M P A

MARINE PROTECTED AREAS EUROPE

PI: Prof. Mark J. Costello, Nord University (NORD, Norway)

Co-funded by the European Union

BGP Marine -
3rd Marine Biogeographical Seminar for the Baltic Marine Region
Anna M. Addamo, NORD
Belinda Bramley, CLIMAZUL

Riga, 09/11/2023

Co-funded by the European Union   UK Research and Innovation

New review of science literature on MPA effects on fisheries found examples from 25 countries

Total examples in literature	51	100%
Increased fishery catch only	33	
Increased body size of fishery species	5	
Both bigger catch and body size	6	
"Spillover" reported	8	
Sub-total benefits to fisheries	**46**	**90 %**
Uncertain effects on fishery	5	
Decreased fishery catch	0	0 %

Costello MJ. 2023. Evidence of economic benefits from Marine Protected Areas. Scientia Marina (*in press*)

MPA EUROPE WILL MAP THE OPTIMAL LOCATIONS FOR MARINE PROTECTED AREAS (MPAs) IN EUROPEAN SEAS

PROJECT COMPONENTS

Carbon sequestration, storage and deposition based on the environmental conditions, habitats, and species present

Develop **blue carbon scoring system** supporting management of blue carbon

Connectivity modelling (present)

Climate velocity (recent and future)

Design **MPA networks covering 10% and 30% of European seas** that maximise coverage of biodiversity and blue carbon

30 000 SPECIES
Environmental niche modelling
Estimate **richness**

Benthic habitats (EMODNET)
Modelled **habitat distributions**

Two way process with marine spatial planners and other interested parties to formulate **regional or national case studies**, ensuring project traceability, transparency and reproducibility

Environmental data (Copernicus)

Project website, peer-reviewed scientific papers, workshops, conference, fact sheets, policy brief for stakeholders

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Standardised and complete data layers

Environmental data (Copernicus)

Benthic habitats (EMODNET)
Modelled **habitat distributions**

Environmental niche modelling
Estimate **richness**

Carbon sequestration, storage and deposition based on the environmental conditions, habitats, and species present

Develop **blue carbon scoring system**
supporting management of blue carbon

SCP approach

MPA EUROPE PROPOSE PRIORITY AREAS TO PROTECT
(A) BIODIVERSITY AND
(B) BLUE CARBON

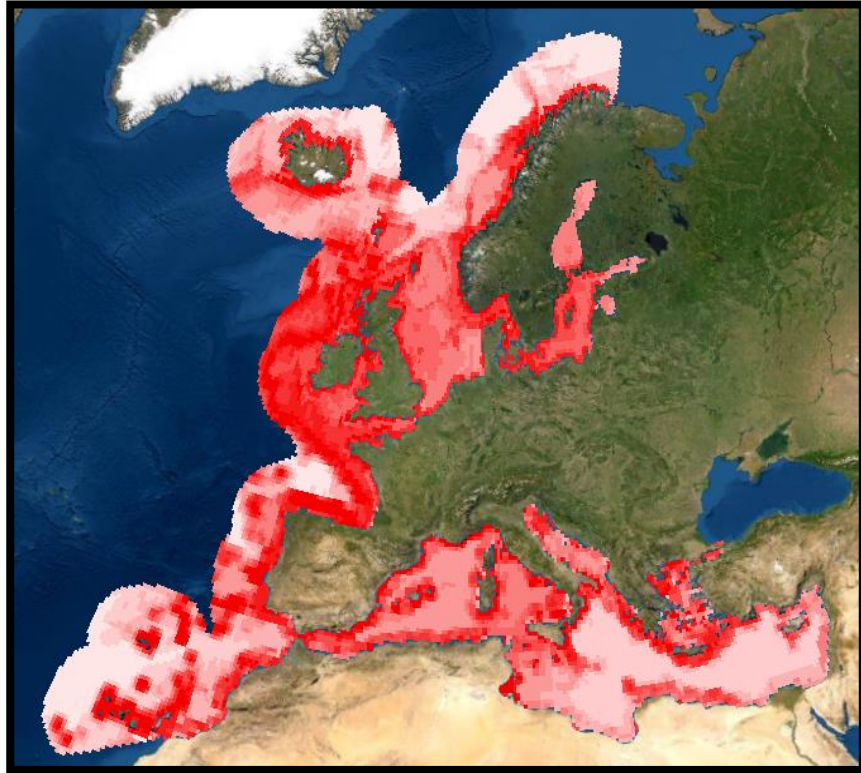Standardised and complete data layers
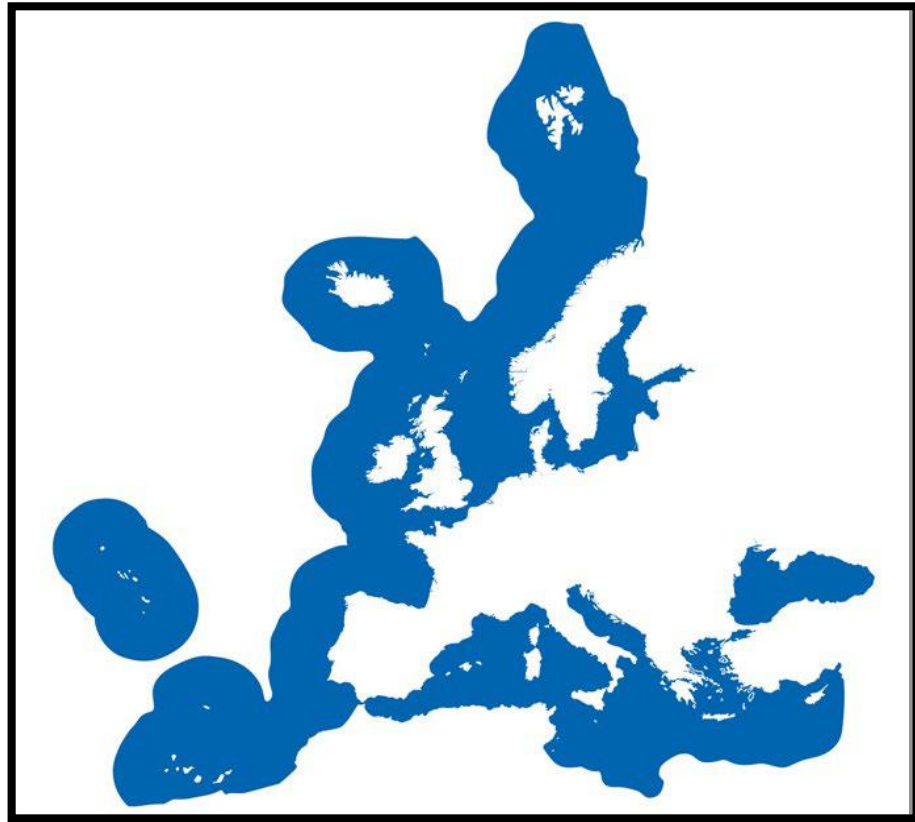
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SCP approach

MPA EUROPE PROPOSE PRIORITY AREAS TO PROTECT
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Standardised and complete data layers
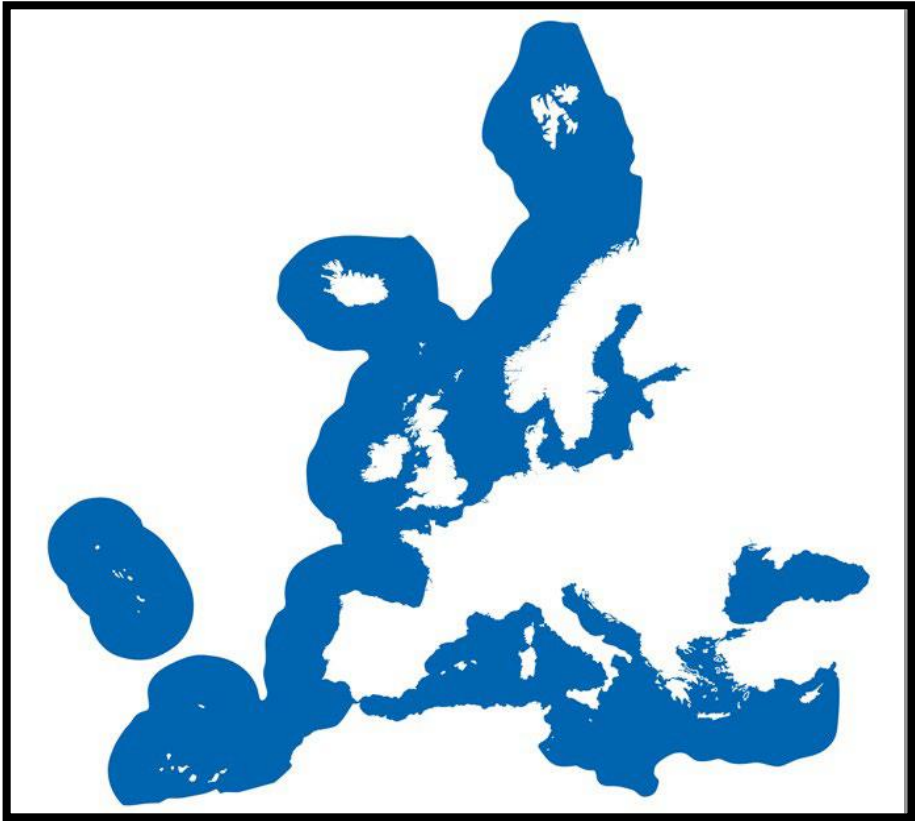
Hypothetical example
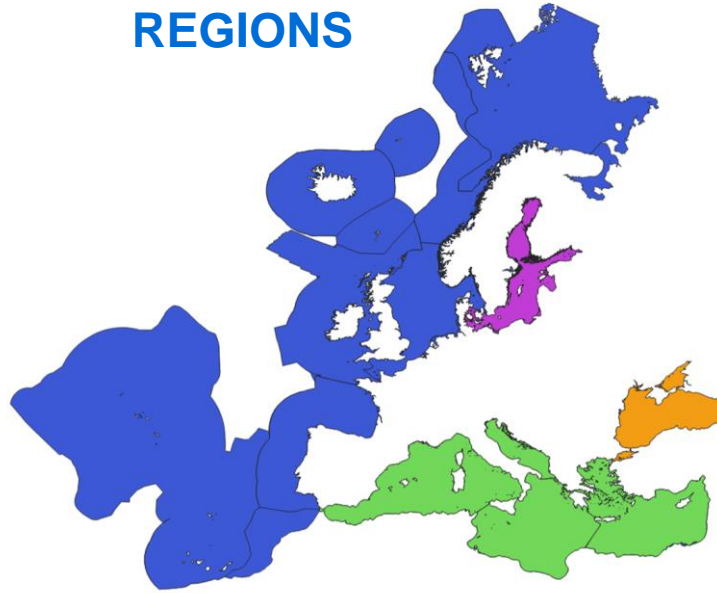of prioritised areas
(darker red being higher priority)

SCP approach
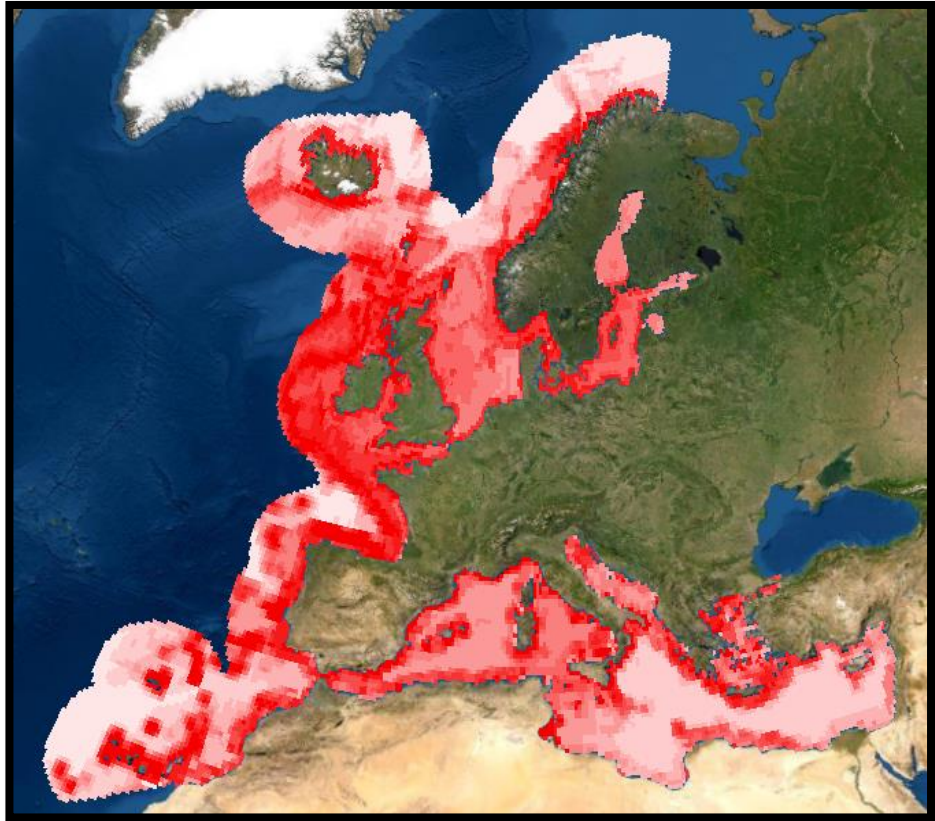
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REGIONS

COUNTRY (EEZ)

COUNTRY (12NM)
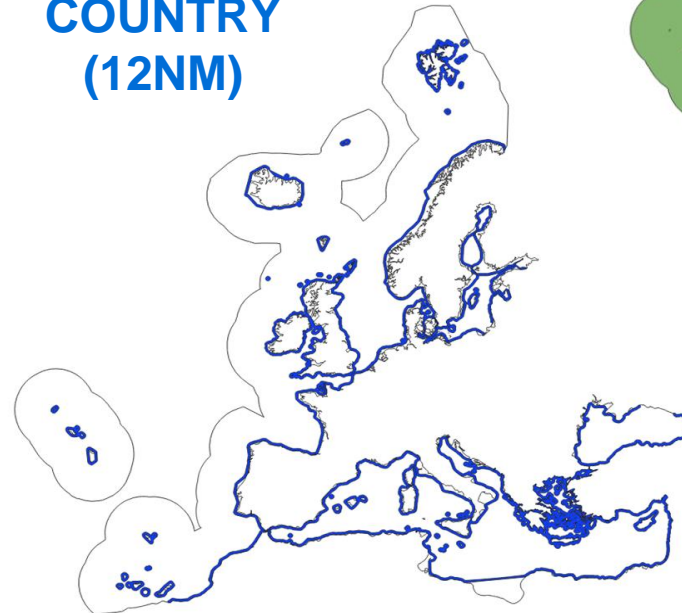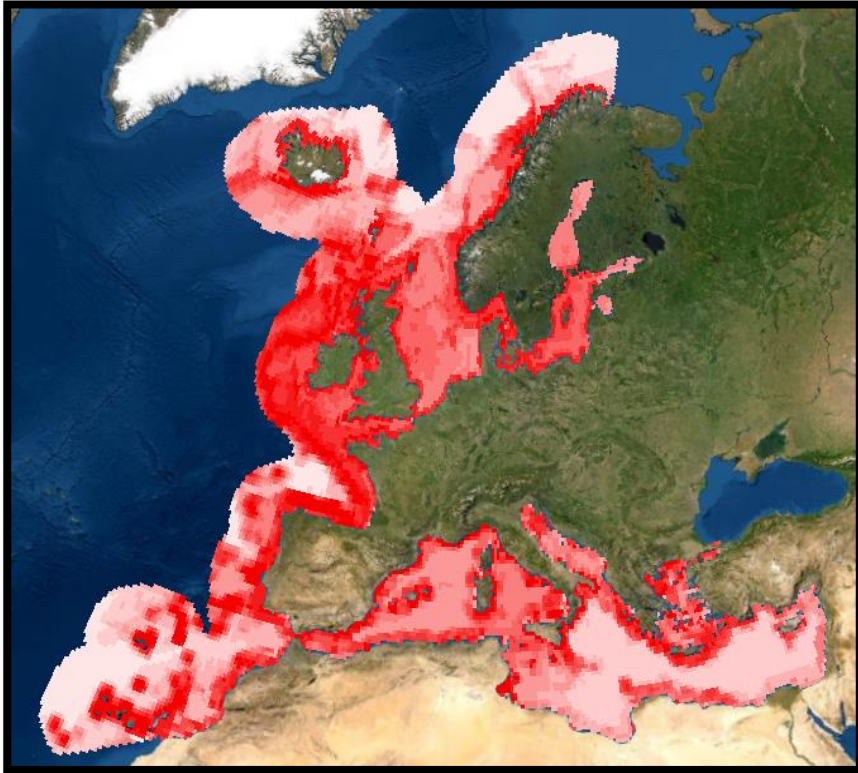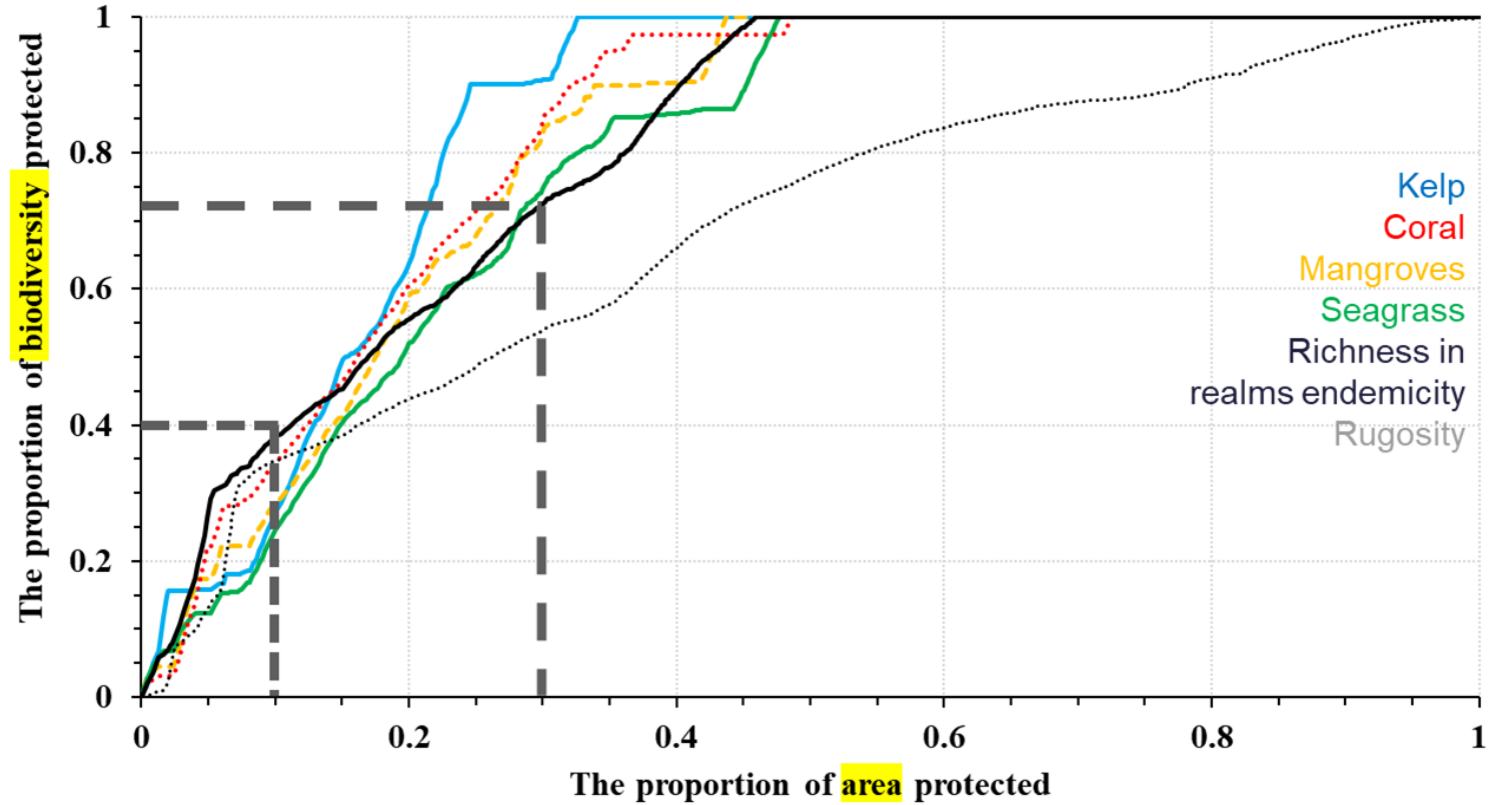
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Zhao et al (2020) *Biological conservation*

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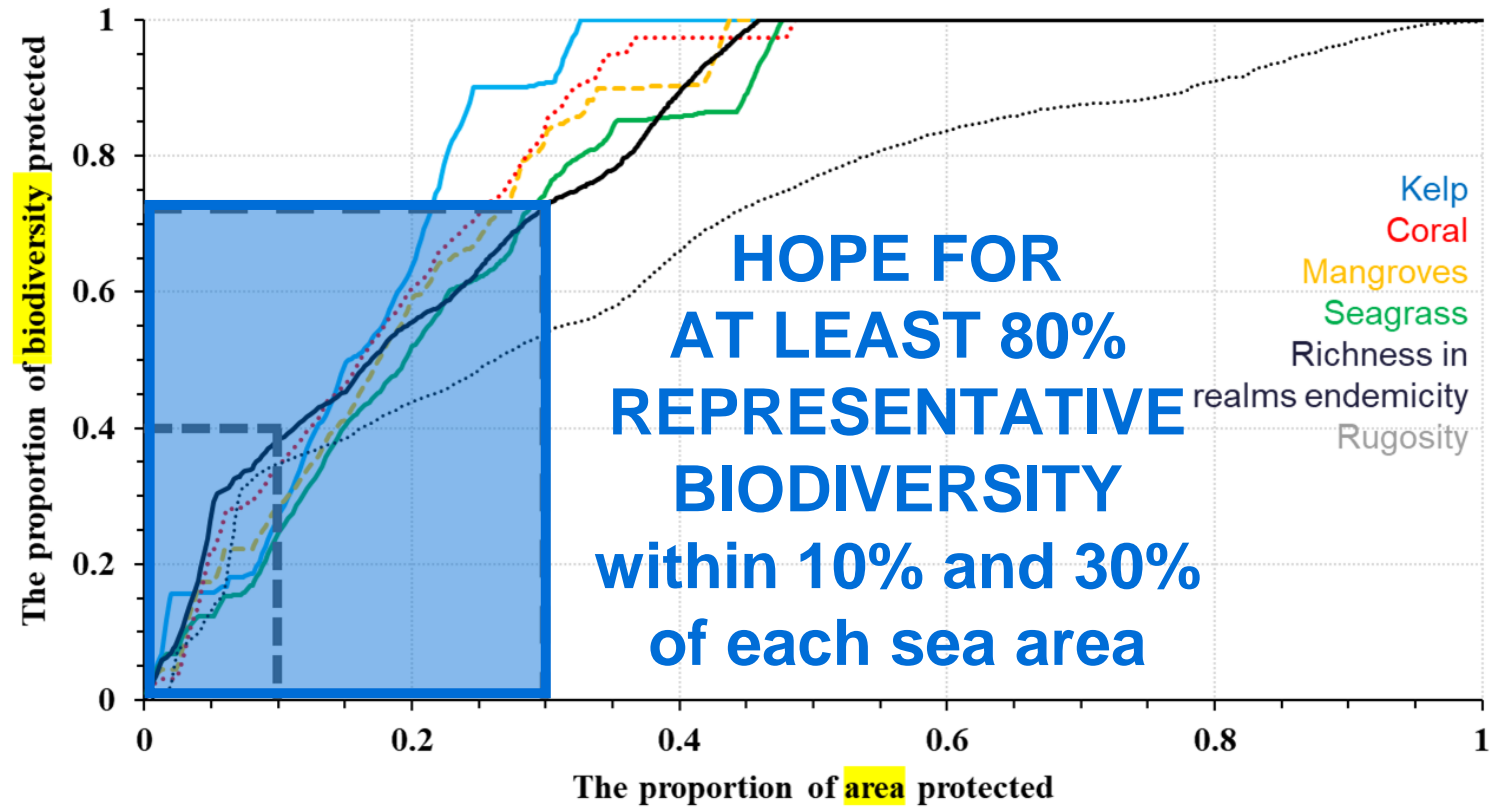
HOPE FOR
AT LEAST 80%
REPRESENTATIVE
BIODIVERSITY
within 10% and 30%
of each sea area

Kelp
Coral
Mangroves
Seagrass
Richness in
realms endemicity
Rugosity

Zhao et al (2020) *Biological conservation*

PROJECT STAKEHOLDERS

TARGET ON PROTECTED AREA
(topics and questions)

1. **Complete the existing MPA network**
2. **Improve coherence of the network**
3. **Identify and develop strictly protected areas**
4. **Ensure adequate management of protected areas**

Seminar report

Marine introductory seminar
for the pledge and review process
in the context of commitments
under the EU Biodiversity Strategy for 2030

9-10 December 2021

Online

Examples of MPA Europe's deliverables relevant for BGP

- **Species distribution maps and models** (NOV 2023)

- **Biogenic habitat maps and models** (JAN 2024)

- **Ecosystem classification for EU surface and near-seabed waters** (JAN 2024)

- **Report on blue carbon storage in seabed habitats** (MAR 2024)

- **Map of carbon storage in seabed habitats** (JUL 2024)

- **Prioritisation analyses based on biodiversity & blue carbon** (MAR-JUL 2025)

- **Online atlas of MPAs for Maritime Spatial Planning** (NOV 2025)

ENVIRONMENTAL DATA

| Variable |
| --- |
| Temperature |
| Salinity |
| Sea Ice Cover |
| Sea Ice Thickness |
| Sea Water Velocity |
| Mixed Layer Depth |
| Diffuse Attenuation Coefficient |
| PAR |
| PAR at bottom |
| Oxygen |
| pH |
| Iron |
| Phosphate |
| Nitrate |
| Silicate |
| Total phytoplankton |
| Chlorophyll |
| Topographic (slope) |
| Topographic (roughness) |
| EMODnet Bathymetry |
| Sedimentation Rates |
| Seabed Substrates |
| Distance to coast |
| Distance to closest port |
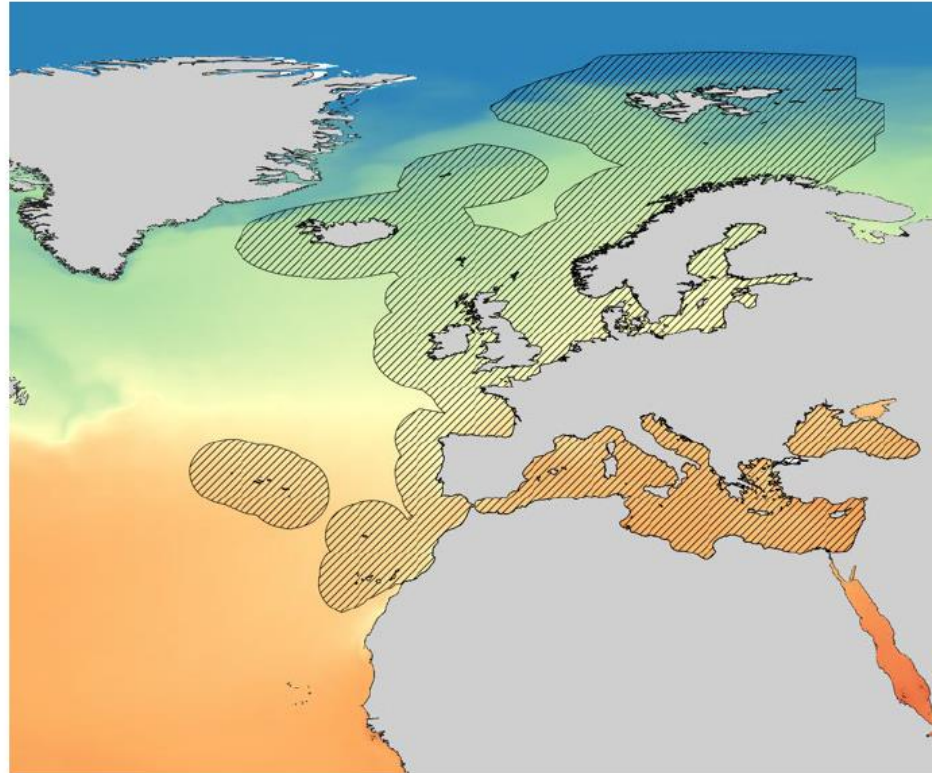
Present-day sea surface temperature
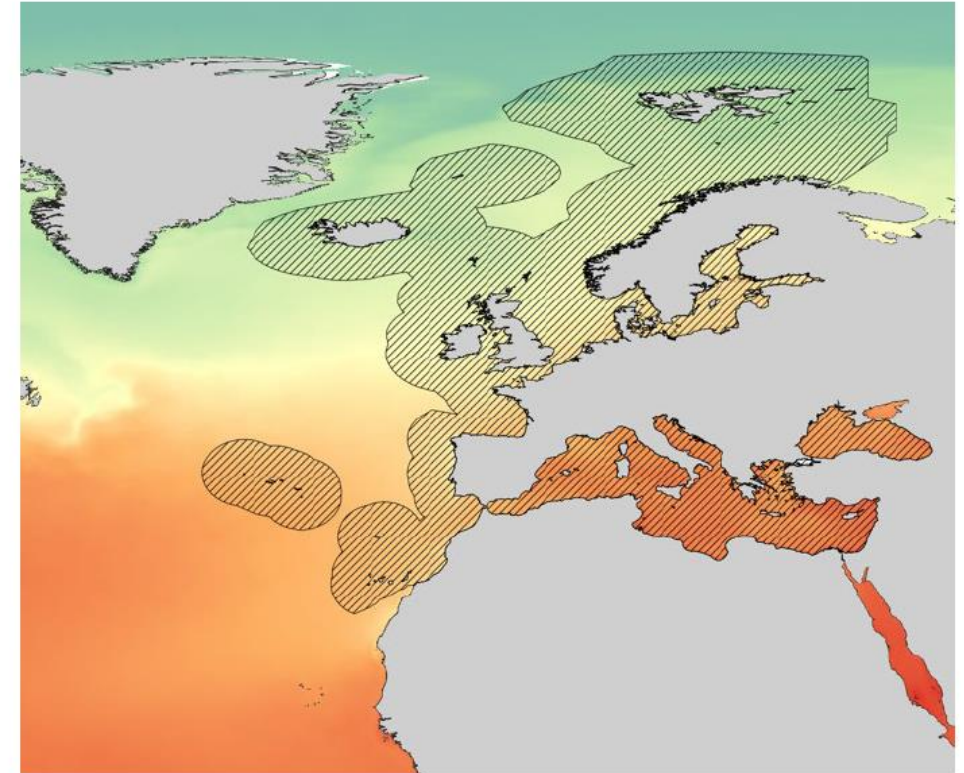
Future (decade 2090) sea surface temperature

Example of data layer produced for the European Seas.
Colour gradients reflect spatial differences in °C from today (left) to 2090 (right)

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ECOSYSTEM CLASSIFICATION
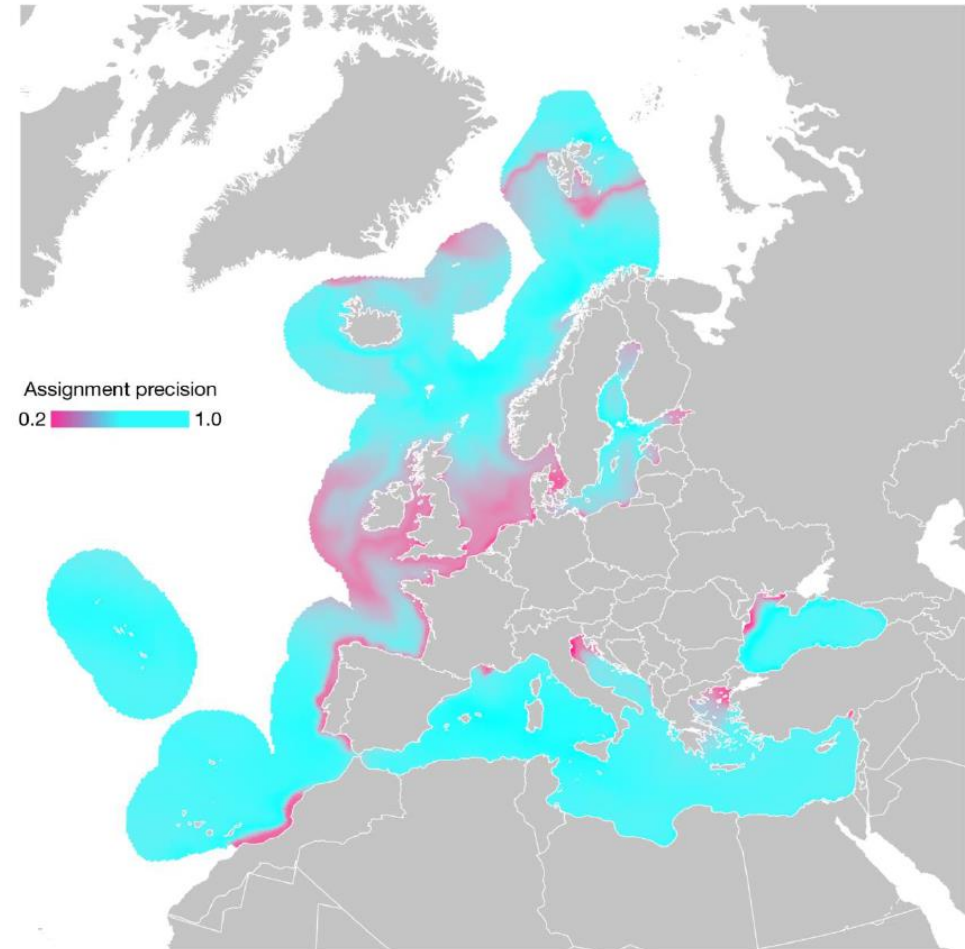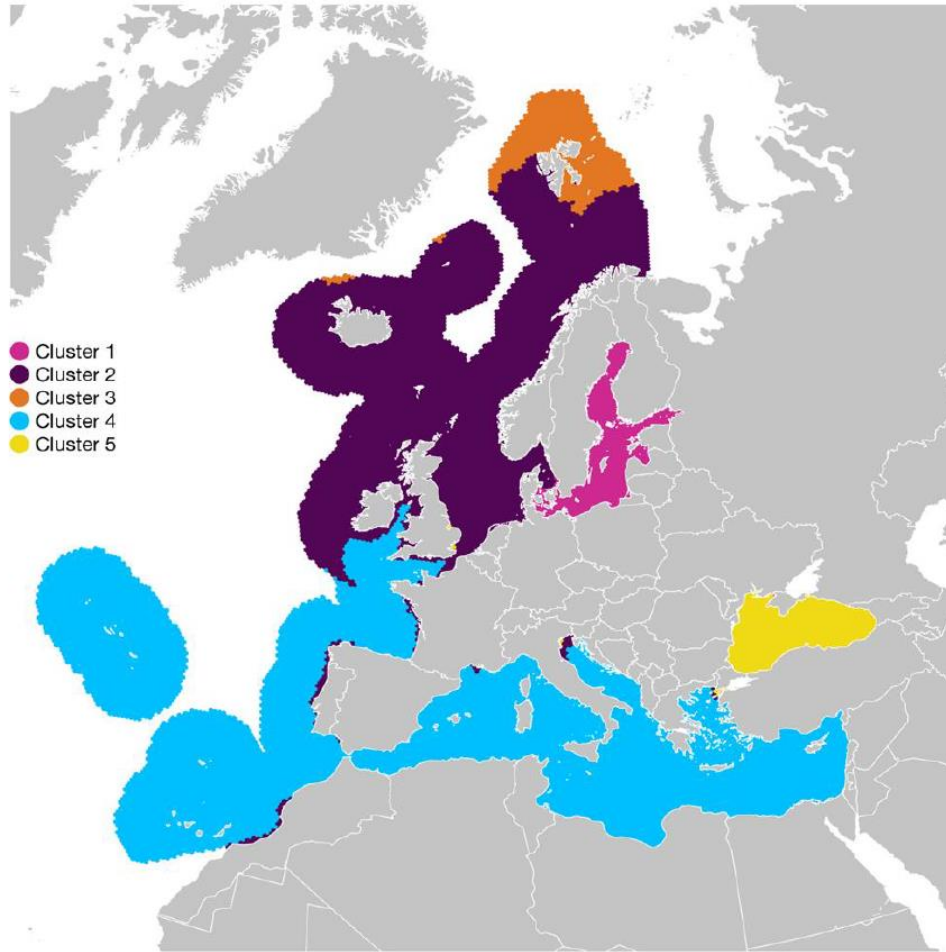
European marine ecosystems of surface waters estimated by k-means clustering analysis of environmental data (left) and clustering assignment precision based on fuzzy logic (right)

SPECIES DATA

© MPA Europe

SOURCE OF ADDITIONAL SPECIES DATASETS
(into OBIS)

- Peer
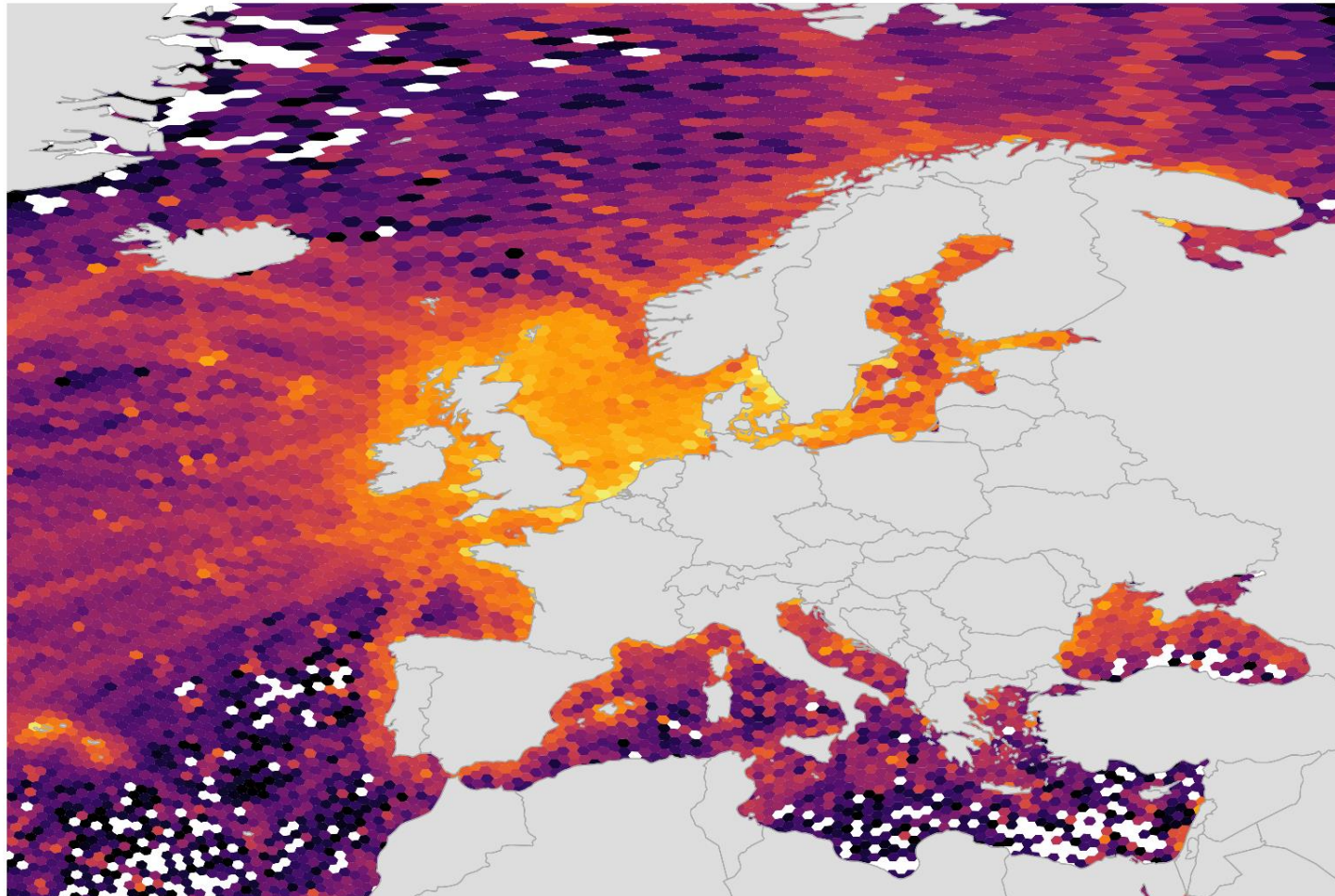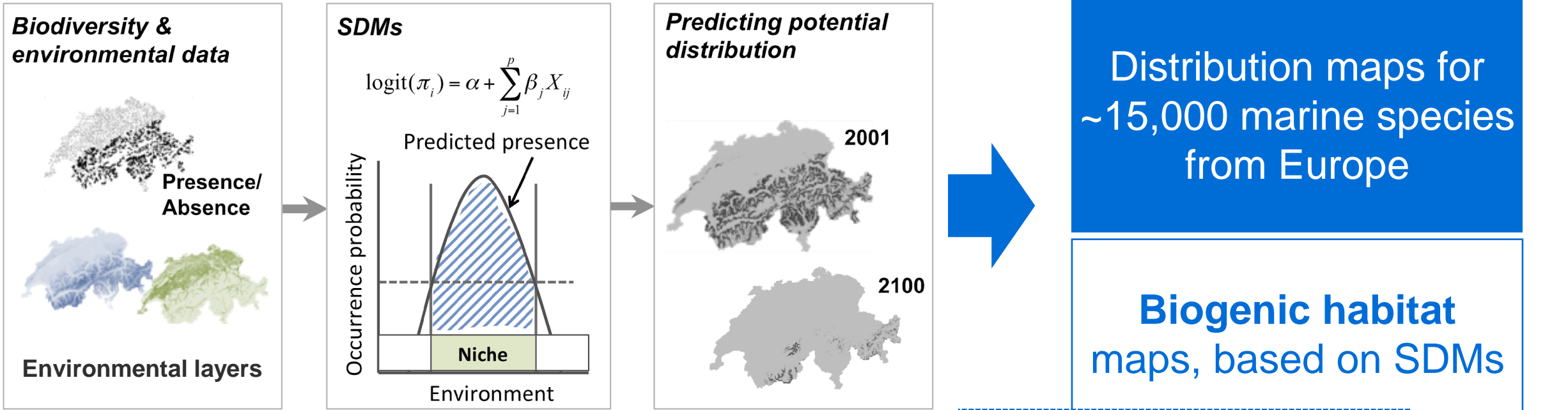- BioTIME
- GBIF
- Dryad
- Literature
- ...

The density of marine species distribution data already available in OBIS, including ~ 30,000 species from 1526-2021 (yellow is more, purple is fewer records)

SPECIES & HABITAT RANGE MODELLING

Biodiversity & environmental data

Presence/Absence

Environmental layers

SDMs

$$\text{logit}(\pi_i) = \alpha + \sum_{j=1}^{p} \beta_j X_{ij}$$

Occurrence probability

Predicted presence

Niche

Environment

Predicting potential distribution

2001

2100

Zurrel 2022

Distribution maps for ~15,000 marine species from Europe

Biogenic habitat maps, based on SDMs

Conservation status of species and habitats **(Red List)**

Species range shifts

Occurrence information from OBIS and GBIF (new pipelines for seamless data integration between both providers)

OBIS OCEAN BIODIVERSITY INFORMATION SYSTEM

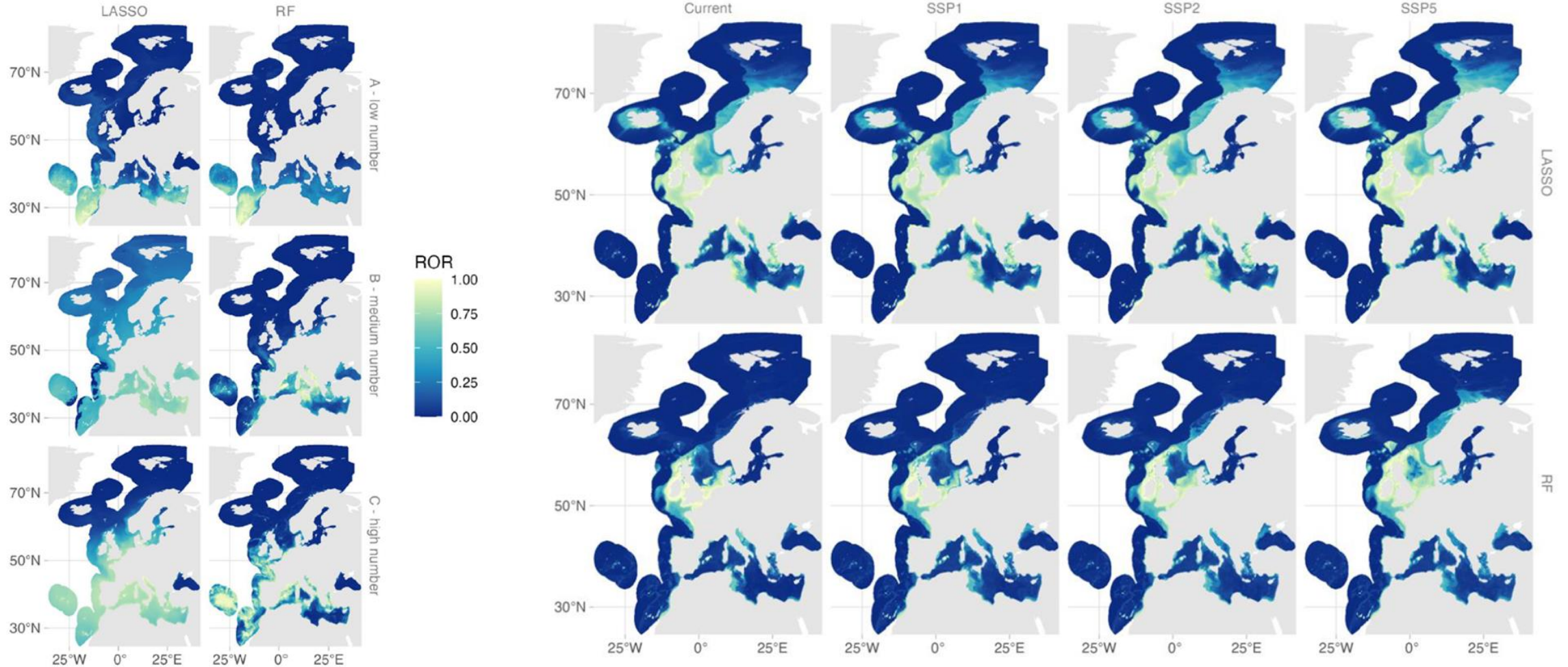Environmental data from Bio-ORACLE v3 (high-resolution ~5 km)

New CMIP6 scenarios SSP1, SSP2, SSP3, SSP4 and SSP5

Two periods: 2050 / 2100

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SPECIES DISTRIBUTION PREDICTIONS

ROR = Relative Occurrence Rate, with higher values indicating areas of higher suitability for the species

Species distribution predictions for three species with different number of records (A-C) according to two methods (left) AND species distribution predictions for the species *Raja brachyura* (right)

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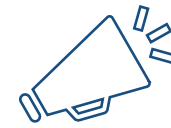
80 CONTRIBUTORS

33 DATASETS

33,650 ENTRIES

5156 Locations

19 EU countries
11 Non-EU countries
High Seas

SOURCES OF ADDITIONAL BLUE CARBON DATASETS

PANGAEA.

SeaDataNet

EMODnet
European Marine Observation and Data Network

Geo-Seas

...

BRACKISH TIDAL — 1449 entries

SHORELINE — 567 entries

MARINE SHELF — 11,001 entries

DEEP SEA — 1196 entries

NOT YET DEFINED — 8973 entries

Saltmarsh sediments — 1387 entries

Seagrass sediments — 4200 entries

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THANK YOU
https://mpa-europe.eu/

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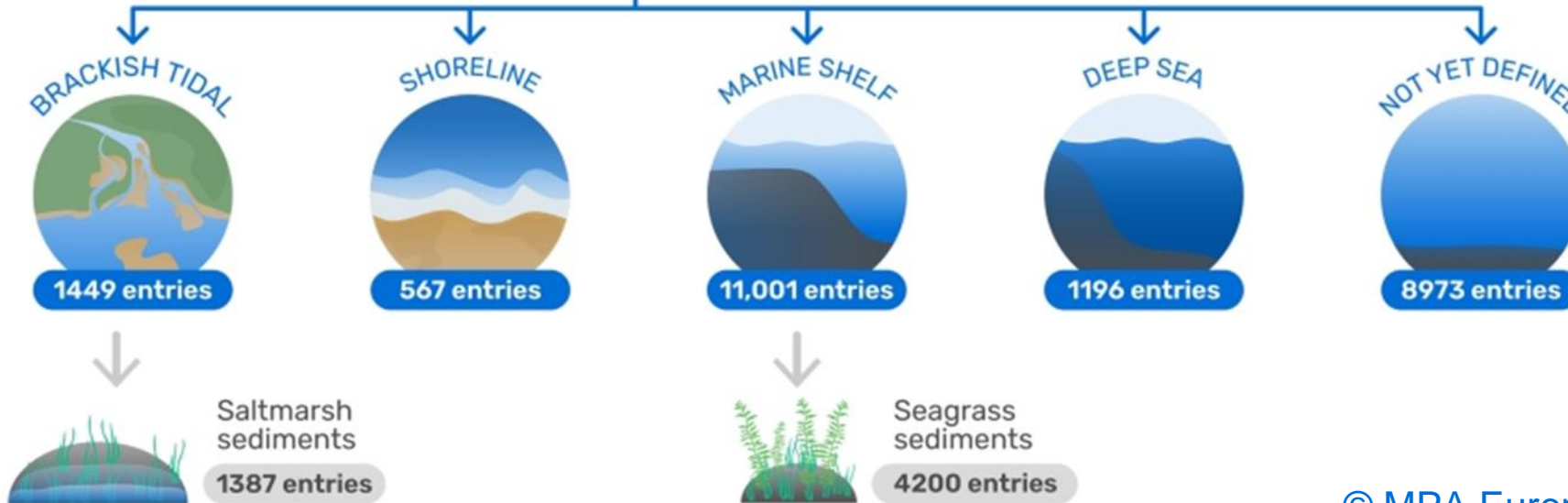
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CLIMAZUL

Co-funded by the European Union

UK Research and Innovation

Grant Agreement 101059988

PROJECT STUDY AREA & MAIN OUTPUTS

- Maps of an optimal MPA network in European seas **prioritised for biodiversity protection** and **blue carbon benefits**

- Maps of **species richness** in European seas **based on multiple indicators**, including actual observed data, statistical estimators, and modelled geographic range maps

- **Potential geographic distributions of important biogenic habitats** in European seas

- The **first data-driven classification of ecosystems** in shallow and deep European seas based on a new comprehensive dataset of high-resolution environmental layers for bioclimatic modelling

- An **online European marine biodiversity atlas** for use by researchers, students, teachers, and in Marine Spatial Planning by policy makers, industry and NGOs

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TIMELINE

Plan or Report ● ◆ Dissemination & Communication materials

Paper ◆ ▲ Databases & maps

2023 → **JANUARY** START OF PROJECT

FEBRUARY
- WP1 ● Data management plan
- WP1 ● Kick-off meeting report
- WP7 ◆ Website & social media

JUNE
- WP2 ● Marine environmental data compilation
- WP3 ▲ New data published into OBIS
- WP7 ● DEC Plan

AUGUST
- WP2 ◆ Paper on European coast's wave exposure index

- WP2 ● Marine ecosystem classification for near seabed waters
- WP3 ▲ Maps and models of biogenic habitats distributions published into EMODnet
- WP4 ▲ Carbon storage in marine biogenic habitats database
- WP4 ▲ Carbon storage in marine non-biogenic sediment habitats database

- WP2 ● Marine ecosystem classification for surface waters
- WP3 ▲ Maps and models of species environmental niches and geographic distributions published into OBIS

DECEMBER

OCTOBER

2024 ←

FEBRUARY
- WP2 ● Depth-integrated marine ecosystem classification
- WP4 ● Carbon storage within and beyond biogenic habitats

APRIL
- WP2 ◆ Paper on marine ecosystem classification for surface and near seabed waters of Europe
- WP3 ▲ Species and habitats conservation status database
- WP4 ● Scoring system for carbon storage within and beyond marine biogenic habitats

JUNE
- WP4 ▲ Map of carbon storage capacity in European marine habitats

DECEMBER
- WP2 ▲ Climate velocity map for European seas under current conditions
- WP5 ◆ Paper on the spatial relationships between measures of biodiversity and environmental conditions
- WP7 ◆ Dissemination articles for children

- WP5 ● Marine environment and ecosystem, species distribution and habitats, and blue carbon layers ready for prioritisation analysis
- WP2 ▲ Current connectivity maps of European seas

AUGUST

2025 →

FEBRUARY
- WP5 ▲ Prioritisation analysis based on biodiversity variables

APRIL
- WP2 ▲ Climate velocity map for European seas under future climate change scenarios
- WP5 ● Prioritisation analysis based on blue carbon scores
- WP6 ● Four regional case studies synthesising stakeholder views identified and outlined, meeting end user needs

JUNE
- WP3 ◆ Paper on marine species and habitat distribution models
- WP5 ▲ Prioritisation analysis based on biodiversity variables and blue carbon
- WP7 ◆ Four dissemination videos

JULY
International Conference on MPA and MSP

2026 ↓

APRIL END OF PROJECT
- WP1 ● International cooperation report
- WP1 ● Final data management plan
- WP7 ● Impacts of DEC activities and updated DEC plan

DECEMBER
- WP5 ● Paper on the MPA networks in European seas based on the prioritisation analysis for biodiversity conservation and blue carbon
- WP6 ● Policy brief on how the proposed MPA network supports MSP in Europe regarding biodiversity and blue carbon

OCTOBER
- WP2 ◆ Paper on how the proposed MPA network accommodates connectivity through current and climate velocities, now and under climate change scenarios
- WP5 ● Online atlas for MSP

Will use **standardised spatially comprehensive** representing species ranges, biogenic habitats (biomes) and functional ecosystem units

Will map **representative network at 5 km** resolution indicating coherence

Will map **oceanographic connectivity** (models of current velocity that account for prevailing wind conditions)

Will **prioritise biogenic habitats** for which data layers exist at:
- European scale (e.g. seagrass, maerl, kelp, fucoids, corals)
- upper levels of EUNIS that cover all seabed habitats

Will **replot predicted species ranges based on climate change scenarios** to indicate:
- how well the representative biodiversity areas (**RBAs**) will still be relevant in the future
- where areas of refugia and high loss and gain (**turnover**) of species may exist

Will run **prioritisation to select best 10% and 30%** at:
- all Europe
- main sea basins
- EEZ
- territorial sea levels

Will **ignore political boundaries** but these can be overlaid to show cross border areas of priority