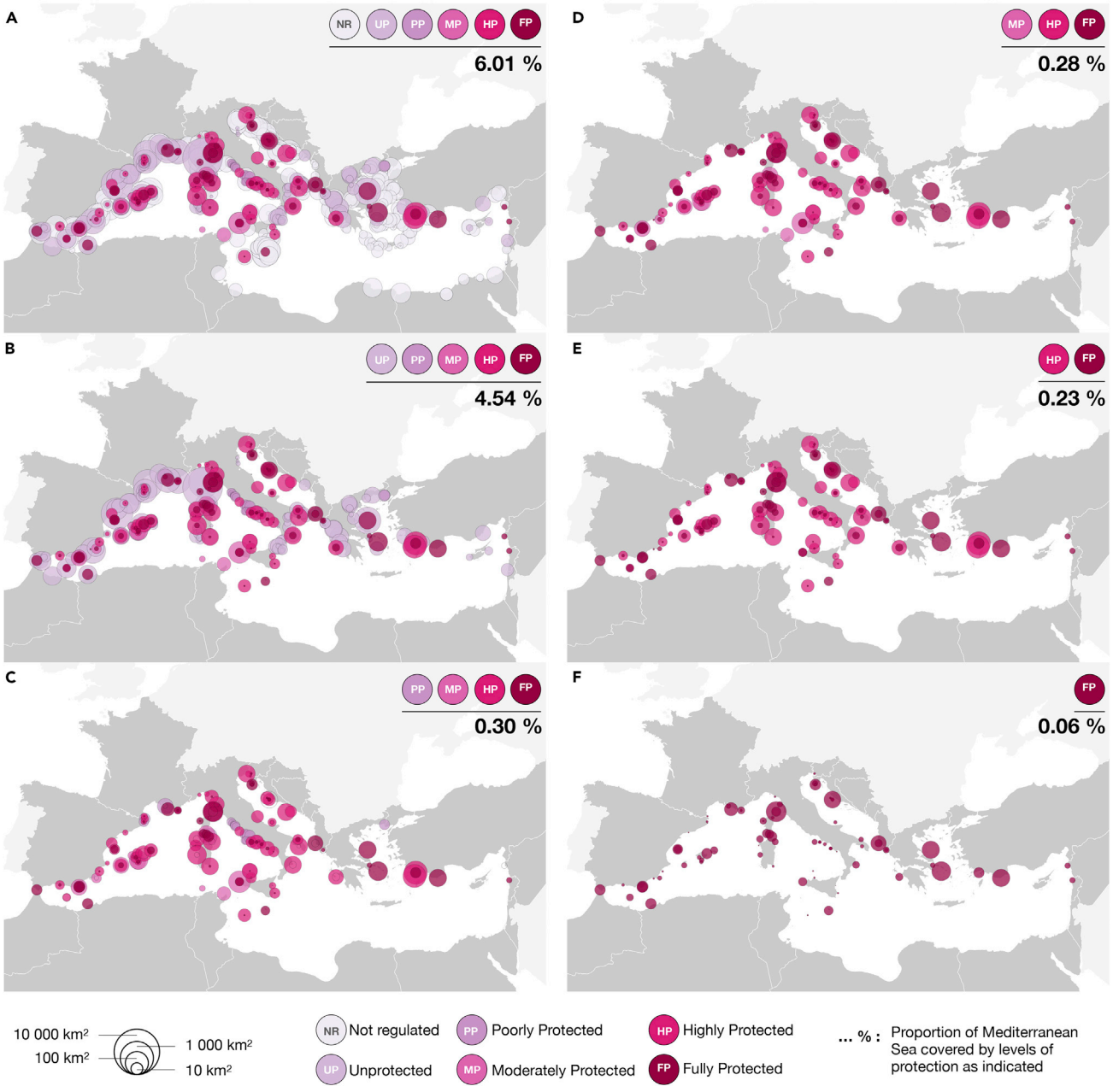


Figure 1. Coverage of the Different Levels of Protection in the Mediterranean Sea

Each dot represents the centroid of a marine protected area (MPA), or a zone within an MPA in the case of multiple-zone MPAs. The size of the dots is proportional to the size of the MPA on a log scale. The color of the dots corresponds to the level of protection of the MPA. The percentage in the top right of each panel represents the cumulative percentage of the Mediterranean Sea covered by the displayed levels of protection in the panel. In each panel (A–F), MPAs from the lower level of protection from the previous panel are sequentially removed.

they have significantly less conservation benefit than fully protected areas.[12,13] Partially protected areas are often preferred over fully protected areas because a broader range of users can still access those areas. However, allowed uses, even if regulated, often concentrate inside such areas[14,15] with potentially higher detrimental impacts on biodiversity.[16]

A recently developed regulation-based classification system for MPAs allows MPAs to be grouped according to the potential impacts on species and habitats of allowed uses.[17] When applied to a range of published literature on MPA effectiveness, it showed that, on average, only fully and highly protected areas, which only allowed infrequent use of some types of non-industrial, highly

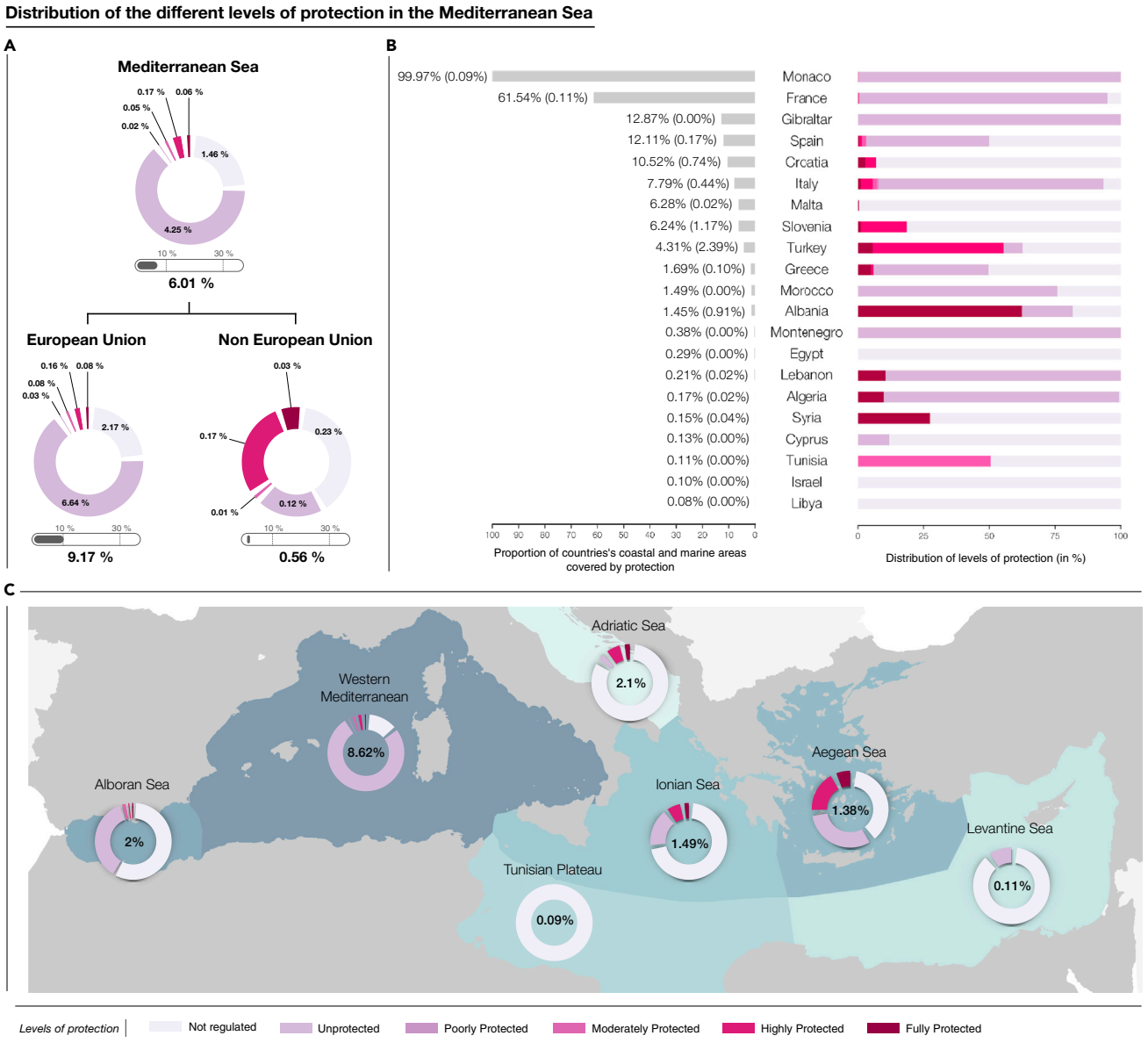


Figure 2. Distribution of the Different Levels of Protection in the Mediterranean Sea

The proportion and distribution of the different levels of protection are displayed at different scales: (A) the entire Mediterranean Sea, European Union, and non-European Union countries (percentages below the progress bars indicate the overall percentage cover of protection in the corresponding grouping, percentages in the colored pie charts show how the different levels of protection are distributed in the corresponding grouping); (B) at the country level (gray bars on the left show the percentage cover of the country's coastal and marine areas under protection for all cumulated levels of protection, percentages inside brackets show the percentage cover of only full and high levels of protection, colored bars on the right show how the levels of protection are distributed inside each country's coastal and marine areas); and (C) at the ecoregion level (colored pie charts show the distribution of the levels of protection inside each ecoregion and percentages indicate the percentage cover of the ecoregion under protection).

selective, low impact, recreational, commercial, or subsistence fishing gears, could deliver ecological benefits.[13] Protection levels are therefore a good indicator of MPA performance.

In this study, we focused on the Mediterranean Sea, which is both a global hotspot for biodiversity and for human pressure,[18–20] and is an area that features an extensive system of MPAs.[21] Our assessment took a critical look at whether conservation efforts are appropriately strategized to deliver ecological benefits.

RESULTS AND DISCUSSION

We exctracted the list of MPAs from MAPAMED,[22] the most complete database for MPAs in the Mediterranean. For multiple-zone MPAs, we worked at the zone level and compiled and reviewed the management plans and legal texts for the 1,062 existing MPAs (or 1,346 zones) to classify them using the regulation-based classification system.[17] All 1,062 MPAs included in our study are approved by countries or focal points of the Barcelona

Convention (UNEP Regional Sea Convention), and thus count toward international biodiversity conservation targets. When several zones (or MPAs, or designations) overlapped, only the one that conferred the strongest level of protection was kept.

We found that 6.01% of the Mediterranean Sea is covered by an MPA. Interestingly, this percentage cover is similar to the global cover; the United Nations Environment Program's World Conservation Monitoring Centre (WCMC) and the International Union for the Conservation of Nature (IUCN) reported 6.97% of global ocean protection as of 2017.[11] In the Mediterranean Sea, more than a fifth of this coverage is neither established nor managed, because no management plan or legal text could be found, and two-thirds lack restrictions on activities that can have an impact on biodiversity (Figure 1). Hence, for 95% of the total protected area in the Mediterranean Sea (72.6% of the MPAs), no differences exist between the regulations imposed inside the MPA compared with those outside.

Full and high levels of protection, known to deliver ecological benefits,[13] cover only 0.23% of the Mediterranean Sea and represent only 3.42% of what is being protected. As the CBD's 10% target of countries' coastal and marine areas was designed to achieve conservation outcomes, most of the MPAs, if not all, should fall within these levels of protection.

The conservation effort is greatly unbalanced across political boundaries since close to 97% of total marine protection, and 80% and 63% of full and high protection, respectively, lay in the European Union's waters (Figure 2A). This striking imbalance between Mediterranean European and non-European countries can be due to differences in governance frameworks, institutional structures, wealth distribution, social capital, or knowledge on the environment.[23] Such a pattern can also be observed globally, where advanced economies account for two-thirds of the global system of MPAs.[24] In the European Union, full and high protection cover 0.15% of countries' coastal and marine areas, whereas it is less than half that in non-European countries. Countries that protect a large part of their coastal and marine areas generally harbor large MPAs with low levels of protection (Figure 2B).

The CBD Aïchi target 11 stipulates that protected areas have to be "ecologically representative."[6] In the Mediterranean, marine eco-regions[25] are not equally protected (Figure 2C). The Western Mediterranean is by far the most protected (8.62%), but only 1.89% of what is being protected is done so by full or high levels of protection. The Adriatic and Alboran Seas are the second most protected marine eco-regions. Aegean and Ionian Seas have similar percentage cover of protection, but full and high protection coverage vary up to three orders of magnitude. The Levantine Sea and the Tunisian plateau are the least protected ecoregions in the Mediterranean.

Our results suggest that much of the Mediterranean Sea is not protected, and more than 95% of what is supposed to be protected does not convey regulations strict enough to confer any ecological benefit.[13] As in other parts of the world, where weak regulations cannot deliver ecological outcomes,[16,26,27] or where protected areas are not properly resourced or managed,[28,29] it is important to ensure that the race to meet key biodiversity targets does not lead us to a false sense of security about appropriate actions being undertaken.[30,31] We believe that classifying MPAs according to their protection levels, as we did here, is necessary to shed light on the fact that current efforts are insufficient with respect to managing human uses of nature at sea.[32] We hope this will translate into more action by policy makers to establish and appropriately manage MPAs with protection levels that are able to deliver tangible benefits for biodiversity conservation.

EXPERIMENTAL PROCEDURES

Marine Protected Areas Classification

Legally binding MPAs were collected from MAPAMED.[22] Fishing Restricted Areas (n = 7), Specially Protected Area of Mediterranean Importance (n = 34), and Particularly Sensitive Sea Area (n = 1) were removed. In the case of non-strictly marine MPAs (n = 46), only the marine part was kept. In the case of multiple-zone MPAs (n = 75), MPAs were considered at the zone level. We then collected information on allowed or prohibited activities from legal texts, management plans, and personal communications with MPA managers in local languages. Specific information from Natura 2000 sites was also obtained from the European Environment Agency official website (https://www.eea.europa.eu/data-and-maps/data/natura-10), but we cross-referenced it, because in many cases it was outdated. We then classified all MPAs, or zones in the case of multiple-zone MPAs, using the regulation-based classification system.[17] We thus obtained a protection level for each of the 1,062 MPAs (or 1,346 zones). In the case of MPAs with no legal text or management plan where regulations would be described, we assigned the MPAs to a non-regulated category.

Data Analysis

Existing georeferenced information in MAPAMED was used. When missing, in multiple instances, and for almost all zoning schemes in the case of multiple-zone MPAs, additional information was obtained as detailed above for the regulations. To avoid overestimating the total area covered by protection, we removed overlapping areas, keeping only those that conferred the strongest levels of protection for each overlapping layer. Exclusive Economic Zones were retrieved from Flanders Marine Institute, Maritime Boundaries Geodatabase, version 10 (2018); available online at https://doi.org/10.14284/319. Mediterranean eco-regions were retrieved from Spalding et al.[25] All analyses were conducted using QGIS v.2.18.0 and R.[33] Areas in square kilometers of the levels of protection levels per country and eco-regions can be found in Tables S1 and S2.

SUPPLEMENTAL INFORMATION

Supplemental Information can be found online at https://doi.org/10.1016/j.oneear.2020.03.008.

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AUTHOR CONTRIBUTIONS

J.C. designed the study. M.S., M.Z., and C.L. compiled the data. J.C., C.L., and M.S. analyzed the data. J.C. and C.L. produced the figures. J.C. wrote the manuscript. All authors approved the manuscript.

DECLARATION OF INTERESTS

The authors declare no competing interests.

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