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Data Article

Regulations of activities and protection levels in marine protected areas of the European Union: A dataset compiled from multiple data sources

Juliette Aminian-Biquet[a,b,c,*], Claire Colegrove[d], Alex Driedger[d], Nicole Raudsepp[d], Jennifer Sletten[d], Timothé Vincent[d], Virgil Zetterlind[d], Julia Roessger[a], Anastasiya Laznya[e], Natașa Vaidianu[f,g], Joachim Claudet[c], Juliette Young[b], Barbara Horta e Costa[a]

[a] *Centre of Marine Sciences (CCMAR), Campus de Gambelas, University of Algarve, Faro 8005-139, Portugal*
[b] *Agroécologie, INRAE, Institut Agro, Université de Bourgogne Franche-Comté, Dijon, France*
[c] *National Center for Scientific Research, CRIOBE, CNRS-EPHE-UPVD, Maison de l'Océan, PSL Université Paris, 195 rue Saint-Jacques, Paris 75005, France*
[d] *Anthropocene Institute, 2475 Hanover St., Palo Alto, CA 94304, USA*
[e] *Stockholm Resilience Centre, Stockholm University, Stockholm 106 91, Sweden*
[f] *Faculty of Natural Sciences and Agricultural Sciences, Ovidius University of Constanta, Constanta 900527, Romania*
[g] *Interdisciplinary Center for Advanced Research on Territorial Dynamics, University of Bucharest, Bucuresti 030018, Romania*

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ABSTRACT

The dataset gathers available regulations of human activities and protection levels of Marine Protected Areas (MPAs) of the European Union (EU). The MPA list and polygons were extracted from the MPA database of the European Environment Agency (EEA) and completed with available zoning systems (all were filtered for their marine area reported under the Marine Strategy Framework Directive). Fully-overlapping MPAs were merged. In the resulting dataset, MPA features are provided (gathered from EEA, WDPA, ProtectedSeas),

* Corresponding author at: Centre of Marine Sciences (CCMAR), Campus de Gambelas, University of Algarve, Faro 8005-139, Portugal.
E-mail address: juliette.biquet@lilo.org (J. Aminian-Biquet).
Social media: @invertebraette (J. Aminian-Biquet)

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MSP

including the year of designation, designation types (e.g., national, Natura 2000) and subtypes (e.g., reserves, national parks), database identifiers (WDPA, Natura 2000, OSPAR, etc.), IUCN categories, and main protection focus. We provide summarized data on maritime activities that overlap with MPA polygons from two types of datasets: activities-focused datasets (national marine spatial plans, and additional European and regional databases, like EMODnet) and MPA-focused datasets gathering data from management plans (ProtectedSeas, expert-based assessments about OSPAR and Portuguese MPAs). This dataset therefore compiles data that could be gathered from accessible legal frameworks regarding aquaculture, fisheries, anchoring, infrastructures (including harbors and renewable energy), mining, transport, coastal land-based uses (desalinization, sewage plants) and other non-extractive uses (e.g., recreational), making them readily accessible. Using the MPA Guide classification system, we computed two scenarios of potential impact for each activity, which were used to assess two scenarios of protection levels per MPA. Some MPAs could not be associated with any MPA features, regulations, or protection levels. Finally, we detail the protocol to match information from multiple databases (e.g., with MPA polygons formatted differently) and provide a quality check by comparing this dataset to previous assessments.

This dataset was used to analyze MPAs' protection levels across countries, regions and MPA features (e.g., IUCN categories, designations). It was also used to investigate the sources of information available and the levels of regulations for each maritime activity in EU MPAs. This dataset can therefore be used for further analyses on the use of EU MPAS to regulate activities and to compare with future assessments or with additional data we did not have access to (e.g., gathered at national scale). Such research is crucial to plan and monitor the implementation of the EU 2030 Biodiversity Strategy, targeting 10% of strictly protected MPAs in each sea region.

Specifications Table

Subject	Nature and Landscape Conservation.
Specific subject area	Regulations in marine protected areas in European Seas
Type of data	Table, polygons Filtered, Processed .xlsx file with all data gathered at MPA and zone scales .shp file with corresponding MPA and zones polygons (EPSG:4326, i.e., WGS84 projection system)
Data collection	EEA MPA polygons were used, their marine area was extracted and fully-overlapping MPA designations were merged into one polygon. Zoning systems were identified from additional databases. Data for nine categories of activities at seas were gathered and formatted from marine spatial plans,

(*continued on next page*)

	other related geoportals publicly available, the ProtectedSeas Navigator database gathering regulations in MPAs, and two expert-based assessments. Information about activities from these databases were formatted (as allowed, restricted, prohibited) and associated with MPAs. Using the MPA Guide framework, we computed two scenarios of impacts per activity and of protection levels per MPA.
Data source location	Data were collected for marine protected areas located in the national waters of the 23 coastal Member States of the European Union, excluding areas of the extended continental shelf.
Data accessibility	Repository name: EU MPAs: features, regulations and protection levels Data identification number: (or DOI or persistent identifier): 10.6084/m9.figshare.26086087 Direct URL to data: https://figshare.com/s/2f9c8a93b777c5dacfcd Instructions for accessing these data: None needed (unpublished yet until acceptance)
Related research article	Eighty percent of EU's marine protection coverage marginally regulates human activities. Aminian-Biquet et al. 2024 [1]. Regulations in EU MPAs are data poor and reflect a lack of ambition to address impactful human activities. Aminian-Biquet et al. in review.

1. Value of the Data

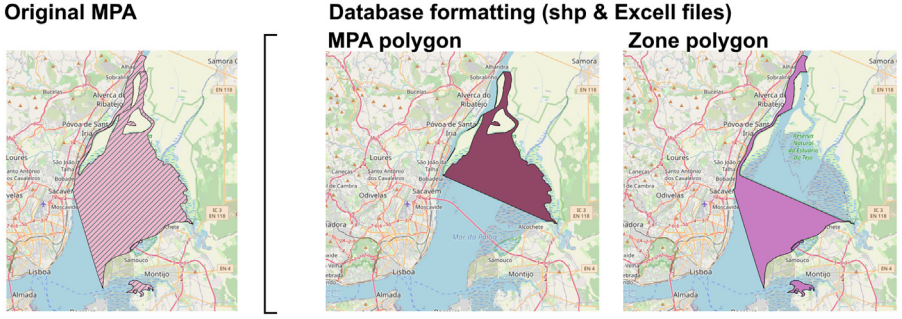
- These data are useful to understand how EU MPAs have been used to protect ecosystems through regulating activities.
- This dataset highlights the important gaps in data on regulations in MPAs, it compiles and completes the limited existing datasets on the topic.
- This dataset can be used as a baseline to monitor and support the European Union and Member States in their implementation of the spatial protection targets of the 2030 Biodiversity Strategy and of the Global Biodiversity Framework.
- These data can be compared and completed with additional datasets focusing on measuring the occurrence of human activities and their scale of impacts in MPAs.
- This dataset could be used in additional analyses that could investigate the interactions between MPA and Marine Spatial Planning policies, to further explore the use of MPAs across regions or MPA features.

2. Background

The effectiveness of MPAs in the EU to protect ecosystems have been highly criticized, as the few assessments found only limited conservation measures and regulations to reduce the impacts of human activities [1–5]. Yet the evaluation of protection levels of EU MPAs was missing. In the EU and worldwide, the lack of data on activities occurrences, their impacts and the legal framework to regulate activities in MPAs have been one of the main barriers to assess EU MPAs ecological and social consequences [6]. This dataset on the regulations and the methodology to compute scenarios of impacts and protection levels are a first step to address this gap. It shows how the MPA Guide protection level classification framework [7] can be used at large scale and in a data-deficient context. It allows for transparency to our published work (see Aminian-Biquet et al. 2024 [1]) and opportunities for others to run additional analyses, for example to compare our EU-wide analysis based on the MPA legal framework with assessments done by local experts and with analyses of what activities are actually occuring and their impacts on ecosystems.

3. Data Description

We only provide the summarized data, the raw data sources used are described in the material and methods section further below. In this dataset, fully overlapping MPAs have been



Shape file:

id	Country	idMPA
73PT	PT	73PT
73PTzone1	PT	73PT

Excell file:

id	Country	idMPA	Name	AREA_KMs_MPA	AREA_KMs_pg
73PT	PT	73PT	ESTUARIO DO TEJO	163.5	82.5
73PTzone1	PT	73PT	ESTUARIO DO TEJO	163.5	81.0

Fig. 1. Format of the database in a shape file and an Excel file, MPAs are formatted as one polygon (shape file) and one row (Excel file), except if zones were identified (231 MPAs).

merged and identified zones were added. We therefore provide an MPA id that is specific to this dataset. We provide a spatial file (a shape file, .shp) only containing the polygons with the MPA id (id from this dataset), and a table (an Excel file, .xlsx) file with all information for each MPA and zone (Fig. 1).

We describe all fields from the dataset (field names in parentheses) below.

3.1. Spatial File (Shape file)

3.1.1. MPA Data

If a zoning system was identified (see Material and methods section), polygons of the MPA and its zone(s) are provided separately (Fig. 1). Note that the polygons of zones were removed from the MPA polygon (to avoid overlapping in coverage calculation). The shape file is set in the WGS84 projection system (EPSG:4326).

- Database identifiers (see the Excel file for identifiers from other databases): unique identifier from the dataset per MPA ("idMPA"), containing the MPA country in the ISO format (code 3166-1 alpha-2) and an additional field differentiates zones if there were any ("idMPAzone", Fig. 1).
- Zoning (“zonesource”): if a zoning system was found for the MPA, the data source is indicated in this field (for the different datasets, “PS” for ProtectedSeas, OSPAR assessment, Portuguese assessment, or MAPAMED; see Material and methods section).
- Country (“country”): country full name.

3.2. Table File (Excel File)

For all fields, if multiple MPA designations have been merged and had different features (e.g., different years of designation, different names, different designations), they are all indicated in

the same field separated by a comma (i.e., all years are given in the year field). If they had the same feature, only one was kept.

3.2.1. MPA Data

- Name ("name"): MPA names from the EEA were capitalized and special characters were removed (homogenizing alphabets, using the "Latin-ASCII" alphabet in R).
- Database identifiers: unique identifier from the dataset per MPA ("idMPA"), containing the MPA country in the ISO format (code 3166-1 alpha-2) and an additional field differentiates zones if there were any ("idMPAzone").
- Whether multiple fully-overlapping MPAs have been merged ("MPAmerged") and how many ("nbMPAmerged")
- Identifiers from other databases: There could be multiple identifiers (separated by a comma), if there were multiple ones corresponding to the MPA (or if fully-overlapping MPAs if they have been merged).
  - WDPA ("wdpa_id"),
  - Natura 2000 ("natura_id"),
  - ProtectedSeas ("ps_id"),
  - EEA database for national designations ("cdda_id"),
  - regional conventions ("helcomraw_id" and "ospar_id"),
  - MAPAMED database ("mapamed_id").
- Zoning ("zonesource"): if a zoning system was found for the MPA, the data source is indicated in this field (PS, OSPAR assessment, Portuguese assessment, or MAPAMED).
- Size in km^2: of the MPA (the whole MPA, merging the area of the different zones if there are any; "AREA_KMs_MPA") and of the polygons if the MPA was subdivided into zones ("AREA_KMs_pg").
- Location:
  - Country full name ("country"),
  - MSFD regions ("mainregion") and subregions ("subregions"),
  - Jurisdiction ("juridisction") indicates if the MPA is located in nearshore waters ("neashore-waters", see Fig. 3), territorial waters ("TW", up to 12 nautical miles), Economic Exclusive Zone ("EEZoutsideTW", from 12 to 200 nautical miles). Multiple jurisdictions are indicated separated by a comma.
- MPA features:
  - The year of designation as reported by the EEA ("legalFound").
  - Designations include main designation types (Natura 2000, National or Regional convention; "DESIG_TYPE"), the detailed designation reported in the WDPA ("DESIG_ENG"), and our simplified classification of the WDPA designations ("DESIG_subtype").
  - MPA goals include the IUCN category as reported in the WDPA ("IUCN"), and the protection focus reported by PS ("protection_focus")

3.2.2. Activity Data

Scenarios are indicated with their corresponding numbers (scenario 1 for lowest range of impacts, scenario 2 for highest range of impacts).

Computed data from all data sources

- Data sources ("datasource"): all sources that had data available (MSP+, PS, OSPAR, PT datasets; if multiple were available they are indicated and separated by a comma).
- Impacts under the two scenarios are provided for each of the seven activities of the MPA Guide ("anchoring_impact1", "aquaculture_impact1", "dredginganddumping_impact1", "infrastructure_impact1", "mining_impact1", "nonextractive_impact1", "fishing_impact1"; and equivalent for the second scenario but with a suffix "_impact2"). They gather data from the different datasets detailed below (following the protocol detailed in methods) were used to compute protection levels, and were not computed for land-based uses and transport, that are not considered in the MPA Guide.

For each of the four datasets (MSP+, PS, and the two expert-based assessments), data is formatted per use (i.e., detailed sea use, sand extraction for example; each use is formatted as a field) that are summarized into the nine categories of activities considered (in this example, mining). Each use and category of activities are indicated as allowed/restricted/prohibited (or more, if more details were accessible), for uses if they made up less than the mandatory threshold to be included (see experimental design), their regulation is followed by "lessthan10p" (allowance or restriction) or "lessthan90p" (prohibition).

MSP±

- Each use from the MSP+ dataset is formatted as a field with the suffix "_MSP". They are summarized into the nine categories of activities considered (fields with the suffix "_summaryMSP").

PS

- Each use of the PS dataset is formatted as a field with the suffix "_PS". They are summarized into the nine categories of activities considered (fields with the suffix "_summaryPS"). "LFP" refers to the "level of fishing protection" index.
- Details on the original legal texts (e.g., the regulation it was extracted from) are provided in the field "dataprovider_PS".

Portuguese expert-based assessment

- Each use of the PT dataset is formatted as a field with the suffix "_PT". They are summarized into the nine categories of activities considered (fields with the suffix "_summaryPT"). Details for each category is provided in fields with the suffix "_detailedPT".

OSPAR expert-based assessment

- Each use of the OSPAR dataset is formatted as a field with the suffix "_OSPAR". They are summarized into the nine categories of activities considered (fields with the suffix "summaryOSPAR")
- Details on data provider are provided in the field "dataprovider_OSPAR".

Zones

- If the activity information was extrapolated at MPA level from the MPA zones (see section 5,b), it can be found in the fields with the suffix "_summaryzones" (the detailed information can be looked for in the zones' rows).

3.2.3. Protection Levels

Scenarios of impacts and corresponding protection levels are indicated with their corresponding numbers (scenario 1 for lowest range of impacts, scenario 2 for highest range of impacts).

- Protection levels were computed for each of the seven activities of the MPA Guide ("anchoring_PL1", "aquaculture_PL1","infrastructure_PL1", fishing_PL1","mining_PL1", "dredginganddumping_PL1","nonextractive_PL1"; and equivalent fields for the second scenario), illustrating what activities drive the overall protection levels (PLallactivities1 and 2).
- Overall protection levels were computed as the lowest protection levels from all protection levels computed by activity and for each scenario ("PLallactivities1" for scenario 1, "PLallactivities2" for scenario 2).

4. Experimental Design, Materials and Methods

The first section presents the marine delimitations used (MSFD, jurisdictions, regions). We used the European Environment Agency (EEA) MPA list that we formatted and completed with

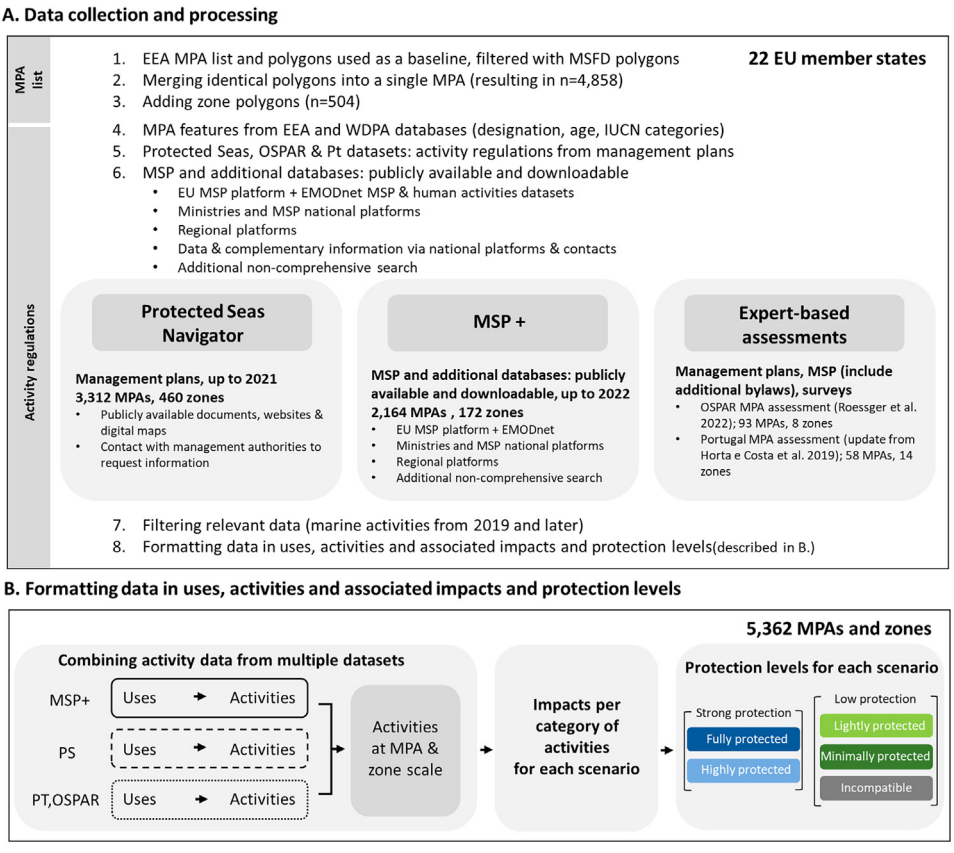


Fig. 2. A. Data collection, datasets summary, and cleaning (see Fig. 6 for the activities reported in each dataset). B. Protocol from to compute protection levels, starting from uses, to activities, to impacts, to protection levels (for more details, see Figs. 5 and 6). Extracted from Aminian-Biquet et al. 2024 [1].

zoning systems described in other databases (Section 2). Data was gathered about activities information and regulations in two main datasets are presented in sections 3 (MSP+) and 4 (PS and expert-based assessments). These datasets gathered detailed maritime uses that we categorized into nine categories of activities (e.g., transport, aquaculture). We determined which of the nine categories of activities were regulated (allowed, prohibited, or restricted) in each MPA by intersecting MPA (and zone) polygons with data from the activity-focused and MPA-focused datasets (as described in Section 5). We then computed two scenarios of theoretical impacts per activity and protection levels (Section 6). The protocol is summarized in Fig. 2. Finally, we describe primary sources of data gathered in the activity-based dataset (Section 7).

All spatial operations (e.g., merging, intersections, calculations) were performed using R and QGIS, notably using sf and ggplot2 packages [8–10].

4.1. Marine Delimitations

To delimitate the EU marine areas, we used the polygons from the EU Marine Strategy Framework Directive (MSFD) reported by Member States and shared by the EEA (https://www.eea.europa.eu/data-and-maps/data/marine-waters-used-in-marine). All geospatial files used and

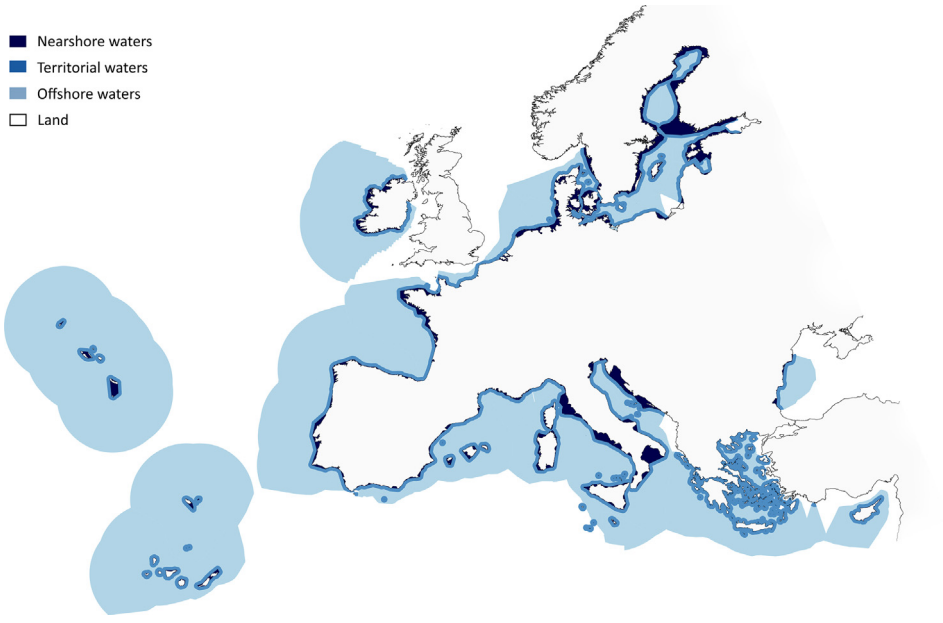


Fig. 3. Delimitations of jurisdictions and national waters of EU Member States (see primary sources in the main text).

presented below have been filtered to include only the areas that overlap with MSFD polygons, which are assumed to represent their marine parts. The same MSFD polygons were used to associate MPAs with sea regions. For calculations at basin scale, we removed the EEZ of non-EU countries from the MSFD polygons (using the EEZ-land union from 2020; https://www.marineregions.org/downloads.php).

Land borders, EEZs (2019, 12-200 nautical miles), territorial waters (2019, up to 12 nautical miles) and nearshore waters (internal waters in the marineregions.org database from 2019, up to 1 nautical miles but the delimitation vary, Fig. 3) have been downloaded from the Marine regions website (https://www.marineregions.org/downloads.php) and filtered using the MSFD polygons. We excluded disputed zones (between Spain and Morocco) from EEZs. The polygons of nearshore waters (reported by marineregions.org) were also completed with internal waters reported in the MSFD.

National waters were considered as the EEZ reported in marineregions.org, excluding areas not reported in the MSFD and adding areas (internal waters) reported in the MSFD and missing from the EEZ.

4.2. MPA List

4.2.1. MPA Polygons

MPA names of all files were corrected to homogenize formatting (capitalized letters and alphabets, using "Latin-ASCII") across databases.

We used the MPA list published by the EEA in February 2023 (https://sdi.eea.europa.eu/catalogue/srv/eng/catalog.search#/metadata/5a8c5848-e131-4196-a14d-85197f284033, last accessed in April 2023), hereafter referred to as EEA MPAs. Their protocol to select marine MPAs can be found in the EEA spatial analyses reports on EU MPAs [11,12]. This list is made of MPAs designated in national waters under national legislations, the Natura 2000 framework (EU Habitats and Birds Directives, so called SPA, SAC and SCIs), and of regional conventions, i.e., OSPAR in the North-East Atlantic Ocean, HELCOM in the Baltic and Barcelona (SPAMI) regional conventions (keeping MPAs from EU Member States only).

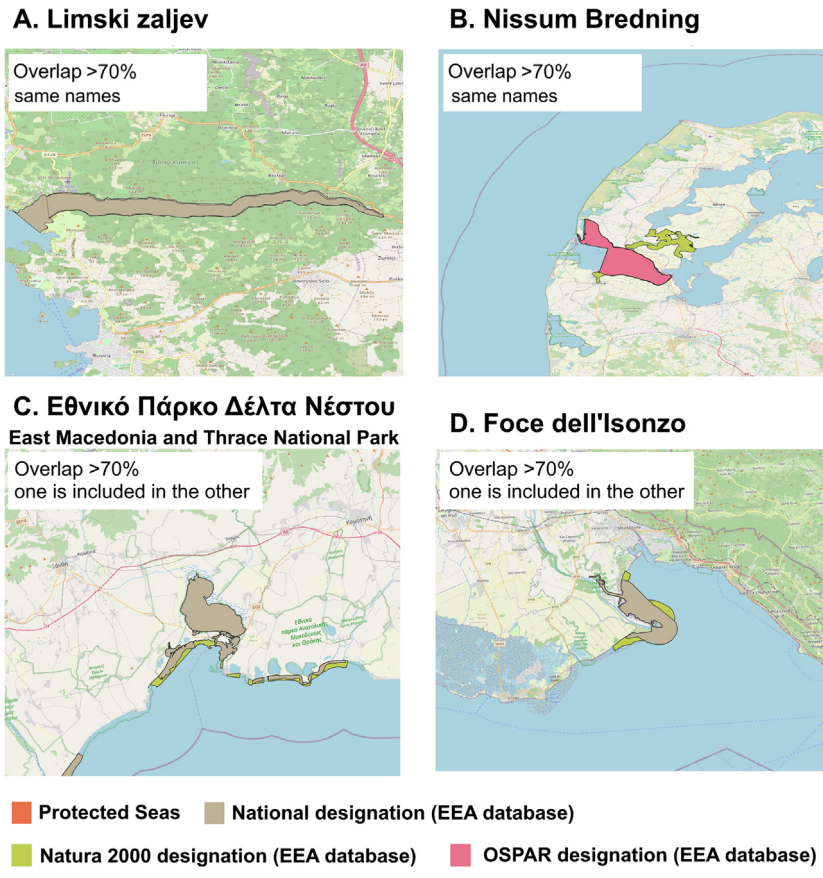


Fig. 4. Examples of MPAs among the 3% of MPAs merged while sharing less than 90% of their respective area, from Croatia, Denmark, Greece and Italy. Polygons are displayed on QGIS with the OSM map.

We added MPAs identified in the Portuguese expert-based assessment that were missing from the EEA MPAs (3 locally-designated MPAs apparently not reported to the EEA; updated from Horta e Costa et al. 2019 and presented in section 4). There might be additional only locally-recognized MPAs missing from our dataset. Some MPAs (Natura 2000) might be already declared to the EEA and not yet implemented in national law. Some non-truly marine MPAs may have been considered in the list, if they are overlapping with the MSFD polygons. It resulted in 6,414 EU MPAs.

4.2.2. Merging Fully-Overlapping MPAs

We merged EEA MPAs, considering them to be multiple designations of the same area, if they shared:

- at least 90% of their respective area (this criteria was sufficient for 96.9% of merged MPA pairs);
- if they shared both less than 90% but at least 70% and the same name (or if the name of one of the site is included in that of the other overlapping site; 2.3% of merged MPA pairs, see Fig. 4 for examples)
- if they shared at least 70% and one is included in the other, i.e. has at least 90% of its area overlapping with the other MPA (0.8% of merged MPA pairs, see Fig. 4 for examples)

Table 1
MPA-related databases used and data extracted. All polygons were filtered with the MSFD polygons for marine delimitation.

Database	URL	Data extracted
World Database of Protected Areas (WDPA), 2022. Filtered for MPAs reported as at least partially marine in the WDPA database.	https://www.protectedplanet.net/en	WDPA ID, IUCN category, designation subtypes
ProtectedSeas (PS), 2021	https://protectedseas.net/mpa-download-data	MPA zones, regulations, main protection focus
MEDPAN, 2019	https://www.mapamed.org/	MPA zones, MAPAMED_ID (extracted based on WDPA IDs and Natura 2000 IDs)
OSPAR assessment (OSPAR), 2021	Data not published 10.1016/j.marpol.2022.105109	MPA zones, regulations
Portuguese assessment (PT), 2022	Data not published; updated from 10.1016/j.marpol.2019.103553	MPA zones, regulations
EEA	https://sdi.eea.europa.eu/catalogue/srv/eng/catalog.search#/metadata/5a8c5848-e131-4196-a14d-85197f284033	MPA list and polygons, year of designation, designation types

These percentages used as thresholds are given for pairs of MPAs, then two or more MPAs could have been considered as the same one.

We computed the percentages of overlap between MPA polygons by running intersections (e.g., extracting the overlapping area between two MPA polygons, using the sf package in R). We designed this protocol based on a sample of three countries (1,227 MPAs in France, Croatia, Poland). This range of spatial criteria enabled us to match nationally-designated and Natura 2000 MPAs that had identical names but slightly different polygons (Fig. 4; they could be managed through the same management plan and body). As a result, we identified 4,858 EU MPAs out of the 6,414 MPAs listed as designated by the EEA.

4.2.3. WDPA and MAPAMED Identifiers Association

The WDPA identifier was needed to retrieve MPA IUCN categories from WDPA, and to associate EEA MPAs with MPAs from ProtectedSeas and expert-based assessments. Only OSPAR MPAs were reported with an identification number from the World Database of Protected Areas (WDPA) in the EEA MPA database. Moreover, the names of MPAs can be formatted differently across databases. We therefore associated EEA MPAs with WDPA MPAs based on spatial overlap, to retrieve their WDPA identification number.

We extracted WDPA data and polygons from the protected planet database (https://www.protectedplanet.net/en, the May 2022 version, Table 1). We considered that an EEA MPA and a WDPA MPA were the same MPA (and so the WDPA ID could be associated with the EEA MPA) if 1) they had the same name (97.1% of EEA-WDPA associations), 2) if there was no match based on their names, but they shared more than 80% of their area (proceeding gradually, first if they shared more than 95% of their area, then 90%, then 85% then 80%; this protocol is later referred to as the 80% gradual threshold; using the sf package in R). This approach prevented for any EEA MPA that had a WDPA MPA matching 95% of its area to be associated with another one matching only 80%. We computed the percentages of overlap between WDPA and MPA polygons by running intersections (using the sf package in R). We designed this protocol based on the same sample of three countries used to try out the merging protocol (1,227 MPAs in France, Croatia, Poland) and noticed that several MPAs were the same but the polygons had been formatted differently in the EEA and the WDPA databases; the 80% gradual threshold worked to match EEA and WDPA MPAs. Overall, it resulted in 86.6% of the 4,858 MPAs with a WDPA match. The remaining 13% of EEA MPAs that could not be associated with a WDPA identifier were mostly Natura 2000 MPAs (98.5%) in Italy (23%) and Sweden (14%).

MAPAMED identifiers from the MEDPAN database (https://www.mapamed.org/, 2019) were associated with EEA MPAs based on Natura 2000 identifiers and on WDPA identifiers for other types of designations.

4.2.4. MPA Zoning Systems

Polygons of potential MPA zones were extracted from the Portuguese and OSPAR MPAs expert-based assessments [13,14] (2021 and 2022, see their description in section 4), the MEDPAN database (https://www.mapamed.org/, 2019) and the ProtectedSeas Navigator (2021, https://protectedseas.net/mpa-download-data, last visited in May 2022, Table 1). We considered zoning systems in MPAs as polygons completely included in MPAs that did not correspond to an MPA from the EEA database (>95% of their surface overlapping with an MPA but not already associated with an EEA site, i.e. not matching WDPA ID and covering less than 90% of the EEA site area it overlaps with). This resulted in 504 zones, originating either from MPA legal zoning or another spatial management tool found inside the MPA (e.g., fishery restriction zone, independent of MPA legislation).

4.2.5. MPA Features

Table 1 presents the source of MPA zones and MPA features. When MPAs were merged, the oldest designation year was kept for the MPA. MPA features include: the year of designation (from EEA), designation types and subtypes, IUCN categories (WDPA), and the main protection focus (PS).

4.3. Activity-Focused Datasets (MSP+)

The MSP+ dataset contains data from various databases focused on activities (not MPAs), including data from national Marine Spatial Plans (MSP). Note that we do not provide these polygons, but only MPA data, so that some of the coverage calculated in articles associated with this work cannot be computed from this dataset (i.e., the overlap of activities with MPAs).

4.3.1. Data Searching

We searched for downloadable polygons, points and lines in Shapefile or WFS formats. For all 23 countries, data was first gathered from the EMODnet platform (https://www.emodnet-humanactivities.eu/; see primary sources of data in Section 7). We searched through the EU MSP platform (https://maritime-spatial-planning.ec.europa.eu/, last checked in March 2023; see Section 7), to find out if the MSP had been published for each country and if this platform reported a national geoportal or website gathering MSP data.

If no national geoportal was found using the EU MSP platform, data was searched through national webpages (environment, maritime affairs agencies and ministries, national or regional MSP platforms). If no data was found, we requested it through the contact email addresses or forms of the ministries (responsible for seas or environmental issues). Using a snowball sampling technique, we searched for national focal points that could know of additional data [15,16]. Finally, if data was still missing for a given country, we searched for specific information both on specific webpages (tool4MSP, Europa https://data.europa.eu/, see Section 7), or using a search browser with specific keywords (e.g. “Country + mining” and format “shape file”). Information from MSP pdfs or non-downloadable/editable files (e.g., WMS layers) has not been retained or formatted. The resulting data was made of polygons, lines, and points, gathered in the “MSP+” dataset. Section 7 lists all data sources from this dataset.

4.3.2. Data Cleaning and Formatting

MSP+ data was formatted as detailed uses that were filtered (for maritime activities), standardized and gathered into nine categories of activities (see Section 5). Only uses known or

planned to occur within MPAs at the latest in 2019 were kept. We made an exception for harbors and ports, keeping data reporting these infrastructures at the latest in 2016, as infrastructures likely little evolved in this period of time. Some activities might have been mapped earlier than 2019, but the validity date spanned at least until 2019 or later (of the MSP, the dataset, or the license of a specific activity). We removed non-active uses (e.g., sewage plants, license for dumping or mineral extraction). We did not include data about occurring fishing activities (i.e., VMS, AIS data about fishing intensity, density) as this work focused on MPA legal frameworks.

We filtered uses and categories of activities according to the area they covered in each MPA, to avoid considering any use to be completely prohibited or allowed at MPA scale when only part of the MPA was concerned by the regulation. Hence, only uses mapped as allowed or restricted in polygons overlapping at least 10% of any MPA polygon were considered as such in the MPA. We used a threshold of 90% of the MPA polygon for any use to be considered as prohibited. If a use was found to be allowed/restricted/prohibited below the mandatory threshold, the regulation was marked with by "lessthan10p" or "lessthan90p" in the dataset, and the use was excluded from computing impacts and protection levels. We ran the same threshold at the scale of categories of activities, because two uses could individually cover less than 10% of the area of an MPA, but considered together as one category of activities, they were covering at least 10%. Such filters based on area overlapping could only be applied to polygons, not to data formatted as lines or points. Therefore, we manually checked, and no lines or points indicating prohibitions resulted in any activity being considered as prohibited in an MPA.

MSP texts (shared on the EU MSP platform or national webpages mentioned earlier) were used to clarify what was allowed in each data polygon/point/line only if the information or the period of validity was not clear. For example, there was no clarification needed for a polygon of "Sand extraction". If important doubts remained, we asked for precision to the contacts indicated on the MSP webpages (focal points are listed in the acknowledgment section). When needed, the data was translated using Google translate and DeepL (e.g., for Croatian data). Importantly, if MSPs have been published after this protocol was conducted, they were not added to the datasets afterwards (e.g., Cyprus published their MSP in December 2023).

4.4. MPA-Focused Datasets (PS and Expert-Based Assessments PT and OSPAR)

4.4.1. Expert-Based Assessments

We used two document- and expert-based assessments. The OSPAR MPA assessment ("OSPAR" dataset) was based on management plans, complementary legal texts (e.g., fishery restrictions independent of MPA regulations) and surveys conducted by Roessger et al. (2022) between 2020 and 2021. The dataset was previously formatted based on the Regulation-based classification system [17], that we matched with corresponding categories of activities.

The Portuguese MPA assessment ("PT" dataset) was based on management plans and MSP investigations conducted up to 2022 (based on Horta e Costa et al. 2019). The dataset was already formatted based on the MPA Guide classification framework [7].

We could associate MPAs and zones from our list with corresponding MPAs in the OSPAR and PT datasets based on identifiers (WDPA and Natura 2000).

4.4.2. ProtectedSeas Database

Activities description

We used data reported in the Navigator database by ProtectedSeas in MPAs and other marine managed areas (see https://navigatormap.org/data-attributes, "PS" dataset [18]). The data are made available by the ProtectedSeas team upon request. Regulations were collected from statutes, implementing regulations, decrees, and management plans (i.e., conservation measures data included in the Natura 2000 database should be included in PS), with a primary focus on human marine activity and fishing restrictions (see Tables 2 and 3). The dataset included some generally applicable national laws (fisheries restrictions at the scale of the EEZ or coastal waters, etc., see next paragraph).

Table 2
Level of Fishing Protection scores described in the ProtectedSeas webpage (extracted in 2021).

Level of Fishing Protection Score	Level of Restriction on Removal of Marine Life	Description
1	Least restrictive	No known restriction on marine life removal beyond national or subnational generally applicable restrictions
2	Less restrictive	At least one species- or gear-specific restriction applies (beyond permit requirements or generally applicable restrictions)
3	Moderately restrictive	Several species- or gear-specific restrictions apply, or: • Commercial marine life removal is prohibited • Both commercial and recreational marine life removal are heavily restricted • Recreational marine life removal is prohibited, and commercial marine life removal is restricted
4	Heavily restrictive	Marine life removal is mostly prohibited, with few exceptions, e.g., very limited or relatively non-intrusive recreational/sport or subsistence fishing
5	Most restrictive	Marine life removal is prohibited (or entry is prohibited)

Uses were coded as unknown, allowed, prohibited or restricted. Uses were coded as restricted if the PS team found a regulation restricting in some way the use and if it was not explicitly prohibited. For fisheries, PS coded a Level of Fishing Protection score (LFP, with 5 levels for least restrictive to most restrictive; see Sletten et al. 2021 and Table 2).

PS also included polygons derived from national fishing and environmental laws, including a specific LFP score (e.g. gear restriction in the 3 nautical miles of a country). Any MPAs that were fully included in one of these polygons and showing a less restrictive LFP were corrected to match the stricter LFP. This included the German part of the Baltic coast (where PS found that trawlers and Danish seines were prohibited, with some exempted zones), the Polish part of the coast (which includes zones closed to fishing), and the Latvian part of the EEZ with depth shallower than 20m (where restrictions include a trawl ban).

In the PS database, one polygon is provided for multiple MPA designations that have the same boundaries (i.e., fully-overlapping MPAs). The dataset therefore does not make it possible to determine which designation the current regulations were derived from.

4.5. Matching with EEA MPAs

We could associate MPAs and zones from our list (based on EEA) with corresponding MPAs in the PS dataset based on the area they had in common. We computed the percentages of overlap between PS and MPA polygons by running intersections (using the sf package in R). We considered EEA and PS polygons were the same MPA if they shared more than 90% of their area. For pairs of polygons that could not be matched based on the 90% criteria, we used a 80% threshold. We used such a range of spatial criteria after we looked at these two steps for three countries (1,227 MPAs in France, Croatia and Poland) and noticed that several MPAs were the same but the polygons had been formatted differently (examples in Fig. 5). For EEA MPAs that could not be matched with a PS MPA based on these criteria, we used the WDPA identifier (though some PS MPAs did not have any and some EEA MPAs could not be associated with one).

Almost all EEA MPAs (95.4%) that could be associated with PS MPAs shared more than 95% of their area. Following this protocol, 66.1% of the 4,965 PS polygons (from EU countries and filtered to remove polygons corresponding to the EEZ, territorial waters) were associated with

Table 3
List of uses in each category and data sources.

Category of activity	Uses	Datasets with data
Mining, mineral oil and or gas prospecting or exploitation	Drilling; exploration and/or exploration sand and/or gravel; exploration and/or exploration mineral extraction (could be raw material, hydrocarbon, or specified oil, gas); Gas and mining; gas extraction; gas production; Industrial or mineral exploration; shell extraction	PS, MSP+, OSPAR, PT
Dredging and dumping	Discharge; Dredge dumping; dredging; dumping; military area shooting or explosive; munition dumping	PS, MSP+, OSPAR, PT
Anchoring	Anchoring	PS, MSP+, OSPAR, PT
Infrastructure	Artificial reefs; bunkering fuel waiting areas for ship; cable and pipeline; communication infrastructure; dikes and breakwaters; economic activities; energy infrastructure; gas or oil pipeline; general use zone in Denmark; geothermal extraction; industry; Infrastructure; marina; mooring; navigation signs; offshore wind farms; pipeline; pipeline chemical; pipeline cooling water; Pipelines; port; recreation infrastructures; renewable energy and wind farms; wreck	MSP+, OSPAR, PT
Aquaculture	Aquaculture unspecified; Algae; Fish; Molluscs aquaculture	MSP+, OSPAR, PT
Fisheries	Level of Fishing Protection from ProtectedSeas; OSPAR and Portugal assessments classification of gears; gear-specific regulation or fishing zone (no gear detailed) from MSP+	PS, MSP+ (not used for protection levels, as very little was provided and comprehensive enough), OSPAR, PT
Non-extractive	access; boating; culture; Diving; Entry; Non extractive and recreation; Stopping; swimming	PS, MSP+, OSPAR, PT
Navigation and shipping (transport) -not used in protection levels	harbor route; navigation; shipping; traffic zone; transport	MSP+
Land-based activities -not used in protection levels	desalination plants; discharge; discharge and sewage waste water; discharge non-hazardous waste; wastewater treatment plant; water extraction; water supply system	MSP+

70.0% of EEA MPAs (knowing that when regulations were not found by the ProtectedSeas team, polygons of MPAs were not included in the PS dataset, so the MPAs list of PS is incomplete).

4.6. Summarizing Data Per Activity

4.6.1. Within Each Dataset

Once data from the multiple datasets were associated with the EEA list of MPAs (from EEA) and zones (from multiple datasets), we summarized uses into categories of activities for each dataset and MPA, though note that the Portuguese assessment was already summarized into protection levels per category of activities, which we used. For MSP+, PS and OSPAR, we gathered detailed uses in nine categories of activities (Fig. 6A; Table 3), including aquaculture, fisheries, anchoring, infrastructures, mining, transport, coastal land-based uses (only including de-

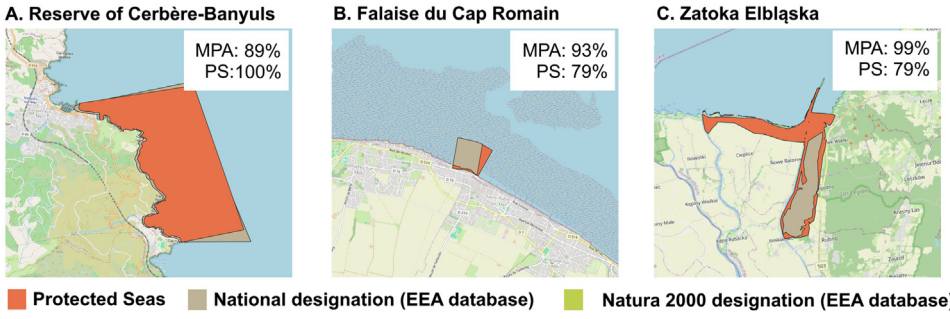


Fig. 5. Examples of polygons from PS and the EEA MPA databases to illustrate how different polygons of the same MPA can be, and justify the threshold choices of 90% and 80% (from France and Croatia) in panels A and B. The panel C illustrates an MPA in Poland, where the PS MPA polygon covered less than 80% but had the same WDPA identifier. Polygons are displayed on QGIS with the OSM map.

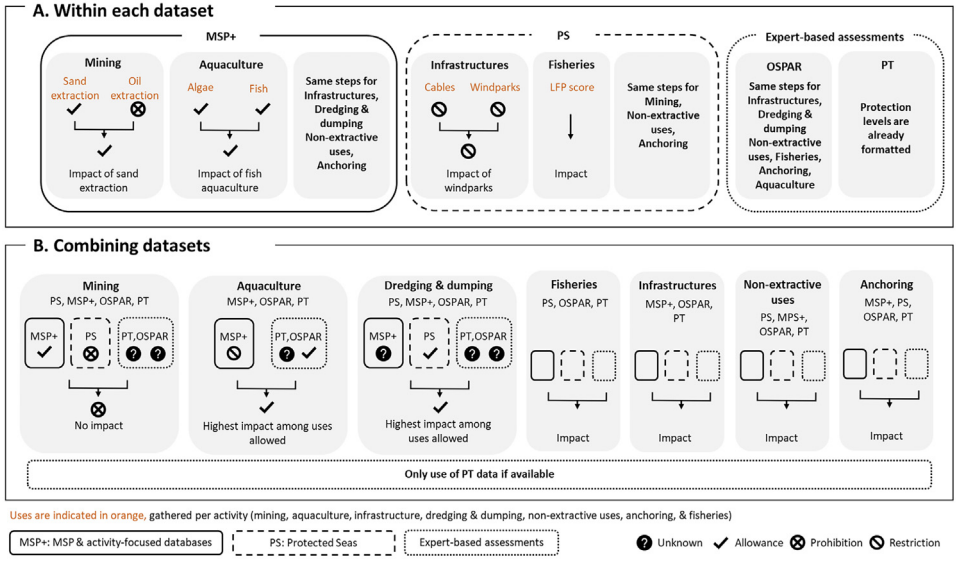


Fig. 6. A. Protocol for categorizing uses by activity. B. Protocol to combine data for each activity from the four datasets. We computed two scenarios of potential impacts. Extracted from Aminian-Biquet et al. 2024 in review.

salinization and sewage plants) and other non-extractive uses. Within each dataset, all categories of activities were then summarized as being allowed, restricted, prohibited or unknown. If one of the uses was allowed, the category of activity it belonged to was considered as allowed (Fig. 6).

4.6.2. Across Datasets

For each activity, we then merged data from all datasets (Fig. 6B): if one of the sources indicated a prohibition, the activity was considered as prohibited, regardless of whether another source indicated it as allowed or restricted. This approach could potentially result in an overestimation of prohibitions. When available, the PT assessment information was prioritized over other sources, as the most recent assessment.

For each activity, when there was no information at MPA level but there was information from one of its zones (if any), the zone data was used for the whole MPA, if the zone covered sufficiently of the MPA area (>10% for allowances and restrictions, and >90% for prohibitions).

4.7. Impacts of Activities and Protection Levels

4.7.1. Impacts

We computed theoretical impacts for each use, needed to compute protection levels and based on the MPA Guide classification framework [7]. Only seven categories of activities were considered (land-based activities and transport are not explicitly used in the MPA Guide framework and often not regulated by MPA authorities). The scale and potential impacts of human activities were not available at EU scale, so we considered two possible scenarios of impacts for each use, based on the type of uses, their scale, how the use is regulated. Scenario 1 considered uses' potential lowest impacts and scenario 2 the highest (Table S1). If mining, dredging/dumping or infrastructures were reported as restricted within an MPA (if no other dataset indicated an allowance), we considered them as allowed under scenario 2 and as prohibited in scenario 1 (assuming their allowance was dependent on approval). Potential impacts for each use are given in Table S1 and were computed from the MPA Guide guidance for protection levels [7].

For each scenario and category of activities found to be allowed, the most impactful type of use known as allowed within this activity was used to compute the impact of the category it belongs to (e.g. for aquaculture, the potential impact would that of fish aquaculture and not of algae aquaculture if both are allowed; Fig. 6). Because data about fishing was not detailed enough from the MSP+ dataset, we only used the data from PS and expert-based assessments to compute impacts of fishing activities.

4.7.2. Protection Levels

Protection levels were based on the MPA guide classification and guidance [7]. MPAs were classified into four protection levels, i.e., fully protected (no extractive activities), highly (low impact activities), lightly (moderate impact activities) or minimally protected (moderate to high impact activities), or were classified as incompatible with biodiversity conservation when very impactful or industrial activities can occur within the MPA.

Protection levels were computed for the two scenarios (Figs. 7, S1) based on the most impactful activity allowed in an MPA (Figs. 2 and 6). Unknown activities were assumed not to downgrade the protection level, as if they had been prohibited. Protection levels were computed for MPAs where 1) fishing (any level of impacts) was known, or 2) dredging/dumping was known as allowed, or 3) mining was known as allowed, independently from the level of information about the other activities (see Aminian-Biquet in review). We considered these three criteria because 1) fisheries are of high concern in MPAs and many have been designated for fisheries regulations/benefits [19], and 2) dredging/dumping or 3) mining are considered incompatible with the conservation of nature in the MPA Guide (whatever the regulations over other activities). MPAs with no information on fishing, mining, or dredging activities were not classified. Finally, and contrary to the MPA Guide guidance, we considered that the allowance of anchoring or other no extractive uses could be compatible with full protection (the highest protection level) under scenario 1 (not under scenario 2; see Table S1), because they were poorly detailed in datasets and their level of impacts could highly vary.

To provide a quality check of the computed protection levels, Fig. 8 shows the difference between protection levels resulting from the two scenarios. When using a two-level classification system (where strong protection includes full and high protection levels, and low protection includes incompatible with conservation, minimal, and light protection levels), the two scenarios classified most MPAs and MPA coverage identically.

Finally, Fig. 9 illustrates the comparison of our dataset with former assessments. We compared protection levels computed using PS and MSP+ only (not provided in the database, but these are the datasets used for MPAs other than Portuguese or OSPAR ones) to the two expert-based assessments (OSPAR and PT [13,14]). We also compared the protection levels (using all datasets) to the assessments on Mediterranean MPAs from Claudet et al. 2020 and French MPAs from Claudet et al. 2021 [3–20]. This comparison reveals that while most MPAs and MPA coverage align closely with previous assessments, there is a noticeable area where what was expected

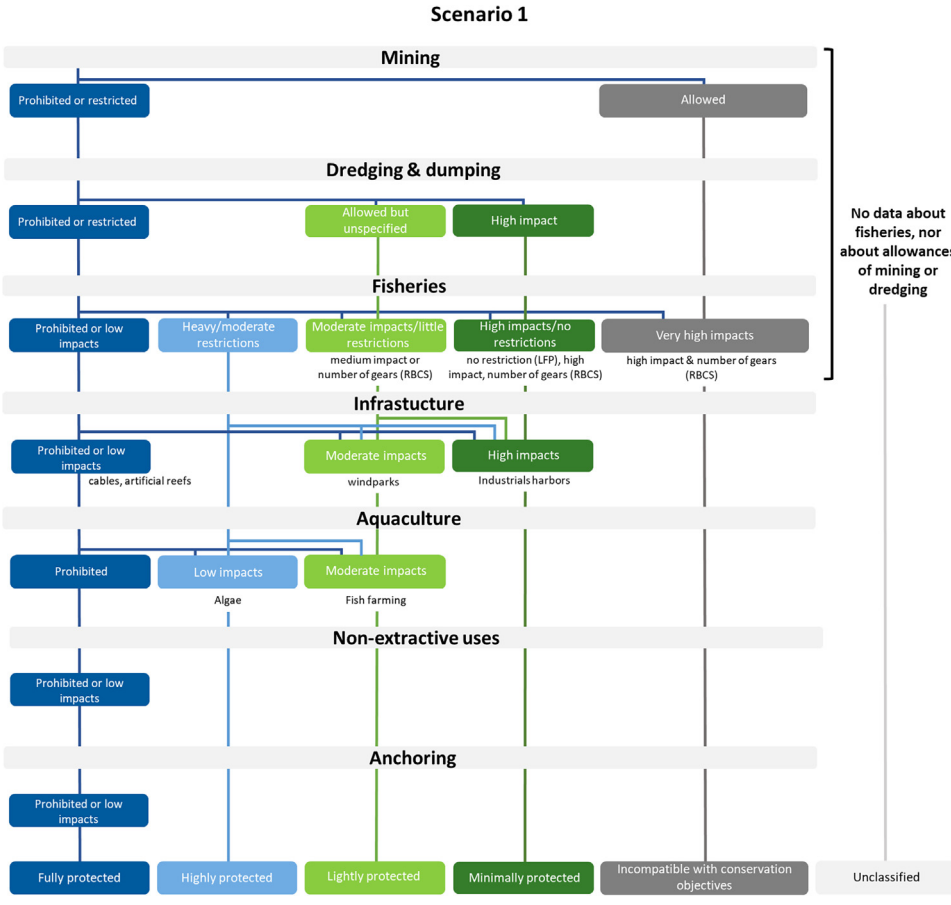


Fig. 7. Decision tree to classify protection levels in scenario 1, based on the highest potential impact for each of the activity (adapted from Grorud-Colvert et al. 2021b, extracted from Aminian-Biquet et al. 2024). Unknown activities did not downgrade the protection level, as if they had been prohibited.

to be highly or fully protected is likely misclassified, and vice versa (e.g., Fig. 9A and B). This discrepancy should be considered when using this dataset.

4.8. Link to Sources

We listed below all relevant sources we could find. We do not list other databases found, with older or non-relevant data. The data use is referred in "Link to data" sections. Some of this data is publicly available, some requires a permission Tables 4, 5.

4.8.1. Sources Included in the MSP+ Other Than National MSP

4.8.2. National MSP.

Limitations. This dataset gathers data on the regulations of activities in MPAs based on the legal framework that was publicly available (except for the expert-based assessments provided by co-authors), at the moment of collection (gathering data from 2021 and early 2023). It does not pretend to inform about the enforcement of regulations, the activities actually occurring

Table 4
Data sources from regional databases. All initial sources are mentioned below, data was then filtered based on MSFD and MPA polygons, i.e., some of the data listed below was excluded.

Database/source	Link(s) to data
EMODnet. See Table 6	https://www.emodnet-humanactivities.eu/view-data.php https://www.emodnet-humanactivities.eu/search-results.php? dataname=Maritime±Spatial±Planning±%28MSP%29
Helcom	https://metadata.helcom.fi/geonetwork/srv/eng/catalog.search#/search? facet.q=topicCat%2Ffarming&resultType=details&sortBy=relevance& from=1&to=100&fast=index&_content_type=json Most of the data on the Helcom website was too old to be used. Some waste dumping was kept.
Thal-Chor: project at the scale of the Aegean Sea	https://www.mspcygr.info Mineral extraction http://www.latomet.gr/ypan/StaticPage1.aspx?pagenb=16515 Energy infrastructures: https://geo.rae.gr/?tab=panel-1346; https://geo.rae.gr/geoserver/wfs?request=GetCapabiliti This data was shared by the University of the Aegean, 2015. Strategic Project "Cross-border Cooperation for Maritime Spatial Planning Development" - "Thal-Chor". Funding: Cross-border Cooperation Programme “Greece–Cyprus 2007–2013” More infrastructure data was shared in Shapefiles by the Thal-Chor project when requested.
Europa platform	https://data.europa.eu/data/ We searched for keywords only in this platform, for example: ‘Offshore energy All WFS or ESRI shape or zip’ or ‘Mineral extraction All WFS or ESRI shape’
Mazaris	http://marliter.mazaris.net/spatial_mapping_toolbox#

Table 5
Primary sources and providers from EMODnet - Human Activities data. Non-EU related sources are excluded.

Identifier
EMODnet_HA_Aquaculture_Marine_Finfish_20210913
EMODnet_HA_Algae_Production_20211110
EMODnet_HA_Aquaculture_Freshwater_20201223
EMODnet_HA_Aquaculture_Shellfish_20220225
EMODnet_HA_Desalination_Plants_20210830 EMODnet_HA_Desalination_Plants_Locations_20210830
EMODnet_HA_DredgeSpoilDumping_Locations_20210608
EMODnet_HA_Dredging_20210927 EMODnet_HA_Dredging_Locations_20210927
EMODnet_HA_MSP_Zoning_Element_20220328
EMODnet_HA_Nuclear_Plants_20190329
EMODnet_HA_OceanEnergy_Projects_20210727 EMODnet_HA_OceanEnergy_TestSites_20210728
EMODnet_HA_OG_Offshore_Installations_20220422
EMODnet_HA_OG_Wells_20201113
EMODnet_HA_UWWTD_Discharge_Points_20210726
EMODnet_HA_UWWTD_Treatment_Plants_20210615
EMODnet_HA_WasteDisposal_DumpedMunitions_20220324
EMODnet_HA_WindFarms_20220324
EMODnet_HA_Cables_Actual_Routes_20210126
EMODnet_HA_Pipelines_20220131
EMODnet_HA_Aggragates_Areas_20211020
EMODnet_HA_DredgeSpoilDumping_pg_Locations_20210608
EMODnet_HA_MilitaryAreas_20210201
EMODnet_HA_OG_Active_Licences_20220309
Primary sources (separated by “;”)
CVO / FVST- Denmark; Ministry of Agriculture, Rural Development and Environment - Cyprus; Ministry of Agriculture and Forestry - Finland; Greek Ministry of Agriculture - Greece; Ministry for Agriculture, Fisheries, Food and Animal Rights - Malta;

(*continued on next page*)

Table 5 (*continued*)

Identifier
Miniterio de Agricultura, Alimentacion y Peca, including the Dirección General de Ordenación Pesquera y Acuicultura – Spain; Joint Research Centre (JRC, including Ocean Energy Status Report, SET Plan progress report); COGEA SRL; Business Management Consultants; AND-International; Główny Inspektorat Weterynarii - Poland; Administration of the Republic of Slovenia for Food Safety, Veterinary Sector and Plant Protection; Bulgarian Food Safety Agency; Bundesministerium für Gesundheit - Austria; Marine Institute - Ireland; Department of Agriculture Food and the Marine – Ireland; IFREMER; Black Sea Basin Directorate; National Institute of Biology of Slovenia; GWI DesalData; Eurostat - GISCO; ESRI; GeoNames; Centro Tecnologico del Mar - Fundación CETMAR; Operational Directorate Natural Environment (Belgium); Management Unit of the North Sea Mathematical Models and the Scheldt estuary (MUMM); Marine Environmental Protection and Monitoring Department - Black Sea Basin Directorate to the Ministry of Environment and Waters; Ministry of Defence of the Republic of Croatia; Independent Public Relations and Publishing Department - Republic of Cyprus; Department of Fisheries and Marine Research - Cyprus; Cerema. Division environnement aquatique et énergies renouvelables; CETMEF-MEDEE (Centre d'Études Techniques Maritimes Et Fluviales - Département Environnement Littoral et Cours d'Eau); Waterways Data Management Specialist (M.Sc) Information Department - Finnish Transport Agency; Hellenic Navy Hydrographic Service; Marine Environment and Food Safety Services; Servizio emergenze ambientali in mare (SEAM); State Environmental Service of Ministry of Environmental Protection and Regional Development - Latvia; Environment Protection Agency. Marine Research Department - Lithuania; ERA – Environment and Resources Authority (Malta); DGRM - Direção-Geral de Recursos Naturais, Segurança e Serviços Marítimos - Portugal; Republic of Slovenia - Slovenian Maritime Administration; Minister of Agriculture, Food and Environment (MAGRAMA); HELCOM (Baltic Marine Environment Protection Commission - Helsinki Commission, Dredging, Map and Data Service); OSPAR (including for Dumping of Wastes or Other Matter at Sea, and from Data and Information Management System ODIMS); AZTI; Denmark - Ministry of Environment and Food of Denmark, Nature Agency; Basin Directorate for Water Management in the Black Sea Region - Varna; Cyprus-Cyprus Port Authority; SEDNET; Malta-Malta Environment and Planning Authority; Italy-Francesco Baittiner; Dredging, Environmental and Marine Engineering (DEME); Italy-Autorita Portuale di Piombino; Italy-Autorita Portuale di Genova; Spain-Basque Government, Direccion de Infraestructuras del Transporte; Spain-Puertos del Estado; Spain-Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO), Dirección General de la Costa y el Mar; Portugal-APA-APFF; France-CEREMA; Ireland-Department of Housing, Local Government and Heritage; Federal Public Service (FPS) Health, Food Chain Safety and Environment; Danish Maritime Authority (Secretariat for maritime spatial planning); Ministry of Finance (Planning Department) (Rahandusministeerium, Estonia); Ministry of The Environment and Regional councils (Uusimaa, Kymenlaakso, Southwest Finland, Satakunta, Ostrobothnia, Central Ostrobothnia, North Ostrobothnia and Lapland); Åland Provincial Government; Bundesamt für Seeschifffahrt und Hydrographie (BSH); Ministry of Environmental Protection and Regional Development of The Republic of Latvia; Ministry of Infrastructure and the Environment (Noordzeeloket); Ministry of Maritime Economy and Inland Navigation - Poland; Maritime offices of Gdynia, Slupsk and Szczecin - Poland; Government of Spain - Ministry for Ecological Transition and the Demographic Challenge; Swedish Agency for Marine and Water Management; Ministry of Environment of the Republic of Lithuania; World Energy Council; Open Power System Data; World Nuclear Association; International Atomic Energy Agency; Power Reactor Information System; Global Energy Observatory; IEA-OES GIS Map of Ocean Energy Installations; MARENDATA; Ocean Energy Europe; Bretagne Ocean Power; Offshore Energy (BIZ); Nord Stream 2; Italy - Ministero dello Sviluppo Economico - Direzione Generale per le risorse Minerarie ed Energetiche; Netherlands - TNO - Geological Survey of the Netherlands; Ireland - Department of the Environment, Climate and Communications; Malta - Ministry for Finance and Employment - Continental Shelf Department; Spain - Ministry for the Ecological Transition and the Demographic Challenge - Energy - Archivo Técnico de Hidrocarburos; Poland - Polish Geological Institute - National Research Institute; Latvia - Latvian Environment, Geology and Meteorology Centre; Germany - Landesamt fur Bergbau, Energie und Geologie; France - BRGM - The French Geological Survey; European Environment Agency (EEA); MRDPW - Ministry of Regional Development and Public Works (NCRD - National Centre for Regional Development) - Bulgaria; Ministry of Defence (Defence Investments Department); Ministry of Defence (Hydrographic Service – Royal Navy, Netherlands); IHM - Instituto Hidrográfico de la Marina; Ministry of Industry, Trade and Tourism - Spain; France - Ministere de la Transition ecologique - Direction Generale de l'energie et du Climat (DGEC); Denmark - Danish Energy Agency; Portugal - Direção-Geral de Energia e Geologia; Ministry of Defence - Spain; European Climate, Infrastructure and Environment Executive Agency; Middlebury Institute of International Studies at Monterey; THE WIND POWER; WIND EUROPE; EPSOG; Lithuanian Energy Agency; Rijkswaterstaat - Ministry of Infrastructure and Water Management; Royal Belgian Institute of Natural Sciences; SHOM (Service hydrographique et océanographique de la Marine); Malta - International Ocean Institute - Malta Operational Centre (University Of Malta) / Physical Oceanography Unit; Germany - Federal Maritime and Hydrographic Agency; Spain - Instituto de Estadística y Cartografía de Andalucía; Italy - Regione Lazio, Direzione ambiente, Centro di Monitoraggio GIZC / ISPRA; The Netherlands - Rijkswaterstaat - Ministry of Infrastructure and Water Management - Wingebieden op de Noordzee; Flemish Institute for the Sea; Germany - Federal Maritime and Hydrographic Agency of Germany, BSH - CONTIS GeoSeaPortal; Germany - NIBIS® KARTENSERVER. Landesamt für Bergbau, Energie und Geologie (LBEG); Poland - Biuletyn Informacji Publicznej (BIP), Ministerstwo Środowiska; Spain - Sistema de Información sobre el Medio Marino (InfoMAR); Adriatic Atlas - SHAPE IPA project.

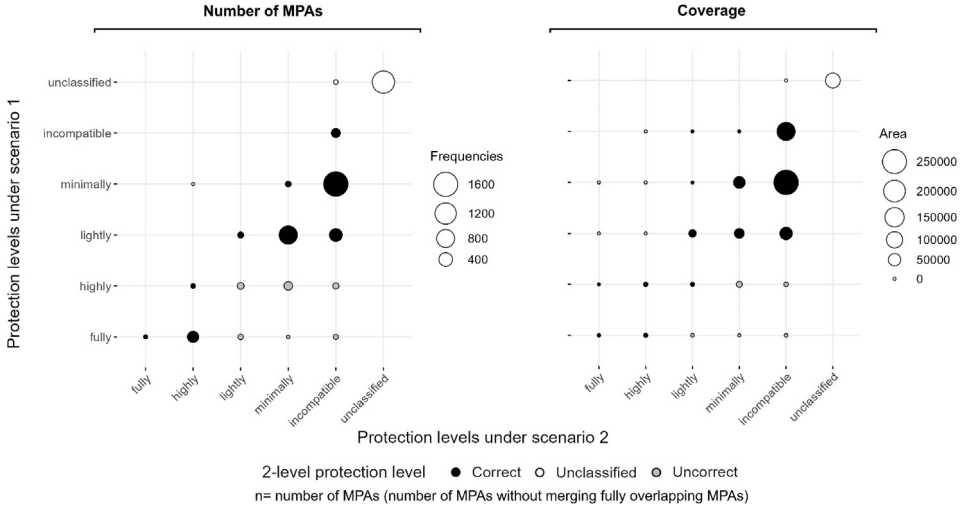


Fig. 8. Comparison of protection levels under the two scenarios, in numbers of MPAs and MPA coverage. The color code illustrate if the scenarios show the same two-level classification of MPAs, grouping protection levels in strong (full and high protection) and low (incompatible with conservation, minimal and light protection) protection.

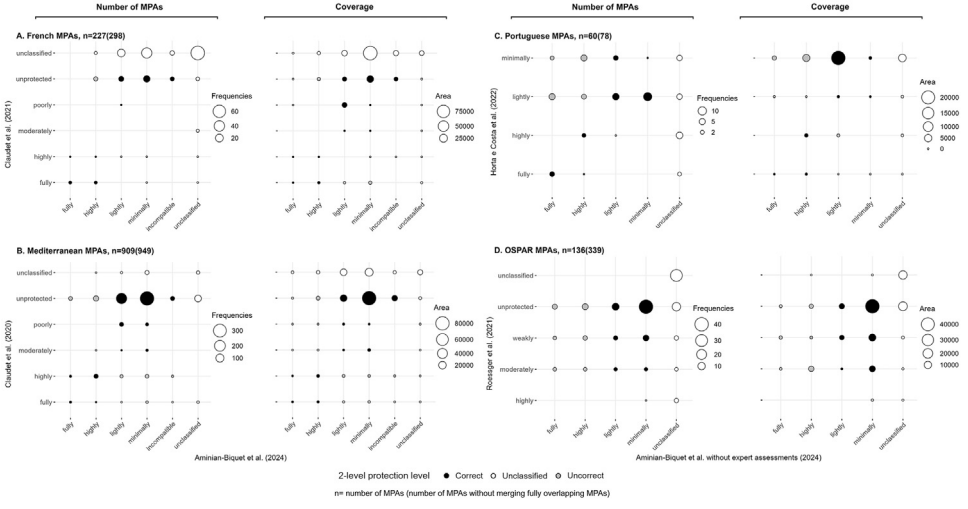


Fig. 9. Comparison of protection levels in numbers of MPAs (excluding zones) and MPA coverage, based on protection levels from scenario 1. The expert-based assessments compared in C. and D. are normally included in the computation of protection levels from our dataset, for this comparison, we computed protection levels excluding this data (i.e., using PS and MSP+ datasets only, so these are not the protection levels provided in the database). Data from the former assessments was collected between 2018 and 2022.

at sea, and the other conservation- or governance- related actions undertaken in MPAs. There might be errors and simplifications in the regulations reported (see Fig. 9) Table 6.

The MPA list was based on the EEA database published in 2023, some most recent or only locally-recognized MPAs can be missing. The spatial delineation of marine areas varies across data sources, and as we used the MSFD polygons reported by Member States, some protected areas might not be considered as marine based on another delineation.

Table 6
Data sources per country from MSP or related geoportals. Additional data that was explored but that was not suitable (at the time of data collection) is provided in "Additional links explored" sections.

Database/source	Link(s) to data
Belgium	Link to data https://www.marineatlas.be/en/data Link to MSP https://www.health.belgium.be/MPAs/default/files/uploads/fields/fpshealth_theme_file/msp-2020-englishtranslation.pdf Additional links explored https://odnature.naturalsciences.be/ (e.g., https://odnature.naturalsciences.be/mumm/fr/cables-pipelines/) https://www.vliz.be/en/datasets-belgian-coast-and-sea
Bulgaria	Link to data https://www.arcgis.com/apps/webappviewer/index.html?id=d7e671b7a2214d21859e5645f63ccf27&extent=2033938.0181%2C4863075.0887%2C4382083.5271%2C6048154.7752%2C102100 Additional links explored https://maritime-spatial-planning.ec.europa.eu/practices/black-sea-case-study
Croatia	Link to data https://geoportal.nipp.hr/; https://envi-portal.azo.hr/node/6; WFS layers http://servisi.azo.hr/voda/wfs?request=GetCapabilities Additional links explored http://www.msp-supreme.eu/files/c-1-3-8-dubrovnik-neretva.pdf https://www.zpu-zadzup.hr/prostorno-uredjenje; https://geoportal.dgu.hr/
Cyprus	Link to data http://portal.dls.moi.gov.cy/en-us/homepage Link to MSP https://maritime-spatial-planning.ec.europa.eu/MPAs/default/files/download/cyprus_policy_statement_on_msp_en.pdf Additional links explored https://www.mspcygr.info/https://eservices.dls.moi.gov.cy/geoportal_inspire/mapviewer/index.html
Denmark	Link to data https://kort.msdi.dk/spatialmap?profile=dmd https://havplan.dk/en/page/info https://mst.dk/service/miljoegis/ https://wfs2-miljoegis.mim.dk/raastofpaahavet/ows?version=1.1.0&OUTPUTFORMAT=GML2 https://wfs2-miljoegis.mim.dk/np3basis2020/ows?service=WFS&request=GetCapabilities Link to MSP https://havplan.dk/portalcache/api/v1/file/en/30a6ed4a-e332-4d2e-8389-dd20c13c1494.pdf Additional links explored https://www.geodata-info.dk/srv/eng/catalog.search?resultType=details&any=S%C3%B8fartsstyrelsen&from=1&to=20&sortBy=relevance#/search?facet.q=topicCat%2Ftransportation&resultType=details&from=1&to=20&sortBy=relevance&fast=index&_content_type=json https://msdi.dk/det-marine-danmarkskort/dataoversigt https://eng.geus.dk/products-services-facilities/data-and-maps/ https://msdi.dk/det-marine-danmarkskort
Estonia	Link to data http://www.sea.ee/adrienne/map/IL http://mereala.hendrikson.ee/kaardirakendus-en.html Link to MSP https://www.fin.ee/en/state-local-governments-spatial-planning/spatial-planning/maritime-spatial-planning Additional links explored http://mereala.hendrikson.ee/kaardirakendus-en.html http://www.panbalticscope.eu/results/online-tools/ https://hendrikson.ee/en/services/compiling-maps-for-different-spatial-plans/

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Database/source	Link(s) to data
Finland	Link to data https://mspfinland.maps.arcgis.com/apps/webappviewer/index.html?id= 97f9d24e2771487995a7cc41fdca11c4 Link to MSP https://meriskenaariot.info/merialuesuunnitelma/wp-content/uploads/2020/10/ Finnish-Maritime-Spatial-Plan-2030-Marking-Card-Library.pdf Additional links explored https://meriskenaariot.info/merialuesuunnitelma/en/vm0-eng/ https://meriopas.ymparisto.fi/meriopas/menu/spatialInfo/62.56246,21.16200/6 https://ckanmtp.ymparisto.fi/en/dataset https://marinefinland.fi/en-US/Data_services
France	Link to data https://geolittoral.din.developpement-durable.gouv.fr/cache/service/wmts http://www.geolittoral.developpement-durable.gouv.fr/ telechargement-en-ligne-donnees-geolittoral-a802.html#sommaire_17 https://cerema.maps.arcgis.com/apps/MapJournal/index.html?appid= be28d76c0c4b44468c3f42f63f174c21 Link to MSP https://www.dirm.mediterranee.developpement-durable.gouv.fr/ adoption-du-plan-d-action-du-document-strategique-a3026.html https://www.dirm.sud-atlantique.developpement-durable.gouv.fr/ plan-d-action-du-document-strategique-de-la-facade-r545.html https://www.dirm.nord-atlantique-manche-ouest.developpement-durable.gouv.fr/ adoption-du-plan-d-action-du-document-strategique-a1321.html Additional links explored https://www.geocatalogue.fr/# https://www.geoportail.gouv.fr/thematiques/developpement-durable-energie/mer-et-littoral

Germany	Link to data
	https://www.geoseaportal.de/mapapps/resources/apps/benthos/index.html?lang=en&stateId=
	8d2adeb6-f95b-4c2b-aade-b6f95bbc2b5a
	Link to MSP
	https://www.bsh.de/DE/THEMEN/Offshore/Meeresraumplanung/Raumordnungsplan_2021/
	_Anlagen/Downloadshttps://www.bsh.de/EN/TOPICS/Offshore/Maritime_spatial_planning/
	Maritime_Spatial_Plan_2021/_Anlagen/Downloads/ROP_2021/Maritime_Spatial_Plan_2021.pdf?
	__blob=publicationFile&v=5/Raumordnungsplan_2021.pdf;
	jsessionid=3414E4332DCBA4546B1B601952170222.live21302?__blob=publicationFile&v=10
	https:
	//www.bsh.de/EN/TOPICS/Offshore/Maritime_spatial_planning/Maritime_Spatial_Plan_2021/
	_Anlagen/Downloads/ROP_2021/Maritime_Spatial_Plan_2021.pdf?__blob=publicationFile&v=5

Greece	Link to data http://ct-thalhor.aegean.gr/flexviewers/PMA/ http://www.latomet.gr/ypan/StaticPage1.aspx?pagenb=16515 Additional links explored https://mspmed.eu/project/greece/
Ireland	Link to data https://atlas.marine.ie/#?c=53.9043:-15.9082:6 Link to MSP https://www.gov.ie/en/publication/60e57-national-marine-planning-framework/ Additional links explored https://marineplan.ie/?page=page_43
Italy	Additional links explored https://amare.interreg-med.eu/toolbox/geoportal/
Latvia	Link to data https://dpps.viss.gov.lv/DPPS.REQ/URN_IVIS_100001_ISS-VIDM-MSP03_WFS_service-v1-0/guest/ URN_IVIS_100273_LIC-93E40030D27FD04B8AC9B52BACF5D6E2?request= GetCapabilities&service=WFS http://proxygds.viss.gov.lv/arcgis/services/Predefined/LVMSP_01_02_WFS/MapServer/WFSServer? request=GetCapabilities&service=wfs

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Database/source	Link(s) to data
	Link to MSP https://drive.google.com/file/d/1mKigVjv6N03cjgPkwR5RSItcQezsn5zY/view Additional links explored https://maritime-spatial-planning.ec.europa.eu/practices/pilot-msp-western-coast-latvia https://maps.helcom.fi/website/mapservice/index.html https://likumi.lv/ta/id/203672-noteikumi-par-aizsargajamam-juras-teritorijam
Lithuania	Link to data https://maps.helcom.fi/website/mapservice/index.htmlhttps: //www.tpdris.lt/lt_LT/web/guest/sarasas Link to MSP https://drive.google.com/drive/folders/1KDyT9MGjDY9kiQmnQZx6y3au0_s0z2I5 Additional links explored https://map.tpdr.lt/tpdr-gis/index.jsp?action=tpdrPortal&reg_tpd_id=78440 https://www.bendrasisplanas.lt/2019/12/13/en/
Malta	Link to data https://workflow.gov.mt/RuntimePublic/Runtime/Form/ Malta±INSPIRE±Directive±Geoportal/?cookiesession8341=STUVWXYZABCDEFGHIJKLMNOPQRS TVWXY Link to MSP https://issuu.com/planningauthority/docs/sped_approved_doc__1_ Additional links explored https://meps.eraportal.org.mt/ http://gismargrey.bo.ismar.cnr.it:8080/mokaApp/apps/AMAV3mt/index.html?null https://msdi.data.gov.mt/search.html
Netherlands	Link to data https://www.informatiehuismarien.nl/uk/open-data-viewer/ https://www.nationaalgeoregister.nl/geonetwork/srv/dut/catalog.search#/metadata/ Link to MSP https://www.noordzeeloket.nl/publish/pages/122239/ integrated_management_plan_for_the_north_sea_2015_-_management_summary_3025.pdf https://www.noordzeeloket.nl/publish/pages/126270/policy_document_on_the_north_sea_ 2016-2021_-_including_the_netherlands_maritime_spatial_plan_screen_.pdf https://www.noordzeeloket.nl/publish/pages/198806/ natuurgebieden-op-de-noordzee-kaart-2-programma-noordzee-2022-2027.pdf Additional links explored https://www.nationaalgeoregister.nl/geonetwork/srv/dut/catalog.search#/search?resultType= details&sortBy=relevance&fast=index&_content_type=json&from=1&to=50&any= telecom_kabels_noordzee https://maps.rijkswaterstaat.nl/dataregister/srv/dut/catalog.search#/map https://www.nationaalgeoregister.nl/geonetwork/srv/dut/catalog.search#/search https://www.noordzeeloket.nl/beleid/programma-noordzee-2022-2027/
Poland	Link to data https://sipam.gov.pl/geoportal?m=g856 https://sipam.gov.pl/geonetwork/srv/eng/catalog.search#/metadata/ 8161c690-1113-422e-a5bc-203f953fc4b65 Link to MSP https://dziennikustaw.gov.pl/D2021000093501.pdf Additional links explored https://sipam.gov.pl/zasoby-gis/dane-gis/
Portugal	Link to MSP https://www.psoem.pt/o-plano-de-situacao/ Additional links explored https://www.psoem.pt/usos-e-atividades/ https://mapy.umgdy.gov.pl/pzp/ https://mapy.umgdy.gov.pl/msp/ https://webgis.dgrm.mm.gov.pt/arcgis/rest/services/PSOEM_GEOPORTAL

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Database/source	Link(s) to data
Romania	Additional links explored https://www.arcgis.com/apps/webappviewer/index.html?id= d7e671b7a2214d21859e5645f63ccf27&extent=2033938.0181%2C4863075.0887%2C4382083. 5271%2C6048154.7752%2C102100 https://geoportal.planificare-maritima.unibuc.ro/mapstore/#/viewer/openlayers/10
Slovenia	Link to MSP https://dokumenti-pis.mop.gov.si/javno/veljavni/PPP2192/index.html Additional links explored https: //egeologija.si/geonetwork/srv/eng/catalog.search#/search?facet.q=type%2Fdataset&resultType= details&fast=index&_content_type=json&from=121&to=140&sortBy=relevance http://data.tools4msp.eu/maps/84/view
Spain	Link to data http://www.infomar.miteco.es:8080/geonetwork/srv/eng/catalog.search#/map https://servicio.pesca.mapama.es/acuivisor/ http://ideihm.covam.es/servicios.html Link to MSP https://www.miteco.gob.es/es/prensa/230201poemcmin_tcm30-559832.pdf Additional links explored https://www.miteco.gob.es/es/costas/temas/proteccion-medio-marino/ ordenacion-del-espacio-maritimo/default.aspx http://barreto.md.ieo.es/arcgis/rest/services/MSFD https://www.miteco.gob.es/es/cartografia-y-sig/ide/descargas/agua/
Sweden	Link to data https://www.havochvatten.se/en/our-organization/data-and-statistics/ swedish-marine-planning—geographical-data.html Link to MSP https://www.havochvatten.se/en/eu-and-international/marine-spatial-planning.html Additional links explored https://www.havochvatten.se/en/policy-and-regulation/commercial-fishing/ fishing-regulations-in-marine-protected-areas.html

Ethics Statement. The authors have read and followed the ethical requirements for publication in Data in Brief and confirmed that the current work does not involve human subjects, animal experiments, or any data collected from social media platforms.

Data Availability

EU MPAs: features, regulations and protection levels (Original data) (figshare).

CRediT Author Statement

Juliette Aminian-Biquet: Conceptualization, Methodology, Data curation, Writing – original draft, Writing – review & editing; **Claire Colegrove:** Data curation; **Alex Driedger:** Data curation; **Nicole Raudsepp:** Data curation; **Jennifer Sletten:** Data curation; **Timothé Vincent:** Data curation; **Virgil Zetterlind:** Data curation; **Julia Roessger:** Data curation; **Anastasiya Laznya:** Data curation; **Natașa Vaidianu:** Data curation; **Joachim Claudet:** Conceptualization, Methodology; **Juliette Young:** Conceptualization, Methodology; **Barbara Horta e Costa:** Conceptualization, Methodology, Writing – review & editing.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary Materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dib.2024.111177.

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