Ref. Ares(2023)7338702 - 27/10/2023

MarinePlan

IMPROVED TRANSDISCIPLINARY SCIENCE FOR EFFECTIVE ECOSYSTEM-BASED MARITIME SPATIAL PLANNING AND CONSERVATION IN EUROPEAN SEAS

Deliverable D2.1

Report on EBSA metrics

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme HORIZON-CL6-2021-BIODIV-01-12 under grant agreement No 101059407 and by UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee grant numbers 10038951 & 10050537. This output reflects the views only of the author(s), and the European Union cannot be held responsible for any use which may be made of the information contained therein.

Document Information and Version Control

Project Acronym	MarinePlan
Project Title	Improved transdisciplinary science for effective ecosystem-based maritime spatial planning and conservation in European Seas
Grant Agreement Number	EU grant agreement No 101059407; UKRI grant numbers 10038951 & 10050537.
Work Package	WP2
Related Task(s)	T2.1
Deliverable Number	D2.1
Deliverable Name	Report on EBSA metrics
Due Date	30 September 2023
Date Delivered	16 October 2023
Dissemination Level	Public — fully open(automatically posted online on the Project Results platforms);

Version Control

Revision-N°	Date	Description	Prepared By	Reviewed By
	13/10/2023	Final version	STN	

EXECUTIVE SUMMARY

A prerequisite for Planning Sites to develop scenarios and planning options is a robust science base for the prioritisation and zonation of MPA networks by measuring the spatial distribution of existing and newly developed EBSA criteria. MarinePlan will develop under WP2 (i) spatially explicit, quantitative metrics for EBSA criteria that are compatible with ecosystem-based, environmental state indicators (e.g., MSFD), (ii) guidance for the application of these metrics at various spatial scales, and (iii) the quantification of dispersal and movement corridors of different life stages (functional connectivity), biodiversity attributes, and species interactions. MarinePlan will expand on previous approaches to operationalize EBSA criteria to be compatible with biodiversity goals including the target of Good Environmental Status. Assessing the spatial connectivity between MPAs, WP2 will also propose spatially efficient zonation and avoiding competing sea uses where possible. Spatially explicit, quantitative measures of the seven EBSA criteria (uniqueness; special importance for life history stages of species; importance for threatened, endangered or declining species and/or habitats; vulnerability; fragility; sensitivity or slow recovery; biological productivity; biological diversity; naturalness) will be established and quantitatively linked to population- and ecosystem dynamics which, in turn, may affect the capacity to supply marine ecosystem services.

A prerequisite for these exercises is to focus on quantifiable criteria and to investigate the availability of data in the differetn study sites. This focus nad data availability is reported in this deliverable. However, focusing on biodiversity, productivity and naturalness does not mean that MarinePlan will ignore other criteria. These will be included where available and relevant.

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1 Aim of the Deliverable

This deliverable provides a first stock take of the definintion of ecologically or biologically significant marine areas (EBSAs) and available data in the eight MarinePlan planning sites.

1.1 Contributors

Table 1 Names and roles of contributors to this deliverable.

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2 INTRODUCTION

The overall goal of MarinePlan is to develop and apply a Decision Support System (DSS) for ecosystem-based maritime spatial planning (EB-MSP) together with best practice guidance to enhance the design and effectiveness of spatial conservation and restoration measures for marine biodiversity in European Seas. The DSS will be founded on a conceptual EB-MSP implementation process and will provide the tools and best available knowledge to ensure the allocation of coherent MPAs and restoration areas in the context of EB-MSP. MarinePlan regards the operationalisation of ecologically or biologically significant marine areas (EBSA) criteria as a main tool for MPA designation. EBSA criteria have emerged from a global effort let by the Convention on Biological Diversity (CBD).

A prerequisite for Planning Sites to develop scenarios and planning options is a robust science base for the prioritisation and zonation of MPA networks by measuring the spatial distribution of existing and newly developed EBSA criteria. MarinePlan will develop under WP2 (i) spatially explicit, quantitative metrics for EBSA criteria that are compatible with ecosystem-based, environmental state indicators (e.g., MSFD), (ii) guidance for the application of these metrics at various spatial scales, and (iii) the quantification of dispersal and movement corridors of different life stages (functional connectivity), biodiversity attributes, and species interactions. MarinePlan will expand on previous approaches to operationalize EBSA criteria to be compatible with biodiversity goals including the target of Good Environmental Status. Assessing the spatial connectivity between MPAs, WP2 will also propose spatially efficient zonation and avoiding competing sea uses where possible. Spatially explicit, quantitative measures of the seven EBSA criteria (uniqueness; special importance for life history stages of species; importance for threatened, endangered or declining species and/or habitats; vulnerability; fragility; sensitivity or slow recovery; biological productivity; biological diversity; naturalness) will be established and quantitatively linked to population- and ecosystem dynamics which, in turn, may affect the capacity to supply marine ecosystem services.

Through the developed EBSA metrics, WP2 (supported by WP6) will consider the different temporal and spatial scales and explicitly address the linkages and connectivity between identified hot spots of biodiversity attributes, and already designated MPAs and EBSAs to effectively address conservation and restoration priorities while accounting for the effects of climate change. Under WP2, MarinePlan will measure temporal dynamics and connectivity relevant for the EBSA criteria, in particular in view of climate change. New measures will be developed where necessary (such as regional extinction risk or predicted changes in productivity rates under warming environments), as conditions for the analyses on trade-offs of planning options (WP3, WP5). Temporal dynamics will be considered by investigating variability in connectivity among MPAs at different temporal and spatial scales, including structural and functional connectivity, climatic velocity, the identification of ecological corridors and hot spots, and spill-over from MPAs.

We expand on existing EBSA metrics and formulate quantitative, measurable EBSA criteria reflecting biodiversity attributes that underpin ecosystem functioning and ecosystem services. Applying the EBSA criteria at appropriate spatio-temporal scales to estimate the risk-probabilities of cumulative human pressures for designated MPA networks is one of the key challenges. The EBSA metrics will be spatio-temporally quantified for the eight Planning Sites together with an analysis of key connectivity metrics using quantitative modelling tools and process models. Furthermore, the potential and limits of applying the EBSA criteria at trans-European scales will be assessed. Below the definition of EBSA criteria and their official implementation is described. Below we further contrast this with the MarinePlan approach of calculating and mapping EBSAs.

A prerequisite for these exercises is to focus on quantifiable criteria and to investigate the availability of data in the differetn study sites. This focus nad data availability is reported in the deliverable. However, focusing on biodiversity, productivity and naturalness does not mean that MarinePlan will ignore other criteria. These will be included where available and relevant.

3 Ecologically and Biologically sensitive area (EBSA)

Describing Ecologically or Biologically Significant Marine Areas (EBSAs)

EBSAs are special areas in the ocean that serve important purposes, in one way or another, to support the healthy functioning of oceans and the many services that it provides.

The criteria for identifying EBSAs were adopted at the Conference of the Parties to the Convention on Biological Diversity (COP 9) in 2008 (CBD, 2008). The criteria are:

1. Uniqueness or Rarity
2. Special importance for life history stages of species
3. Importance for threatened, endangered or declining species and/or habitats
4. Vulnerability, Fragility, Sensitivity, or Slow recovery
5. Biological Productivity
6. Biological Diversity
7. Naturalness

In 2010, COP 10 stated the following:

- the application of the EBSA criteria is a scientific and technical exercise.
- the identification of EBSAs and the selection of conservation and management measures is a matter for States and competent intergovernmental organisations, in accordance with international law, including the UN Convention on the Law of the Sea.
- the identification of EBSAs should use the best available scientific and technical information and integrate the traditional, scientific, technical, and technological knowledge of indigenous and local communities.
- the Executive Secretary should facilitate availability and interoperability of the best available marine and coastal biodiversity data sets and information across global, regional and national scales.
- the Executive Secretary should organize a series of regional workshops with a primary objective to facilitate the description of EBSAs through the application of scientific criteria as well as other relevant compatible and complementary nationally and inter-governmentally agreed scientific criteria, as well as the scientific guidance for the application of EBSA criteria.

Following the request by COP 10, the Executive Secretary has convened a series of regional workshops, inviting CBD Party stakeholders, experts and data holders to **assess available information against the seven EBSA criteria** for specific areas of the ocean. Each workshop is tasked to describe the areas meeting the scientific criteria for EBSAs based on best available scientific information. From the workshops result a list of **proposed areas** for consideration as EBSAs. Each of these areas then undergoes a formal evaluation through a structured United Nations (UN) CBD approach and Areas deemed to fulfil the remit of EBSAs are formally described and communicated to the UN General Assembly.

The EBSA identification process

The first step in the EBSA description process is the collection of all available information, for example:

- Scientific publications
- “Grey literature”, including unpublished reports
- Reports from scientific cruises
- Fisheries data
- Internet-based databases and repositories (which may include bathymetric and species distribution data, as well as other GIS data)
- Conference presentations
- Indigenous and local communities and other expert knowledge

Types of knowledge that may be relevant to the process of EBSA description include:

- Distribution of key physical and biogenic habitats
- The distribution of habitats of selected species, such as marine turtles,
- cetaceans, seabirds, sharks, fish and other species of importance
- Hot spots of benthic biodiversity
- The presence of geomorphological and oceanographic features (such as
- seamounts, canyons, ridges, upwelling areas and frontal systems)

Prior to the workshops, selected experts are asked to provide relevant scientific and technical information of potential EBSAs (in the form of scientific articles, reports or websites, and including filling in an EBSA information template). Submissions of scientific information can be made by Parties, other Governments, relevant organizations and in collaboration with relevant scientists within their respective countries, to support the workshop discussions. The workshop technical support team commissioned by the Secretariat also compiles relevant data prior to the workshop.

Workshop participants include experts nominated by governments, intergovernmental organizations (including regional organizations), non-governmental organizations, academia, research institutions, and indigenous peoples and local communities (IPLCs). The workshop participants, with the support of a team dedicated to analysis and mapping of marine geospatial data, review and synthesize as much available information as possible in order to map and describe areas that may meet the EBSA criteria.

The EBSA identification process **is not based on a structured method** for data input and evaluation and its description often relies on a **combination of expert opinion and analytical techniques.**

According to the EBSA criteria several **analytical approaches can be used** to identify areas, for example: Kernel density estimates, habitat suitability modelling, biodiversity indices, measures of productivity, etc. **Strategies for dealing with weak or incomplete data** can be used: predictive modeling; biogeographic classifications; and expert processes.

The collection of **expert opinion** (Delphic process) usually involves convening a workshop or a panel of experts. **Local and traditional knowledge** is also used (including individual interviews). Final results and maps produced through a Delphic process must be presented to experts for validation (whether they are scientists or local community members). An expert process is, ideally, a first step in process that also incorporates some of the analytical methods. However, where sufficient data are not available to undertake robust quantitative analysis, the Delphic process alone can provide a sufficient basis for EBSA description.

For each criterion, candidate sites are ranked as **high, medium or low**. A site must rank "high" in **at least one criterion to be recognized** as an EBSA. For areas that meet **multiple EBSA criteria** it is necessary to consider how to identify the best EBSA sites amongst them. Typically, this will involve evaluations at both the site and network level: a) how sites compare with each other; and b) how well a given site advances the overall objectives of a given region, which likely includes a network of other EBSAs. Multiple criteria decision-making (MCDM) approaches should be used in the case of areas that meet multiple EBSA criteria.

Table 1 describes the scientific criteria for identifying EBSAs, including rationale, considerations in the application of each criterion and methods, and examples. Table 2 shows additional examples of features that would meet the scientific criteria for identifying EBSAs.

Table 1. Scientific criteria for identifying EBSAs (adapted from COP decision IX/20, annex 1 (CBD, 2008) and the Training manual for the description of EBSAs in open-ocean waters and deep-sea habitats (CBD, 2012)).

Criteria	**Uniqueness or rarity**
Definition	Area contains either (i) unique ("the only one of its kind"), rare (occurs only in few locations) or endemic species, populations or communities, and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanographic features
Rationale	Irreplaceable; Loss would mean the probable permanent disappearance of diversity or a feature, or reduction of the diversity at any level.
Consideration in application and Methods	- Where biological information is scarce, physical data may provide the only basis for application (e.g., unique substrates and bathymetries) - Risk of biased-view of the perceived uniqueness depending on the information availability- - Scale dependency of features such that unique features at one scale may be typical at another, thus a global and regional perspective must be taken. - The application of this criterion may be based on biological, ecological and oceanographic information from peer-reviewed literature, technical reports and data sets. Areas containing similar features may be compared to assess the ways in which one area is different or unique.
Examples	*Open ocean waters:* Sargasso Sea, Taylor column, persistent polynyas. *Deep-sea habitats*: endemic communities around submerged atolls; hydrothermal vents; sea mounts; pseudo-abyssal depression
Criteria	**Special importance for life-history stages of species**
Definition	Areas that are required for a population to survive and thrive.
Rationale	Various biotic and abiotic conditions coupled with species-specific physiological constraints and preferences tend to make some parts of marine regions more suitable to particular life-stages and functions than other parts.

Consideration in application and Methods	- Connectivity between life-history stages and linkages between areas: trophic interactions, physical transport, physical oceanography, life history of species. - Spatial and temporal distribution and/or aggregation of the species. - Sources for information include: e.g., remote sensing, satellite tracking, historical catch and by-catch data, vessel monitoring system (VMS) data. - Survey data can be used to directly determine abundances/densities within an area if coverage is adequate if the data capture the likely degree of natural variation in a species' distribution and behaviour (covering the appropriate time and spatial scales). - Satellite tracking data offers more detailed information about the movement of a single organism and can be used to identify core use areas for individuals or aggregated to better understand the importance of areas to a population(s). - General techniques that can be used on tracking data: • Sinuosity Analysis • Fractal Analysis • First-Passage Time Analysis • Kernel Analysis • Regression, Autocovariate and other Habitat Modelling • State-Space Models - This criterion can be informed by survey data and models by using physical features known to be associated with biotic features.
Examples	Area containing: (i) breeding grounds, spawning areas, nursery areas, juvenile habitat or other areas important for life history stages of species; or (ii) habitats of migratory species (feeding, wintering or resting areas, breeding, moulting, migratory routes).

Criteria	**Importance for threatened, endangered or declining species and/or habitats**
Definition	Area containing habitat for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species
Rationale	To ensure the restoration and recovery of such species and habitats
Consideration in application and Methods	- The application of this criterion must be based on pre-existing determinations of the population status of a given species. The use of the IUCN Red List is fundamental to understanding to which species this criterion applies. In data-poor situations the listing for organisms with similar life history traits should be used until further information on the status of the species is available. - Includes species with very large geographic ranges. - In many cases recovery will require reestablishment of the species in areas of its historic range. - Sources for information include: e.g., remote sensing, satellite tracking, historical catch and by-catch data, vessel monitoring system (VMS) data. - Methods: Same as criterion "Special importance for life-history stages of species"
Examples	Areas critical for threatened, endangered or declining species and/or habitats, containing (i) breeding grounds, spawning areas, nursery areas, juvenile habitat or other areas important for life history stages of species; or (ii) habitats of migratory species (feeding, wintering or resting areas, breeding, moulting, migratory routes).

Criteria	**Vulnerability, fragility, sensitivity, or slow recovery**
Definition	Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.
Rationale	The criteria indicate the degree of risk that will be incurred if human activities or natural events in the area or component cannot be managed effectively or are pursued at an unsustainable rate.

Consideration in application and Methods	- Interactions between vulnerability to human impacts and natural events. - Existing definition emphasizes site specific ideas and requires consideration for highly mobile species. - Criterion can be used both in its own right and in conjunction with other criteria. - Information on which species or biomes qualify as vulnerable, fragile, sensitive or slow to recover should be based on peer-reviewed scientific literature to the extent possible. - The fragility of certain features to certain pressures (e.g., ice-dependent communities to the effects of climate change) can be taken as self-evident. - This criterion can be informed by survey data and models by using physical features known to be associated with biotic features that are sensitive or slow to recover. - Application of models that extrapolate results of studies in one area to other areas of similar features will be particularly helpful, especially models that predict the sensitivity or fragility of particular community types
Examples	*Vulnerability of species:* - Inferred from the history of how species or populations in other similar areas responded to perturbations. - Species of low fecundity, slow growth, long time to sexual maturity, longevity (e.g. sharks, etc). - Species with structures providing biogenic habitats, such as deepwater corals, sponges and bryozoans; deep-water species. *Vulnerability of habitats:* - Ice-covered areas susceptible to ship-based pollution. - Ocean acidification can make deep-sea habitats more vulnerable to others and increase susceptibility to human-induced changes.
Criteria	**Biological productivity**
Definition	Area containing species, populations or communities with comparatively higher natural biological productivity.
Rationale	Important role in fuelling ecosystems and increasing the growth rates of organisms and their capacity for reproduction.
Consideration in application and Methods	- Can be measured as the rate of growth of marine organisms and their populations, either through the fixation of inorganic carbon by photosynthesis, chemosynthesis, or through the ingestion of prey, dissolved organic matter or particulate organic matter. - Can be inferred from remote-sensed products, e.g., ocean colour or process-based models (global datasets are available for Chlorophyll-a, primary productivity, and secondary productivity). - Due to high temporal variability (years, seasons, and short time scales) appropriate temporal coverages should be considered. - High primary productivity near the surface may not necessarily mean higher secondary productivity near the seafloor. - Time-series fisheries data can be used, but caution is required.
Examples	- Frontal areas - Upwellings - Hydrothermal vents - Seamonts polynyas
Criteria	**Biological diversity**
Definition	Area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.
Rationale	Important for evolution and maintaining the resilience of marine species and ecosystems.

Consideration in application and Methods	- Diversity needs to be seen in relation to the surrounding environment - Diversity indices are indifferent to species substitutions - Diversity indices are indifferent to which species may be contributing to the value of the index, and hence would not pick up areas important to species of special concern, such as endangered species. - Diversity can be inferred from habitat heterogeneity or diversity as a surrogate for species diversity in areas where biodiversity has not been sampled intensively. For benthic habitats, this can be approximated by measuring physical topographic complexity or rugosity; for pelagic habitats, this can be estimated by identifying convergences of differing water masses. - When comparing measures of species diversity among areas, sampling should be sufficient to statistically support such comparisons, for example, by ensuring that species accumulation curves (when considering richness) are saturated prior to conducting pair-wise comparisons. Otherwise, there is a danger of identifying areas with more research effort. - Examples of diversity indices that can be used: • Berger-Parker Index • Simpson's Index • Shannon-Wiener Index • Pielou's Evenness Index • Hurlbert (ES50) Index • Rank Abundance Curves
Examples	- Seamounts - Fronts and convergence zones - Cold coral communities - Deep-water sponge communities

Criteria	**Naturalness**
Definition	Area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.
Rationale	- To protect areas with near natural structure, processes and functions. - To safeguard and enhance ecosystem resilience.
Consideration in application and Methods	- Priority should be given to areas having a low level of disturbance relative to their surroundings. - In areas where no natural areas remain, areas that have successfully recovered, including reestablishment of species, should be considered. - Criterion can be used both in their own right and in conjunction with other criteria. - This criterion is a relative measure. - Mapping and analysing the cumulative effects of human maritime activities should reveal overall patterns that would be useful to identify possibly (more) natural areas of a given habitat type. Stressors can be mapped using a GIS and overlaid on habitat maps to predict the 'naturalness' of an area.
Examples	Most ecosystems and habitats have examples with varying levels of naturalness, and the intent is that the more natural examples should be selected.

Table 2. Additional examples of features that would meet the scientific criteria for identifying ecologically or biologically significant marine areas or species (CBD, 2007):

Benthic features
• Seamount communities • Cold water coral reefs • Coral, sponge and bryozoan aggregations • Hydrothermal vent ecosystems • Gas hydrates

• Cold seeps • Pseudo abyssal depressions (basin-like structure) • Canyons • Submerged atolls, bank and guyot communities • Carbonate mounds • Trenches
Pelagic habitats
• Upwelling areas • Fronts • Gyres • Recurrent or persistent polynyas
Vulnerable and /or highly migratory species
• Whales and other cetaceans • Seabirds, • Sea turtles • Sharks • Highly migratory fish • Discrete deep-sea fish populations

Criteria were designed to be applied individually with regard to their relative significance within the region under consideration. **All of the EBSA criteria (except for uniqueness) are relative measures**, i.e., they comparatively order places that are more "significant" than surrounding areas based on the ecological role played by the area within the larger region where an evaluation of EBSAs is occurring. The properties of marine ecosystems vary widely from region to region, so global absolute thresholds (i.e., measurement "X" must exceed "a" units) are not appropriate. Instead, the evaluation process must determine relative importance of specific features or places in a given ecological region on each of the criteria. In the best cases, ecological knowledge of the area can be used to establish and justify a particular threshold value above which any area would qualify as an EBSA on the given criterion. This is the ideal approach, but also the most demanding of both data and ecological knowledge of an area. Examples of strategies to determine relative rankings: identify natural break point(s) in the data; select a cut-off based on standard deviations.

The scientific description of EBSAs should also be complemented with **network-level considerations**, like representativity, in which a biogeographic classification system can be very helpful.

Following the EBSAs description, CBD Parties have recognised that the efficiency of EBSAs may be enhanced by assigning them to one of four EBSA categories. These categories are linked to the spatial and temporal dynamics of ecological and biological characteristics and the degree to which the boundaries are ecologically distinct within an area that meets the EBSA criteria (Johnson et al., 2008). The categories are:

- **Spatially stable features whose positions are known and individually resolved on the maps.** Examples include individual seamounts and feeding areas for sharks and seabirds. Such areas do not have to be used all year round, nor does all the area have to be used every year. However, the feature(s) is entirely contained in the corresponding map polygons.
- **Spatially stable features whose individual positions are known but where a number of individual cases are being grouped.** Examples include a group of coastal areas, seamounts or seabird breeding sites where the location of each is known but a single polygon on the

map and corresponding description encompasses all the members of the group. The grouping may be done because there may be insufficient knowledge to evaluate each separately or the information is basically the same for all members of the group, so one description can be applied to all group members.

- **Spatially stable features whose individual positions are not known**. Examples include areas where coral or sponge concentrations are likely, based on, for example, modelling of suitable habitats, but information is insufficient to specify the locations of each individual concentration. Each such area may be represented by a single map polygon and description, but the entire area inside the polygon is not to be interpreted as filled with the feature(s) meeting the criteria. Narrative about these areas should stress the importance of getting better information on the spatial distribution of these features.
- **Features that are inherently not spatially fixed.** An example is the North Pacific frontal transition zone. The position of this front moves seasonally and among years. The map polygon for such a feature should include the full range occupied by the front (or other feature) during a typical year. However, the description and its narrative should describe seasonal movement of the key feature(s). The text for description should also make very clear that at any given time, the ecological importance usually is highest wherever the feature is located at that time and often decreases as distance from the feature increases. It may even be the case that at any given time some parts of the total area contained in the polygon are ecologically little different from areas outside the polygon.

Finally, it should be noted that the EBSA description process is open-ended, and additional regional or subregional workshops may be organized when there is sufficient advancement in the availability of scientific information (CBD, 2019b). However, there is still a lack of a process on how to describe new areas through mechanisms other than regional workshops and how to incorporate outputs from national processes (CBD, 2020).

4 THE EBSA CONCEPT IN MARINE PLAN

Marine Plan focuses on quantifying biological productivity P, biological diversity D and naturalness N. The other EBSA criteria are considred, but by their nature they canot be quantified as well as the three aforementioned cirteria.

In the following section, we used quantification and measurement synonymous. If model data are applied instead of actual measurement it will be explicitly stated.

P, D and N are ideally samples on a spatial scale much smaller than potential EBSAs. This way, we can assess variability and hotpots, and in case can fit designated EBSAs.

Disentangling and decoupling the temporal and spatial dynamics of species diversity is a critical pre-requisite for elucidating the effect of EBSAs and the most promising locations for protected areas inside EBSAs. This way, such an understanding can provide valuable input for informing and planning broad-scale conservation and ecosystem-based management strategies. In Marine Plan, we examine spatial and temporal patterns and compare drivers of multiple marine biodiversity, productivity and naturalness indicators (Figure 1).

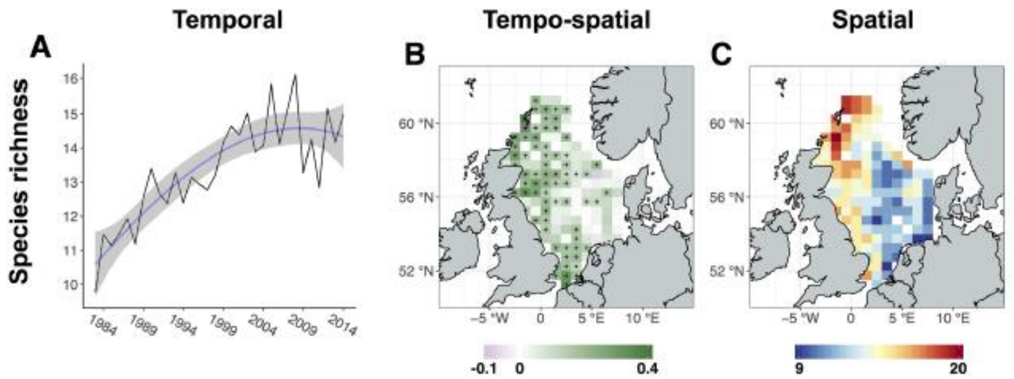

Figure 1: Example for species richness, a biodiversity indicator, in the North Sea. Panel A gives the temporal development aggregated for the whoel North Sea, panel C on the right the average spatial gradient, while panle B in the center combines these two and shows the areas with the greatest temporal variability (Dencker et al. 2017).

These data can in the future be used to assess natural and environmental drivers on productivity, biodiversity and naturalness. The drivers can be selected based on their demonstrated importance in shaping patterns of fish biodiversity in marine ecosystems. This way, the Marine-Plan concept for quantifying EBSAs maintains compatibility to quantitive ecological research and allows for forecasting of EBSA properties for example in the course of ongoing climate changes.

The EBSA criteria have strong links to the FAO VME criteria and the CBD COP14/8 biodiversity attributes (Fig. 2). However, while e.g. biological diversity (EBSA) is a measurable quantity, the corresponding criteria 'key biodiversity areas' (CBD COP 14/8) and 'functional significance of habitat' are poorly defined quantitatively.

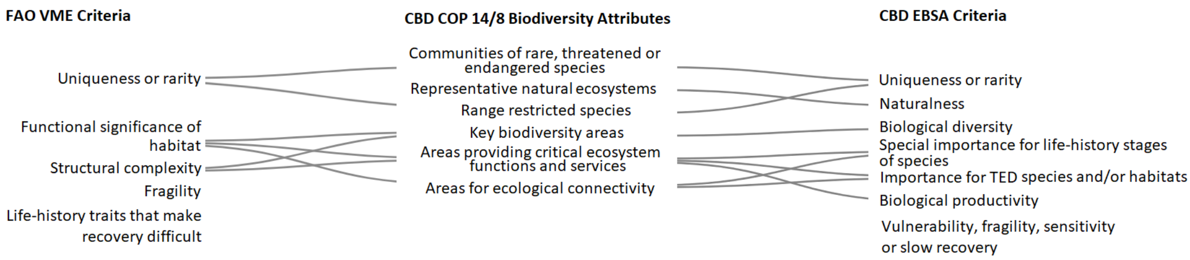

Figure 2: Comparison of the criteria used for VME (FAO 2009) and CBD EBSA (CBD/COP/DEC/IX/20) identification with those provided as CBD Biodiversity Attributes for OECM descriptions of in situ conservation of biodiversity (Criterion C). TED=Threatened, Endangered and Declining. (REF, ices report vanessa mail)

5 DATA AVAILABILITY IN THE PLANNING SITES

The EBSA criteria with data avialble in each study site are listed in table 3. The remainder of the chapter gives a condensed overview over data availability and possible restrictions.

Table 3. Ecologically and Biologicall Sensitive Areas (EBSA) criteria with data available in each Marine Plan study site. EEZ: Exclusive Economic Zone; VMS: Vessel Monitoring System; AIS: Automatic Identification System.

EBSA Criterion	Azores	Celtic Sea	Aegean Sea	Naples/ Campana	Southern North Sea	Western Baltic Sea	Bay of Biscay	Western Med.
Biological Productivity		Survey data; Chl-a sat data	Satellite data for upwelling areas		Lots of data, need to create overview, go beyond fisheries and primary production.	Lots of data, need to create overview, go beyond fisheries and primary production.	Chl-a satellital data Survey data with acoustic techniques for a number of species of commercial interest.	Data from primary productivity (such as Chl-a satellite data)
Biological Diversity	Several indicators for benthos health	Survey data, biodiversity indices	Model data for species richness	Canyons, deeps forests: habitat extent, number of species per unit area	Lots of data, need to create overview, go beyond fisheries and primary production.	Lots of data, need to create overview, go beyond fisheries and primary production.	Up to now, we have been working with presence models extracted from AquaMaps because we do not have data of a big amount of species	Data for the whole area from pelagic and benthic biodiversity (low resolution) and high-resolution data for specific EEZs
Naturalness	VMS/AIS data on bottom fishing	VMS data	AIS data for fishing effort of large vessels; model of small-scale fisheries' effort; population density of nearest coastal areas /river basins; tourist arrivals		VMS data to identify areas not traditionally fished	VMS and AIS data; Gravel extraction and Klapping.	AIS data from EMODnet VMS (but only for spain).	Priority areas for Management (PAMs): Heat maps of Multiple Environmental Value Areas (MEVAs) and relatively low bottom trawling fishing effort

5.1 Celtic Sea

The Celtic Sea PS is planning to incorporate all the specified EBSA criteria, with most of the required data already at their disposal. However, in several instances, while they have initial data, the team has yet to finalize how this information will be integrated into the analysis. The PS team is working to establish contact with partners to gain access to some data sources. Of particular concern is the lack of solid data for certain features, such as rare species. The Celtic Sea has very unique habitats and efforts are underway to collaborate with partners who possess data e.g. on seagrasses and maerl beds to gain access to the dataset. Data collection is ongoing for important habitats related to fish species' feeding and breeding, as well as significant zones for cetaceans. While point data exists for various ecological features like leatherback turtles and elasmobranchs, the aim is to develop models spanning the entire PS. To assess productivity, the team plans to utilize chlorophyll-a as an indicator, considering the Celtic Sea's high productivity. Considering diversity, they are contemplating the use of a species richness index, primarily focused on fish species. This data is likely to be sourced from fisheries surveys but they will need to think on how to transform it into a spatial metric. Data regarding the presence and distribution of benthic fauna are currently lacking and need to be addressed. The team intends to use VMS data to account for naturalness, though this information is available only for vessels exceeding 12 meters. Additionally, they are exploring the incorporation of a cumulative pressure index being developed under the GES4SEAS project.

5.2 Aegean Sea

The Aegean Sea contains a good amount of data for most of the criteria. These data are also coming from other projects e.g. endangered species and they are in the middle of updating. They have a wider coverage from the Aegean Sea/region. They have modelled data for this region and they miss data from the Ionian Sea. The biggest challenge is how to use the data in the end; point data, presence data, they don't have in situ data for deeper areas. VMS data are lmited, so in The Aegean Sea, AIS data are going to be used for naturalness, however, these data don't account for all the fishing effort. For the Aegean Sea, we will run a small scale model using multi-criteria analysis that accounts for ecological, distance to coast, legislation, weather data. Small scale boats operate locally and the fishing effort depends on local conditions. Some areas have low and others have higher fishing effort. The model will include these considerations to include fishing effort. For biological productivity, an upwelling index will be used, and for biological diversity species richness derived from maps provided by AQUAMAPS will be applied.

5.3 Bay of Biscay

Generally, there are quite good data available for the Bay of Biscay planning site. However, there are significant differences in the quality and resolution of data when comparing shallow and deep waters.

For the assessment of biological productivity, satellital Chl-a data are available. Biomass estimations for a number of species of commercial interest are also available (mainly for pelagic species, including anchovy, makerel, tuna and sardine). In contrast, productivity data for deep-sea areas is limited.

In terms of biodiversity, there is not an unified database and information derived from species presence models (i.e. AquaMaps) will be used as a proxy.

In terms of naturalness, information derived from research studies and environmental status assessments (under the Marine Strategy Framework Directive (MSFD)) and conservation status assessments (under Habitats Directive), will be used together with information on human activities producing pressues (e.g. fishing activity data from EMODnet). VMS data are also available, but only for Spanish waters and fishing activity of artisanal fisheries is also available but only for the Basque Country zone.

5.4 Gulf of Naples

The Gulf of Naples, is not an EBSA. It is a small region compared to the other PS (450 km coastline) hosting high biodiversity and archaeological remnants embedded in areas with high cumulative pressures. High-quality data are already available with a dedicated spatial geoportal. The Geoportal contains information derived from field activities (habitat mapping, anthropogenic uses, socio-economic data) and desk-based analyses. It is organized in a GIS environment, in accordance with an INSPIRE protocols developed by the EU and already tested in EU projects such as CoCoNet, Adriplan and Cohenet in a Maritime Spatial Planning context. Data (e.g. habitat distribution, species abundance and richness) are available in Natura 2000 sites, and Marine Protected Areas (one is a SPAMI) already integrated in the Geoportal. The area also includes two IMMAs (Important Marine Mammal Areas, https://www.marinemammalhabitat.org/), identified by IUCN for their importance for some endangered cetacean species, and one ISRA (Important Shark and Ray areas) at the S. Croce Bank (https://sharkrayareas.org/e-atlas/).

Two spatial databases, a small-scale one created for the protected sites and the regional-scale one, communicate through a single geoportal that will ensure the integration of information. There is a regional MSP framework not connected with the ScP process. All seven EBSA criteria can be applied. In terms of biological diversity, both univariate and multivariate approaches can be adopted to test spatial gradients in biodiversity and to assess protection effectiveness across species/habitats. Data on invasive species within and outside MPAs are also available. In addition, data are available to test MPA network effectiveness and to assess where eventually to expand present protection schemes to reach EU targets. Even though shallow habitats and protected species are better known in terms of distribution and status, there are ongoing projects carried out also in deeper habitats (e.g. canyons).

(https://geonetwork.bioinfo.szn.it/geonetwork/srv/eng/catalog.search#/home)

5.5 Southern North Sea

The Southern North Sea planning site has great amounts of data available addressing productivity, diversity and naturalness. Most information on productivity is collected through national MSFD monitoring every year by three different institutes. Furthermore, Chl-a satellite data are available for the whole area. Trawl survey data from DATRAS and EMODNET are available for fish diversity, bottom classifications, and habitat maps that could be used to develop North Sea fish species distribution models, as well as marine mammals and bird distribution models. CEFAS conducts a plankton survey that can be used to assess plankton diversity. Both VMS and AIS data are widely available to assess the usage respectively naturalness in the Southern North Sea on narrow spatial scales.

The recently compiled 2023 Quality Report Assessment[1] of OSPAR will provide recent and uniformized data for the Southern North Sea case study.

5.6 Western Mediterranean

The Western Mediterranean Sea Planning Site represents an area of about 846,000 km^2, and it includes EU and non-EU countries (Europe and North Africa) from the Sicily Channel to the Strait of Gibraltar. This region is subjected to intense human pressures, including high fishing of commercial species and large discarding and by-catch rates of non-commercial and vulnerable species, as well as climate change effects such as intense sea warming (including marine heatwaves), ocean acidification and changes in primary production. In addition, habitat degradation, pollution and the introduction of invasive species (e.g., blue crab) are challenging the management of coastal and marine resources. In the case of EU countries, national plans are still in their first steps in some of them and they do not exist yet in other ones. There is not a global regional Marine/Maritime Spatial Planning (MSP) structure but there are some international sectorial marine planning initiatives including Fisheries Restricted Areas or conservations figures such as the Specially Protected Areas of Mediterranean Importance (SPAMIs) areas. Furthermore, the establishment of new Fisheries Restricted Areas (FRAs), and the implementation of larger Marine Protected Areas (MPAs) to conserve and restore Vulnerable Marine Ecosystems (VME) and Essential Fish Habitats (EFH), achieving 30% protection for 2030 is being discussed. Several EBSAs are already in place (Sicilian Channel, North-western Mediterranean Benthic Ecosystems, North-western Mediterranean Pelagic Ecosystems), but they are very large areas and it is so far unclear their protection function . According to stakeholders interviewed during the first year of MarinePlan, EBSAs, as currently defined, are not a major contribution to MSP in the region. As currently defined they are very broad, and according to the interviewees, it is not clear their added value. In a context where most of the MSP is done at the national level, stakeholders usually consider that the national MSP and MPAs processes provide them with enough specific environmental information. However, actual nationally designated MPAs are very small and all are placed in the coastal areas.

The main aim of this Planning Site within the Work Package 2 approach is to evaluate all the criteria that define the already identified EBSAs in all the region, incorporating climate change in the analysis (considering changing/stable areas), and redefine efficiently the current EBSAs to inform decision-making processes.

For the Western Mediterranean:

- **Uniqueness or rarity criterion** will be assessed by using the distribution of endemic species (e.g. *Larus audouinni*, sharks and rays, ...) and unique vulnerable marine ecosystems (VMEs, seamounts, bamboo coral).
- **Special importance for life-history stages of species criterion** will be evaluated using data from nursery and spawning habitats of commercial species, and VMEs (seagrass, maerl, coraligenous).
- **Importance for threatened, endangered or declining species and/or habitats criterion** will be assessed with data from *Posidonia oceanica* meadows location (protected habitat) and bamboo coral.
- **Vulnerability, fragility, sensitivity, or slow recovery criterion** will be analysed using data from VMEs and species at risk.

[1] https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/

- **Biological productivity criterion** will be measured using data from primary productivity (such as Chl-a satellite data).
- **Biodiversity criterion** will be evaluated with data for the whole area from pelagic and benthic biodiversity (low resolution) and high-resolution data for specific EEZs.
- **Naturalness criterion** will be assessed by using priority areas for Management (PAMs) following established analysis: Heat maps of Multiple Environmental Value Areas (MEVAs) and relatively low bottom trawling fishing effort. We could overlap other layers related to human activities.

5.7 Azores

The main objective of this Planning Site is to provide scientific information to the regional government of the Azores in support of the expansion of the network of MPAs. The Azores Planning Site adopted ecological management goals and SMART objectives for the development of the systematic conservation planning scenarios for the deep-sea waters of the Azores EEZ, based on the broad overarching mission statement of protecting natural diversity, ecosystem structure, function, connectivity and resilience of deep-sea communities in the Azores EEZ in climate change scenarios, while allowing the environmentally sustainable use of natural resources. For this, MarinePlan will contribute to fill some of the identified knowledge gaps and use the extensive data gathered over the last years (e.g., through the H2020 projects ATLAS and iAtlantic) along with systematic conservation planning tools (e.g., Marxan implemented with PrioritizeR) to develop multiple EB-MSP scenarios to improve the systematic conservation planning.

Identifying areas of ecological relevance, such as those that fit the FAO criteria for defining Vulnerable Marine Ecosystems (VME) or the CBD criteria for identifying Ecological and Biological Significant Areas (EBSA), is currently of upmost importance to implement efficient management measures that would ensure the protection of the natural heritage in commitment with a sustainable use of marine resources and the implementation of the Biodiversity Strategy 2030 and the UN Biodiversity 2030 Agenda for Sustainable Development. In the Azores PS, the EBSA criteria were translated to VME (Table 1) criteria because VME criteria are more related to management goals and objectives. Taking advantage of the large volume of data collected in the Azores over the last years on VME indicator species, VME communities, and their spatial distribution, but also on the efforts to identify VMEs, the Azores PS assessed the geomorphological units against each of the five criteria for defining what constitutes a VME using expert judgement. The methodology used for the assessment was based on a qualitative scoring adapted from Morato et al. (2018). The degree to which sampling areas fit each of the five FAO criteria was scored as 1 (low), 2 (medium), 3 (high) or 4 (very high). The scoring procedure was discussed and agreed by a group of deep-sea scientists using existing informed expert judgment, and the following specific guidelines adapted from Morato et al. (2018).

The features were generally assessed in relation to the diversity of species and biological communities, with unique characteristics in terms of the composition of endemic, rare or threatened species (VME criteria 1 / EBSA Uniqueness or Rarity), and to the presence and abundance of communities composed of tall, and arborescent species that provide complex habitat for other species (VME criteria 5 / EBSA Biological Productivity). The fragility of the habitat-forming species (VME criteria 3 / EBSA Vulnerability, Fragility, Sensitivity, or Slow recovery) was based on evidence of vulnerability to physical contact, such as accidental capture during longline fishing (based on Sampaio et al., 2012; COLETA database), and the capacity of species for retraction, retention or re-growth or natural protection in some way. In general, there is limited information to assess the life history and functional significance of the species and communities (VME criteria 2 / EBSA Special importance for life history stages of species, and VME criteria 4 / EBSA Importance for threatened, endangered or declining species and/or habitats respectively) due to major knowledge gaps on species reproductive cycles, growth rates, reproductive output, larvae biology and dispersal, recruitment and their role in the functioning of the ecosystems such as nursery areas for other species, nutrient regeneration, and carbon remineralization and sequestration. When available, information on life-history traits for closely related species or same taxa was used as a proxy to score for that criterion, based on the assumption that these traits are phylogenetically conserved. As for the functional significance of the habitat, there is information regarding fish and sharks' aggregations in or close to coral gardens, for example the deep-water kitefin shark *Dalatias licha* and the orange roughy *Hoplostethus atlanticus*. However, it is difficult to infer a direct link between habitat-forming species such as corals or sponges and their role as nursery grounds, especially based on observed adult fish and shark species. Because of limited knowledge, in most cases it was assumed that those features that presented the highest diversity of species and communities had a potentially higher functional significance. This is based on studies that show a direct relationship between biodiversity and ecosystem functioning for deep-sea ecosystems and how habitat heterogeneity increases the number of niches for associated species, ecological interactions, and food web complexity. Though, as new scientific knowledge is gathered in the future, a better assessment of these criteria will be possible.

There are two major data limitations in this Planning Site, spatial resolution related to environmental variables as well as models from climate projections, and the spatial scale in order to address connectivity. In this case, the spatial scale should be larger than the Planning Site area.

EBSA Criterion	Description of the criteria	Scoring guidelines	Data
Uniqueness or Rarity (VME criteria 1 ”Uniqueness or rareness”)	An area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by similar areas or ecosystems	According to presence on IUCN red list, and if the VME indicator species and/or communities are known to be endemic, rare, threatened or declining. Hydrothermal vent (HV) fields are recognized as important VMEs	• Deep-sea benthic occurrence database • Ventbase 3.1 database
Special importance for life history stages of species (VME criteria 2 ”Functional significance ”)	Discrete areas or habitats that are necessary for the survival, function, spawning/reproduction or recovery of fish stocks, particular life-history stages (e.g., nursery grounds or rearing areas), or of rare, threatened or endangered marine species	Evaluating if the VME indicator species and/or communities were known to create nursery areas for other species, or known for having higher level ecosystem role, such as nutrient cycling and water filtration. Acknowledging all knowledge gaps and uncertainties essential fish habitats (EFH) are an example of such areas.	• VME assessments (e.g., Morato, Carreiro-Silva, Dominguez-Carrió et al., unpublished data; Beaulieu & Szafranski, 2019) • Known essential fish habitats (Santos et al., 2010; Menezes et al., 2012; Melo and Menezes, 2002) • Habitat suitability and abundance models of commercially important deep-sea benthic fish (Parra et al., 2017)
Importance for threatened, endangered or declining species and/or habitats (VME criteria 4 ”Life-history”)	Ecosystems that are characterized by populations or assemblages of species with one or more of the following characteristics: slow growth rates, late age of maturity, low or unpredictable recruitment, or long-lived	Against the longevity of the VME indicator species and/or communities as a proxy for potential recovery after disturbance, fecundity, age at maturity, growth rate, and known frequency of recruitment success	• Known occurrence records of selected Vulnerable Marine Ecosystems indicator taxa (endemic, extremely long-lived, and reef engineers) (COLETA database; multiple other sources) • Habitat suitability models of endangered or critically endangered deep-water sharks and rays (Das et al., unpublished data)
Vulnerability, Fragility, Sensitivity, or Slow recovery (VME criteria 3 ”Fragility”)	An ecosystem that is highly susceptible to degradation by anthropogenic activities	According to the fragility of the VME indicator species and/or communities against physical contact, the height and complexity of its structure, and the capacity for retraction, retention or re-growth or if being naturally protected in some way	• VME assessments (e.g., Morato, Carreiro-Silva, Dominguez-Carrió et al., unpublished data; Beaulieu & Szafranski, 2019)

Biological Productivity (VME criteria 5 "Structural complexity").	An ecosystem that is characterized by complex physical structures created by significant concentrations of biotic and abiotic features	Based on structural habitat created by the VME indicator species and/or communities, and presence of commensal or closely associated species	• Habitat suitability models of habitat-forming and vulnerable cold-water corals (Taranto et al., 2023) • Inferred Vulnerable Marine Ecosystems index (Morato et al., 2018)
Biological Diversity	Because of the perceived rich biodiversity and vulnerability of some seamount communities to human activities, Watling & Auster (2017) suggested that seamounts should be managed as VMEs. Although not all seamounts are the same, shallow-water and abyssal seamounts have often been nominated as (proxies for) biodiversity hotspots not only for the benthic fauna but also for the large megafauna that visits these features.	Based on the depth of the seamount summit: shallow water are those with summits shallower of approximately 250m depth; while abyssal seamounts are roughly deeper than 1500m.	• Deep-sea benthic occurrence database • Multibeam bathymetry data • Known shallow (<250m) and deep (>1500m) seamounts (Morato et al., 2008; 2013; Rodrigues et al., unpub. data)
Naturalness	Potential near-natural seabed areas in the Azores were defined as those areas within fishable depths (i.e. shallower than 1200m) that may not have been exploited by deep-sea bottom fishing.	Analyses of VMS data for the period 2002 to 2018	• VMS data on bottom fishing and Natural Jenk breaks for defining categories • Known near natural areas in the range of current deep-sea benthic fishing activities (< 1200m) (Morato et al., unpublished data) • Existing area-based management tools (e.g. MPAs)
Representativity	Representativity is captured in a network when it consists of areas representing the different biogeographical subdivisions of the global oceans and regional seas that reasonably refl ect the full range of ecosystems, including the biotic and habitat diversity of those marine ecosystems	A full range of examples across a biogeographic habitat, or community classifi cation; relative health of species and communities; relative intactness of habitat(s); naturalness	• Geomorphic Management Units derived from the best-compiled bathymetry dataset (Gerald Taranto, unpublished data)

5.8 Western Baltic Sea

The National Monitoring Programme for Aquatic Environment and Nature (NOVANA) in Danish monitors the state of the aquatic environment and nature in the areas prioritised by the politically determined economic framework. NOVANA contributes in particular to Denmark fulfilling our obligations in relation to national legislation, EU directives and international conventions on monitoring of the aquatic environment, nature and air. The data on the aquatic environment and nature collected by the Novana programme meet much of the natural status knowledge needs needed to draw up the national river basin and Natura 2000 plans.

Despite the intensive sampling, biodiversity can only be asessed to a limited extent using NOVANA data. The sampling is disaggregated, and diversity is not monitored comprehensively, There are data on plankton species and benthic diversity, however, fish diversity needs to be deducted from the Baltic international bottom trawl survey conducted by ICES twice a year. Productivity is monitored by direct measurements as well as satellite data. The Western Baltic is one of the most intensively used marine areas world-wide, and there is an abundance of VMS and AIS data available on ship traffic as well as trawling operations.

Similar to Denmark, Germany has a wide range of National Federal/State Monitoring Programs (deutsche Bund/Länder-Messprogramme, short BLMP) monitoring the marine environment of the North Sea and Baltic Sea to fulfill the obligations set by national legislation (e.g., Water Resource Act – WHG), EU directives (e.g., MSRL) and international conventions (e.g., HELCOM). Data is collected on biological (i.e., macro- and phytoplankton, makro- and zooplankton, fishes, birds, mammals, invasive species), chemical (i.e., pollutant and nutrients sources and concentrations, biological effects of pollutants) and physical (i.e., bathymetry, hydrography, substrate) aspects. Furthermore, habitat monitoring (i.e., specially protected benthic habitats) and monitoring of anthropogenic stressors (i.e., energy and noise under water, waste, commercially used fish and shellfish, human activities) take place. All of which to assess the environmental status of the two seas. Sampling is done by a diverse set of authorities (e.g., federal/state authorities, research institutes, external contractors).

Also here, despite the intensive sampling, biodiversity can only be asessed to a limited extent from this data as data gaps exist on species and areas. The Baltic International Trawl Survey (BITS) by ICES is designed to monitor commercially important fish species twice a year (Q1 & Q4). Other species are not recorded representatively but rather as bycatch. Since 2013 the Box Survey (BaltBox) has been registered under the MSRL at the EU as a long-term survey to monitor the biodiversity of demersal fish species communities and to record its natural variability off the German Baltic Sea coast including the Western Baltic Sea. Commercially important pelagic fish communities are monitored during ICES Baltic acoustic surveys (BIAS & BASS). All ICES data are available (open access) at the DATRAS-database. A comprehensive fish monitoring is only conducted within coastal areas (within 12 nm). This coastal fish monitoring already takes place in various countries bordering the Baltic Sea within the HELCOM guidelines, but there are spatial and temporal gaps and the methodology is not uniform and standardized yet. Furthermore, despite the high number of surveys, large areas of the Western Baltic remain unexplored due to gear limitations. These include especially hard substrate and reef habitats as well as shallow water areas < 20 m (which make up to 70% of the total SD 22).

HELCOM zooplankton monitoring in the EEZ started in 1979 (few data) and 1983, respectively. In German coastal waters, monitoring has been conducted since 2013 (Mecklenburg-Vorpommern) and 2015 (Schleswig-Holstein). Data is taken in the open Baltic Sea five times each year and 10 x per year in coastal waters. However, data net in the German AWZ is scarce (only one station in Western Baltic Sea). Data on zooplankton is available on the MUDAB data base.

The phytoplankton monitoring of the coastal waters is carried out by the state authorities. Monitoring in the open Baltic Sea (German EEZ) is carried out by the IOW (Institute for Baltic Sea Research Warnemünde) on behalf of the BSH within the framework of HELCOM monitoring. Productivity is monitored by direct measurements as well as satellite data (Chl-a). Data on phytoplankton is available on the MUDAB data base.

Marine birds are monitored on a yearly basis. Marine mammal monitoring is carried out each year in protected areas and twice in six years for the entire German Baltic Sea region. Population monitoring of harbor seals and grey seals is conducted through areal surveys (usually by flight counts and/or observations by ship) for harbor porpoises on transects with aircraft. In areas with low harbor porpoise density, acoustic monitoring is used. Data on marine mammals and birds is only available upon request from the responsible state authorities.

VMS and AIS data are available but limited to ships > 12m (not obligatory for ships < 12 m).

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