PART B9

METHODOLOGY

For assessment and mapping of MARINE ecosystems condition and their services in Bulgaria

METHODOLOGICAL FRAMEWORK FOR ASSESSMENT AND MAPPING
OF ECOSYSTEM CONDITION AND ECOSYSTEM SERVICES IN BULGARIA

**METHODOLOGY FOR ASSESSMENT AND MAPPING
OF MARINE ECOSYSTEMS CONDITION AND THEIR SERVICES IN BULGARIA**

PART B9

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1. Introduction

1.1. What is this methodology about?

The current methodology forms a part of the national methodological framework on mapping and assessment of ecosystem services, which aims at streamlining the national ecosystems and ecosystem mapping and biophysical assessment process in Bulgaria. The methodology is not aimed at completing the full cycle of ecosystem service valuation and reporting. It delivers a practical step-by-step guidance to the process of:

1. Assessing the condition (state) of the **Bulgarian Marine** ecosystems
2. Assessing the **Bulgarian Marine** ecosystems' potential to deliver ecosystem services (biophysical valuation).

The methodology is relevant to marine ecosystems along the entire Bulgarian Black Sea waters including: territorial waters/sea (12 nautical miles from the coast baseline), Contiguous zone (24 nautical miles from the coast baseline) and the Exclusive economic zone (200 nautical miles (from the territorial waters/sea baseline) although its implementation will differ between NATURA 2000 areas and areas outside NATURA 2000 due to different data availability, waters use and the spatial distribution of ecosystems. Marine habitats include those below mean water level and enclose.

Saline coastal lagoons (areas of shallow, coastal saline water, wholly or partially separated from the sea by sandbanks, shingle or, less frequently rocks (Brown et al., 1997). The methodology will form a part of a wider national methodological framework (under development) which details the theoretical background behind the ecosystems approach practiced in Bulgaria, as well as the necessary steps to undertake towards fulfilling Action 5 "Improve knowledge of ecosystems and their services in the EU" of Target 2 "Maintain and restore ecosystems and their services" of the EU Biodiversity Strategy to 2020.

1.2. Who is this methodology for?

This methodology is to be used by:

- Organizations and scientists who perform ecosystems status assessment and biophysical valuation of ecosystem services. Such organizations are expected to include the beneficiaries/partners under the programs that have set aside funding for the national process of ecosystems mapping and assessment – e.g. for NATURA 2000, the Operational Program Environment 2014-2020 and outside NATURA 2000 – Program BG03 Biodiversity and ecosystem services 2009-2014
- National or local authorities who wish to contribute data they produce to the Biodiversity information system for Europe (BISE)- Bulgaria.
- Project promoters and partners under other projects, including for example research organizations and NGOs,
  - who wish to contribute to the national assessment results from their past or ongoing projects targeting wholly or in part a more detailed ecosystem biophysical valuation and ecosystem services assessment on a regional or local scale in smaller scale pilots
  - Plan future projects to complement the national scale assessment and valuation
- Data users wishing to understand the content and collection method of data, including but not limited to, organizations involved in environmental reporting, regional and local authorities, environmentally responsible companies, NGOs, and other stakeholders.

1.3. How to use this methodology?

The methodological framework provides a combination of information on relevant information sources that may be of interest to a wider circle of stakeholders, while the current methodology is dedicated to specific guidance to assessing ecosystem status and ecosystem services (including data collection and verification, and mapping guidance).

The wider introductory parts are more likely to be of interest to policymakers and the general public. The more targeted use defined in the current methodology will be mostly needed by professionals involved in the national mapping and assessment exercise.

As the current methodology is a living document, comments are welcome in order to shape it as a national, widely reviewed, and adopted guidance document.

2. Typology of ecosystems in Bulgaria

2.1. Typology of marine ecosystems in Bulgaria

The proposed typology of marine ecosystems (Level 1 and Level 2) corresponds with the ecosystem classification of Mapping and Assessment of Ecosystems and their Services (MAES, 2013). Level 3 corresponds with the classes of the European Nature Information System (EUNIS) habitat classification types, Table 1.

Table 1. Typology of marine ecosystems in Bulgaria

Level 1	Level 2	Level 3
Marine	Marine inlets and transitional waters Coastal areas Shelf Open ocean	**A1.** Littoral rock and other hard substrate **A2.** Littoral sediment **A3.** Infralittoral rock and other hard substrate **A4.** Circalittoral rock and other hard substrate **A5.** Sub-littoral sediment **A6.** Deep sea-bed **B3.** Rock, cliffs, ledges and shores, inl. Supralittoral **X2.** Saline coastal lagoons

2.2. Detailed ecosystem typology of marine ecosystems in Bulgaria

A selection of EUNIS classification on level 2 is proposed for detailed typology as level 3 for target ecosystem type. Total number of 8 marine sub-types is selected. They belong to EUNIS groups “A” “B” and “X”: “A1”, “A2”, “A3, “A4”, “A5”, “A6”,“B3” and “X2”. Due to the lack of signifficant tides in the Black sea “Estuaries (EUNIS- X1) and “Brackish coastal lagoons” (EUNIS- X3) are considered outside of the scope of marine ecosystems. The typology of **marine ecosystems** reduces the 3-dimensional structure of the ocean to the 2 dimensions of the seabed (benthic) habitats, attributing the 3rd dimension, the water column (pelagic habitats), to depth zones (MAES, 2013). Descriptions and relations to other classification systems of proposed subtypes of are presented in Table 2.

Table 2. Black Sea Marine ecosystem typology (Level 3)

EUNIS	Subtype	Description	Nomenclature(s)
A1.	Littoral rock and other hard substrate	Littoral habitats of bedrock, boulders and cobbles which occur in the splash zone. The upper limit is marked by the top of the lichen zone and the lower limit by the top of the brown algae zone. There are many physical variables affecting rocky shore communities - wave exposure, salinity, temperature. Wav e exposure is most commonly used to characterize littoral rock, from 'extremely exposed' on the open coast to 'extremely sheltered' in enclosed inlets. Exposed shores tend to support faunal-dominated communities of barnacles and mussels and some robust seaweed. Sheltered shores are most notable for their dense cover of seaweeds, with distinctive zones occurring down the shore. In between these extremes of wave exposure, on moderately exposed shores, mosaics of seaweeds and barnacles are more typical.	EUNIS A1.1 – A1.4 Natura 2000 1170 MSFD predominant habitats: Littoral rock and biogenic reef
A2.	Littoral sediment	Littoral sediment includes habitats of shingle (mobile cobbles and pebbles), gravel, sand and mud or any combination of these which occur in the zone of waves action (known also as mediolittoral). Littoral sediment is defined further using descriptions of particle sizes - mainly gravel (16-4 mm), coarse sand (4-1 mm), medium sand (1-0.25 mm), fine sand (0.25-0.063 mm) and mud (less than 0.063 mm) and various admixtures of these (and coarser) grades - muddy sand, sandy mud and mixed sediment (cobbles, gravel, sand and mud together). Littoral sediments support communities tolerant to some degree of drainage at low tide and often subject to variation in air temperature and reduced salinity in estuarine situations. Very coarse sediments tend to support few macro faunal species because these sediments tend to be mobile and subject to a high degree of drying when exposed at low tide. Finer sediments tend to be more stable and retain some water, and therefore support a	EUNIS A2.1 – A2.8 Natura 2000 1110 MSFD predominant habitats: Littoral sediment

EUNIS	Subtype	Description	Nomenclature(s)
A2.	Littoral sediment	greater diversity of species. Medium and fine sand shores usually support a range of oligochaetes, polychaetes, and burrowing crustaceans, and even more stable muddy sand shores also support a range of bivalves. Very fine and cohesive sediment (mud) tends to have lower species diversity, because oxygen cannot penetrate far below the sediment surface. A black, anoxic layer of sediment develops under these circumstances, which may extend to the sediment surface and in which few species can survive. Some sediments are dominated by angiosperms, e.g. eelgrass (*Zostera marina* and *Zostera noltii*) beds on the mid and upper shore of muddy sand flats, or saltmarshes which develop on the extreme upper shore of sheltered fine sediment flats.	EUNIS A2.1 – A2.8 Natura 2000 1110 MSFD predominant habitats: Littoral sediment
A3.	Infralittoral rock and other hard substrate	Infralittoral rock includes habitats of bedrock, boulders and cobbles which occur in the shallow subtidal zone and typically support seaweed communities. The upper limit is marked by the top of the brown algae zone whilst the lower limit is marked by the lower limit of brown algae or the lower limit of dense seaweed growth. In exposed states the brown algae is *Cystoseira bosphorica* whilst in more sheltered habitats it is usually *Cystoseira barbata*; other brown algae species may dominate under certain states. Areas of mixed ground, lacking stable rock, may lack brown algae but support seaweed communities. In estuaries and other turbid-water areas the shallow subtidal may be dominated by animal communities, with only poorly developed seaweed communities.	EUNIS A3.1 – A3.7 Natura 2000 1170 MSFD predominant habitats: Shallow sublittoral rock and biogenic reef
A4.	Circalittoral rock and other hard substrate	Circalittoral rock is characterized by animal dominated communities (a departure from the algae dominated communities in the infralittoral zone). The circalittoral zone can itself be split into two sub-zones; upper circalittoral (foliose red algae present but not dominant) and lower circalittoral (foliose red algae absent). The depth at which the circalittoral zone begins is directly dependent on the intensity of light reaching the seabed; in highly turbid states, the circalittoral zone may begin just below water level at mean low water springs (MLWS). The biotopes identified in the field can be broadly assigned to one of three energy level categories: high, moderate and low energy circalittoral rock (used to define the habitat complex level). The character of the fauna varies enormously and is affected	EUNIS A4.1 – A4.7 Natura 2000 1170 MSFD predominant habitats: Shelf sublittoral rock and biogenic reef

EUNIS	Subtype	Description	Nomenclature(s)
A4.	Circalittoral rock and other hard substrate	mainly by wave action, tidal stream strength, salinity, turbidity, the degree of scouring and rock topography. It is typical for the community not to be dominated by single species, as is common in shore and infralittoral habitats, but rather comprise a mosaic of species. This, coupled with the range of influencing factors, makes circalittoral rock a difficult area to satisfactorily classify; particular care should therefore be taken in matching species and habitat data to the classification.	EUNIS A4.1 – A4.7 Natura 2000 1170 MSFD predominant habitats: Shelf sublittoral rock and biogenic reef
A5.	Sub-littoral sediment	Sediment habitats in the sublittoral near shore zone (i.e. covering the infralittoral and circalittoral zones), typically extending from the extreme lower shore down to the edge of the bathyal zone (200 m). Sediment ranges from boulders and cobbles, through pebbles and shingle, coarse sands, sands, fine sands, muds, and mixed sediments. Those communities found in or on sediment are described within this broad habitat type.	EUNIS A5.1 – A5.7 Natura 2000 MSFD predominant habitats: Shallow sublittoral sand; Shallow sublittoral coarse sediment; Shallow sublittoral mud; Shallow sublittoral mixed sediment
A6.	Deep sea-bed	The sea bed beyond the continental shelf break. The shelf break occurs at variable depth, but is generally over 200 m. The upper limit of the deep-sea zone is marked by the edge of the shelf. Includes areas which are deeper than 200 m. Excludes caves in the deep sea which are classified in A4.71 irrespective of depth.	EUNIS A6.1 – A6.9 Natura 2000 MSFD predominant habitats: Upper bathyal rock and biogenic reef; Upper bathyal sediment;
B3.	Rock, cliffs, ledges and shores, incl. Supralittoral	Rock exposures adjacent to the sea and associated coastal lagoons, or separated from them by a narrow shoreline. The faces, ledges and caves of sea-cliffs and the expanses of rocky shore are important as reproduction, resting and feeding sites for seabirds, sea-mammals and a few groups of terrestrial birds. Sea-cliffs may also harbor highly distinctive, specialized salt-tolerant vegetation with associated terrestrial fauna, e.g. Common gull (Larus canus L.) and Shag (Phalacrocorax aristotelis L.)	EUNIS B3.1 – B3.4 Natura 2000: 1170 MSFD predominant habitats: Shallow sublittoral rock and biogenic reef

EUNIS	Subtype	Description	Nomenclature(s)
X2.	Saline coastal lagoons	Lagoons are expanses of shallow coastal salt water, of varying salinity and water volume, wholly or partially separated from the sea by sand banks or shingle, or, less frequently, by rocks. Salinity may vary from brackish water to hypersalinity depending on rainfall, evaporation and through the addition of fresh seawater from storms, temporary flooding of the sea in winter or tidal exchange. With or without vegetation of seagrasses or charophytes. Habitat types typical of lagoons are included in A5, although many other habitat types may also occur in lagoons.	EUNIS – X2 Natura 2000: 1150

3. Data availability

3.1. Existing data sources, gaps, uncertainty of data

For mapping and assessing of marine ecosystem conditions and services the most significant stage is the availability of data. In this section we give a short overview of the data used to map and assess ecosystem condition and services in the smaller scale, concerning marine ecosystems. We then put this in the context of data available at the national level. In order to identify the data used for the quantification of ES, we focused on the parameters included in the tables, used as a basis for the primary and optional indicators proposed. For each parameter, we identified and grouped the type of data used (e.g. sea maps, land property maps, cadastre, statistics). Available spatial and quantitative database for marine areas can be found free of charge or after special request to the stakeholders (Table 3).

The available data sources at national level, which cover the information needed for indicators proposed and relevant parameters are reports of the National systems of monitoring of waters (monitoring of the coastal water bodies ecological state, according to the Water Framework Directive (WFD), monitoring of the marine environment status in accordance with the Marine Strategy Framework Directive (MSFD), monitoring of bathing waters), National Plans and Strategies, National Concept for Regional Development, Natura 2000 habitat mapping, Scientific publications, EU data sources, National data (MOEW, MAF, ME, MRD), National Statistics and other sources.

Data sources in this guidance included point data (sampled observations from scientific papers), regional data (information and project reports for watersheds, settlements and resorts, protected and other specific study areas), and data covering European and national extents.

Modeling data could be applied for such parameters, if models are validated for the specific ecosystems. These parameters could create indicators for the ecosystem condition.

The most commonly used data to derive ecosystem services indicators sea maps, data from the National systems of the monitoring of waters and data about investment attentions concerning the Black Sea region (in data bases of the Ministry of the Environment and Waters (MOEW), Executive Environment Agency (ExEA), Black Sea Basin Directorate (BSBD), Regional Inspectorates of Environment and Waters (RIEW), Ministry of Regional development and Public Works (MRDPW), data about the fisheries and aquaculture (Executive Agency of Fisheries and aquaculture (EAFA)) data about

the navigation available in the Executive Agency Maritime Administration (EAMA), statistical data and data from scientific researches. These data sources include a wide variety of data types including maps, biotic and abiotic parameters of water bodies, navigation, pollution data, tourism, but also goods and products statistics. Some European data available could be applied at national scale, where there are gaps defined. Data, obtained using satellite imagery, are widely available and often free of charge. Modeling data could be also applied for such indicators and their parameters, if models are validated for the specific component of ecosystem or for the whole ecosystem. Experts' opinion should be taken into consideration.

National statistics are available from the national database which has wide coverage. This data availability is also reflected in some ecosystem services that are mapped at regional level. Local data are needed to quantify supporting or cultural ES. Cultural services such as spiritual or aesthetic enjoyment are very local with variation from individuals to cultural groups; therefore mostly data sources can be used. Supporting services, mostly mapped in terms of habitat suitability, often using sub-national species distribution data and conservation indices.

In the tables proposed there is a list of parameters for primarily and optional indicators found in our review, for which there is no data at all and additional investigations and/or case-studies are needed. The majority of these is case-specific and could be produced by several research groups.

As mentioned earlier, for a few parameters and the corresponding data types used, such as tourist information data, the data is missing, but the intention to generate such data is underlined.

Table 3. Sources of spatial and qualitative/quantitative database

EUNIS	Subtype	DATABASE Sources – main stakeholders	
		Spatial	Quantitative/Qualitative
A1.	Littoral rock and other hard substrate	Database EUNIS Level 2, Natura 2000 habitats mapping, MSFD predominant habitats, National Concept for Spatial Development 2013-2025, Initial assessment of the environmental status of marine waters under the MSFD, Remote sensing.	NATURA 2000; Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, monitoring reports and data bases (MOEW/ExEA/BSBD/ RIEW, MRDPW, EAFA), Publications, Reports of Research Projects.
A2.	Littoral sediment	Database EUNIS Level 2, Natura 2000 habitats mapping, MSFD predominant habitats, National Concept for Spatial Development 2013-2025, Initial assessment of the environmental status of marine waters under the MSFD, Remote sensing.	NATURA 2000; Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, monitoring reports and data bases (MOEW/ExEA/BSBD/ RIEW, MRDPW, EAFA), Publications, Reports of Research Projects.

EUNIS	Subtype	DATABASE Sources – main stakeholders	
		Spatial	Quantitative/Qualitative
A3.	Infralittoral rock and other hard substrate	Database EUNIS Level 2, Natura 2000 habitats mapping, MSFD predominant habitats, National Concept for Spatial Development 2013-2025, Initial assessment of the environmental status of marine waters under the MSFD, Remote sensing.	NATURA 2000; Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, monitoring reports and data bases (MOEW/ExEA/BSBD/ RIEW, MRDPW, EAFA), Publications, Reports of Research Projects.
A4.	Circalittoral rock and other hard substrate	Database EUNIS Level 2, Natura 2000 habitats mapping, MSFD predominant habitats, National Concept for Spatial Development 2013-2025, Initial assessment of the environmental status of marine waters under the MSFD.	NATURA 2000; Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, monitoring reports and data bases (MOEW/ExEA/BSBD/ RIEW, MRDPW EAFA), Publications, Reports of Research Projects.
A5.	Sub-littoral sediment	Database EUNIS Level 2, Natura 2000 habitats mapping, MSFD predominant habitats, National Concept for Spatial Development 2013-2025, Development 2013-2025, Initial assessment of the environmental status of marine waters under the MSFD, Remote sensing.	NATURA 2000; Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, monitoring reports and data bases (MOEW/ExEA/BSBD/ RIEW, MRDPW, EAFA), Publications, Reports of Research Projects.
A6.	Deep sea-bed	Database EUNIS Level 2, Natura 2000 mapping, navigation maps and data (National Maritime Agency), MSFD predominant habitats, Development 2013-2025, Initial assessment of the environmental status of marine waters under the MSFD.	NATURA 2000; Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, monitoring reports and data bases (MOEW/ExEA/BSBD/ EAFA), Publications, Reports of Research Projects.
B3.	Rock, cliffs, ledges and shores, inl. Supralittoral	Database EUNIS Level 2, Natura 2000 mapping, navigation maps and data (National Maritime Agency), MSFD predominant habitats, Development 2013-2025, Initial assessment of the environmental status of marine waters under the MSFD, Remote sensing.	NATURA 2000; Flood Risk Management Plans, Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, monitoring reports and data bases (MOEW/ExEA/BSBD/ RIEW, MRDPW, EAFA), Publications, Reports of Research Projects.

EUNIS	Subtype	DATABASE Sources – main stakeholders	
		Spatial	Quantitative/Qualitative
X2.	Saline Coastal Lagoons	Database EUNIS Level 2, Natura 2000 mapping, National Concept for Spatial Development 2013-2025, Development 2013-2025, Initial assessment of the environmental status of marine waters under the MSFD, Remote sensing.	NATURA 2000; River Basins Management Plans; Flood Risk Management Plans, Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, monitoring reports and data bases (MOEW/ExEA/BSBD/ RIEW, MRDPW, EAFA), Publications, Reports of Research Projects.

4. Mapping of ecosystem types

4.1. Description of the mapping procedure

The workflow for mapping of ecosystem types comprises several main steps:

- Generation of vector dataset with representation of polygon, polyline, or point features each of them containing information on level 3 ecosystem type;
- Assembling the product in the geodatabase schema provided in the Annex 9 (Annex 9.00_ EcosystemDatabase_Schema);
- Validation of the product accuracies, described in point 4.6. of this methodology;
- Preparation of digital maps of ecosystem types;
- Generation of metadata.

The specifications of the final product should follow the requirements provided in this section. As the outcome of each mapping project will be used for preparation of national dataset for ecosystem types at level 3, it is mandatory to follow each requirement described below.

4.2. Data format

Output data have to be delivered in GIS compatible vector format - geospatial standards of OGC and INSPIRE.

The vector format should be with the following topology:

- One complete coverage in a single layer – in case all the ecosystems are presented as one geometry type;
- In case the different ecosystem types are represented with different geometry type, up to 3 layers could be delivered – one for polygon, one for polyline and one for point features.
- The vector layer has to be delivered in topologically correct geometries: see rules in http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/An_overview_of_topology_in_ArcGIS/006200000001000000/.

4.3. Geographic projection / Reference system

Vector layer should be delivered in ETRS89-LAEA. The description and definition of ETRS89 is based on the convention of ISO19111, the 'Spatial referencing by coordinates' standard. For further documentation on ETRS89, see:

- http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_RS_v3.2.pdf, and;
- http://www.eionet.eu.int/gis

4.4. Geometric resolution – Scale and Minimum Mapping Units

The source data which will be used for the ecosystem type mapping vary in their geometric resolution, as well as the level of detailisation of different ecosystem types. Hence, the output vector dataset containing the graphical representation of the ecosystem types should be delivered in scale between 1:10 000 and 1:25 000, depending on:

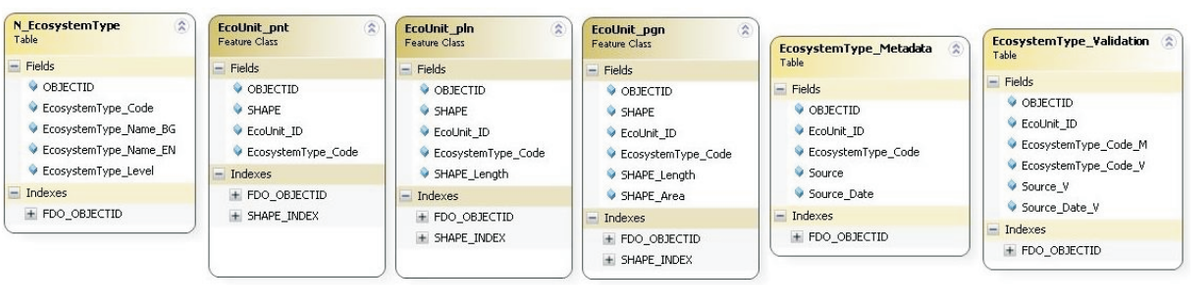
- source data used;
- ecosystem type on level 3.

The minimum mapping area should be between 0.1 and 0.25 ha also depending on the source data used and ecosystem type mapped. The same apply for minimum mapping width for representing linear features: minimum 10 and up to 30 m.

4.5. Data structure/schema

The data structure should follow the one provided in the Annex 9.00 – both on number of vector and tables delivered, as well as the structure of each feature class and tables, and nomenclatures provided in the same Annex. The database schema in Annex 9.00 is provided in XML and Personal DataBase format – OCG and INSPIRE compatible.

The schema of the database for the ecosystem types is the following:



The detailed technical description of the classes and tables of the ecosystem types database is provided in Annex 9.01_Schema_Report_ES_Database / 9.01_1_Schema_Report_ES_Database.htm.

The main steps of generation of the geodatabase are the following:

- Feature Class **"EcoUnit"**: This is the vector feature class which contains the information on ecosystem types at level 3. The attribute fields of the feature class which have to be filled are as follows:
  - EcoUnit_ID: each object should have unique ID;
  - EcosystemType_Code: this field should contain 3 digit value of the ecosystem type

at level 3. The value for the ecosystem code should be taken from the nomenclature table N_EcosystemType/EcosystemType_Code provided in Annex 9.02_NOMENCLATURES_XLS. This field is used for relating all the tables and feature classes in the database.

Since, the object geometry of the different ecosystem types could be point, polyline, or polygon, up to 3 feature classes **"EcoUnit"** could be generated and named as follows:

- **EcoUnit_pnt:** for objects with point geometry;
- **EcoUnit_pln:** for objects with polyline geometry;
- **EcoUnit_pgn:** for objects with polygon geometry.

- Table **"N_EcosystemType"**: Nomenclature table for ecosystem type levels at level 2 and 3. This table should not be changed. It has the following fields:
  - EcosystemType_Code: integer codes for ecosystem types at level 2 and 3;
  - EcosystemType_Name_BG: names in Bulgarian of ecosystem types at level 2 and 3;
  - EcosystemType_Name_BG: names in English of ecosystem types at level 2 and 3;
  - EcosystemType_Level: check field defining the level of each ecosystem type with values 2, for level 2 and 3 for level 3;
- Table **"EcosystemType_Metadata"**: Table providing information on datasources used when defining the ecosystem type for each feature from the Feature Class **"EcoUnit"**:
  - EcoUnit_ID: field to relate with the feature class;
  - EcosystemType_Code: integer codes for ecosystem types at level 3;
  - Source: free description of the source used to map the specific ecosystem type for each feature;
  - Source_Date: date of the source used to map the specific ecosystem type for each feature;
- **Table "EcosystemType_Validation"**: Table providing information on work performed to validate the thematic accuracy for the final product:
  - EcoUnit_ID: field to relate with the feature class;
  - EcosystemType_Code_M: integer codes for ecosystem types at level 3 of the final product;
  - EcosystemType_Code_V: integer codes for ecosystem types at level 3 derived in the validation process;
  - Source_V: free description of the source used to validate the ecosystem type;
  - Source_Date_V: date of the source used in the validation.

4.6. Thematic accuracy and validation

The overall thematic accuracy for all ecosystem types should be >=85%.

The validation should be based on scientifically sound approach used for validation of the product thematic accuracy.

Apart from providing information in Table **"EcosystemType_Validation"**, the validation should be accompanied by Quality Control/Quality Check Reports for each ecosystem type.

4.7. Digital Maps for Ecosystem Types

Maps in scale 1:125 000 for the ecosystem types should be in PDF at size A2. In addition the maps could also be prepared in paper format in the same size.

Each data frame should contain one cell from the EEA reference grid at 50km; hence up to 77 maps could be produced for all the cells from the 50km EEA gird for Bulgaria. In case that no objects from Feature Class **"EcoUnit"** fall in certain cell, map for this cell should not be delivered. Therefore, the actual number of maps to be delivered will depend on the number of cells that contain at least one object from Feature **"Class EcoUnit"**. The EEA reference grid is available at:

http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids/

Color codes for visualization of the ecosystem types at level 3 should be in accordance to these used in the European Map of Ecosystem types:

http://biodiversity.europa.eu/maes/mapping-ecosystems/map-of-european-ecosystem-types

The technical details for the map, as well as colour codes are accessible at:

http://projects.eionet.europa.eu/eea-ecosystem-assessments/library/draft-ecosystem-map-europe/

The ecosystem types in the European Map of Ecosystem types are defined based on EUNIS classification. Hence, not all of the level 3 types determined for Bulgaria will correspond to the European ones. In this case, similar colour codes should be used, which are closer to these of EUNIS classes. When generating these colour codes the guideline of EEA should be used, available here:

http://www.eionet.europa.eu/gis/docs/EEA%20Corporate%20identity%20manual%20Map%20colour%20guide.pdf

The layout of the maps of the ecosystem types should follow the guidelines of EEA:

http://www.eionet.europa.eu/gis/docs/GISguide_v4_EEA_Layout_for_map_production.pdf

4.8. Metadata

Each dataset should be accompanied by INSPIRE conformal metadata. The minimum requirement is the metadata to be generated using the INSPIRE MetadataEditor:

http://inspire-geoportal.ec.europa.eu/editor/

5. Assessment of marine ecosystem condition

5.1. Description of the procedure

Step 1: Identify the indicators of ecosystem condition for the given ecosystem type - levels 3.

We use the table in Annex 1 with Indicators and their Rationales (Table 4) to assess the Ecosystem condition. Indicators assess environmental conditions (climatic, chemical, physical state of habitat or land cover) in marine ecosystems. We have defined and quantified 11 major indicators that are relevant for the marine ecosystem conditions. The indicators represent the ecosystems structure and ecosystem processes of marine types of ecosystems. For some of the parameters there is no available data or there is some information from publications, but only for single marine types.

Table 4. Rationales of ecosystem condition's indicators

Ecosystem condition Indicator group	Indicators/Rationales
Biotic diversity	**Biotic diversity is caused by organisms.** Biodiversity is associated with both spatial and/or temporal variability of bioresources. It may occur even in absence of abiotic heterogeneity. The biotic diversity of small-range species in marine environments might be well predicted based on habitat heterogeneity but this is not valid for the entire biodiversity (Mora and Robertson, 2005). It was demonstrated the existance of two distinct patterns of global marine biodiversity - for species in coastal and for species in open ocean habitats (Tittensor et al., 2010). Biodiversity is directly dependant on local (pollution, disturbance, anthropogenic impact) and global factors (climate change, regime shifts, acidification, etc). **To determine main biotic factors and marine habitat heterogeneity the following indicators are proposed**: *"Plant diversity",* *"!nimal diversity",* *"Habitat diversity",* **Optional indicators are:** *Other biotic heterogeneity indicators (for example, naturalness related to "Invasive species" etc.). The Optional indicators are Specific biotic indicators for ecological condition and may vary depending on the ecosystem type, e.g: Ecological Quality based on Biological Quality Elements (according to WFD), Environmental Quality based on Descriptor 1 Biodiversity (according to MSFD).* The ecosystem service projects using other indicators, must define them consistently to the current methodology.
Abiotic heterogeneity	**Abiotic heterogeneity has abiotic origin** and is described by the spatial and/or temporal variability of abiotic resources and factors. They could be heavily impacted by natural (storms, vulcano, floods) as well as human activities (climate change, waters and air pollution, disturbance, etc) at local and global scales. In marine ecosystem the type of substrate is of major importance for ecosystem functioning. To determine abiotic factors and marine abiotic heterogeneity the following indicators are proposed: *"Sediment heterogeneity", e.g. Type of bottom substratum* *"Water column heterogeneity",* *"Air heterogeneity",* *"Disturbance regime"* **Optional Abiotic heterogeneity indicators are:** *Nutrient content and Eutrophocation, Water pollution, Ecological states of bathing waters, Ecological states of waters for aquaculture, Climate change indicators (temperature, acidification).* The ecosystem service projects using other indicators, must define them consistently to the current methodology.
Energy budget	**Ecological energy budget describes the ways in which energy is transformed from one state to another within different marine ecosystems**. Includes analysis of inputs, outputs, and changes in the quantities stored. Ecological energy budget focuses on the use and transformations of energy in the components of marine ecosystems. To

Ecosystem condition Indicator group	Indicators/Rationales
Energy budget	account energy budget in marine ecosystems the following indicators are proposed: *"Energy balance (capture, storage)",* *"Entropy production",* *"Metabolic efficiency",* **Other energy budget indicators** The ecosystem service projects using other indicators, must define them consistently to the current methodology.
Matter budget	**Matter budget describes the cycle in which matter is transformed from one state to another within the components of marine ecosystems.** The input/output balance provides information on the ecosystem efficiency and health. To account matter budget in marine ecosystems the following indicators are proposed: "Matter balance" Input, output), *"Matter storage",* *"Element concentrations",* *"Efficiency measures".* **Optional matter budget indicators** The ecosystem service projects using other indicators, must define them consistently to the current methodology.
Water budget	**The cyclical movement of water between the atmosphere, mainland and the sea, considering river inflow, precipitation, evaporation and outflow.** Water budget may signifficantly affect both biological and abiotic heterogeneity conditions. The following indicators are proposed: *"Water balance (inflow, outflow, precipitation, evaporation)",* *"Water storage",* **Other state indicators*:*** *"Suspended matter content",* *"Turbidity".* The ecosystem service projects using other indicators, must define them consistently to the current methodology.

Step 2: Identify the parameters of each indicator

For the set of indicators describing marine ecosystem condition different parameters of evaluation are proposed. In fact for some indicators there are relevant parameters in current inventories database (habitat area and distribution, elements concentration, depth, wave exposure, water temperature, water transparency/turbidity, organic carbon (Corg.) in sediments, Chlorophyll A concentration, number of species, diversity, abundance, ratios etc.). Considering the number of proposed parameters, the number of parameter combinations and possible (optional, additional) indicators is very large, which ensures the assessment of marine ecosystem condition – Annex 6.

Step 3: Collecting data – national data sets – Annex 5

Comprehensive data availability at smaller scales and across different marine ecosystem types is

necessary if decision-makers are to use ecosystem service indicators to maximum effect. The availability of ecosystem services data for smaller regions varies greatly by location and by the kind of data required for each indicator. In some cases, data constraints at local scales will be greater than at regional scale. While the specifics will vary, data will be a constraint in applying ecosystem services concepts in different types of ecosystems. For some data international sources of information can be used and applied. Because the data will be needed at multiple scales, in spatial and non-spatial formats, and include ancillary information to support normalization and disaggregation, different sources of information will need to be used.

Some of data underlined are highly relevant for establishing indicators (Statistics, reports, remote-sensing, EU and national database), but other data sources as additional measurements must also be utilized.

Step 4: How to assess indicators

The indicators of marine ecosystem condition can be assessed through a corresponding scale, for example the one shown in Table 5. The range determined in this scale is specific in describing ecosystem services conditions for each sub-type and should be determined by the experts in the specific field, approved with professional experience and expertise.

The example presented in Table 5 could be applied in performing the assessment of both condition and ecosystem services supply. The ecosystem service projects using other indicators, must define them consistently to the current methodology.

Table 5. Ecosystem conditions indicator assessment for Marine Ecosystems

Ecological condition indicators		Indicator	Parameter	Unit	Measurement approach	Assessment scale and score				
Type	Indicator Group					Score 1 very bad	Score 2 bad	Score 3 moderate	Score 4 good	Score 5 very good
Ecosytem structure	Biotic heterogeneity	*Plant diversity*	Phytoplankton numbers (in summer)	cells.l^{-1}	Ord. No N-4/14.09.2012	>3000	3000	1500	800	500
			Macroalgae and Angiosperms Ecological Index (EI)	EQR	Ord. No N-4/14.09.2012	0.04-0.00	0.24-0.04	0.47-0.25	0.75-0.48	⩾ 0.76
		Animal diversity	Macrozoobentos M-AMBI index	EQR	Ord. No N-4/14.09.2012	< 0.20	0.39-0.20	0.55-0.39	0.85-0.55	⩾ 0.85
			Birds diversity	number of species per plot area	Calculation	<20	41-60	61-80	81-100	>100

Ecological condition indicators		Indicator	Parameter	Unit	Measurement approach	Assessment scale and score				
						Score 1 very bad	Score 2 bad	Score 3 mode rate	Score 4 good	Score 5 very good
Type	Indicator Group									
Ecosytem structure	Biotic heterog eneity	*Animal diversity*	Fish diversity	Shannon index-H'(log2)	Classification scale, developed under ISMEIMP project	Coastal zone A3 habitats 1.834 A5 habitats <1.438			Coastal zone A3 τ1.834 A5 τ1.438	
						Shelf zone 20-40 m <1.274 41-100 m <0.325			Shelf zone 20-40m τ1.274 41-100m τ0.325	
	Abiotic hetero-geneity	*Water column heterogeneity*	Water Transparency	metter	Ord. No N-4/14.09.2012	>1.5	1.5	2.6	3.7	4.5
			TRIX index	Index units	Ord. No N-4/14.09.2012	<7.6	7.6	6.5	5.4	4.5
			$P\text{-}PO_4$, summer	$mg.l^{-1}$	Ord. No N-4/14.09.2012	-	-	>0.010	0.005 - 0.010	<0.005
			$N\text{-}NH_4$, summer	$mg.l^{-1}$	Ord. No N-4/14.09.2012	-	-	>0.022	0.008 - 0.022	<0.008
			$N\text{-}NO_3$, summer	$mg.l^{-1}$	Ord. No N-4/14.09.2012	-	-	>0.040	0.016 - 0.040	<0.016
			$N\text{-}NO_2$ summer	$mg.l^{-1}$	Ord. No N-4/14.09.2012	-	-	>0.010	0.006 - 0.010	<0.006
			BOD-5, summer	$mg.l^{-1}$	Ord. No N-4/14.09.2012	-	-	>3	3.0-3.3	<3.0
			O_2 concentration summer	$mg.l^{-1}$	Ord. No N-4/14.09.2012	-	-	<8.0	8.00-8.29	8.30-8.70
		Bottom heterogeneity	O_2 saturation summer	%	Ord. No N-4/14.09.2012	-	-	<75	75-85	>85

Ecological condition indicators		Indicator	Parameter	Unit	Measurement approach	Assessment scale and score				
Type	Indicator Group					Score 1 very bad	Score 2 bad	Score 3 moderate	Score 4 good	Score 5 very good
Ecosytem processes	Matter budget	*Matter storage*	Phytoplankton biomas	EQR	Ord. No N-4/14.09.2012	<0.23	0.23	0.53	0.8	1.0
		Matter storage	Chlorophyl A	EQR	Ord. No N-4/14.09.2012	<0.23	0.23	0.53	0.8	1.0

The above listed indicators were chosen with aim to serve for a comprehensive assessment of the condition (state) of the ecosystem types. They must be used as described in the present methodology. At the same time, the team realizing the practical assessment may add and test in assessment, after using the above listed, other new indicators – which are being recently developed and under development on European and national level or based on the good practices and practical experience- that the experts involved will consider useful, adequate or more appropriate for the purpose to comprehensively assess the ecosystem condition. Such indicators must be used by the same methodological manner – by determining parameters, units, measurement and assessment scale from 1 to 5, and must consist with the MAES research activities, guidelines and reports on the EU scale. The more convenient indicators to assess ecosystem condition are those reflecting naturalness, wilderness, status of representative species or species group and communities, high nature value areas, etc, which can rely with the grid used for mapping.

To ensure data representativeness a regular in-situ monitoring program should be carried out. More details on the time intervals can be found in the Monitoring guide developed as a supplement to this Methodology. More information regarding the efforts at the EU level to determine the most adequate and appropriate indicators to the ecosystem condition can be obtained via the web-pages of the institutions and research centers involved, for ex. http://projects.eionet.europa.eu/eea-ecosystem-assessments/library, where can be found publications such as “Developing conceptual framework for ecosystem mapping - part B Ecosystem condition mapping (draft)” and other relevant documents.

Such new indicators, proposed and tested in the course of the practical assessment, must be described in the final reports for task accomplishment and motivated proposals have to be made for the use of the indicators on question in future assessments. At the same time comments and estimations regarding the usefulness and applicability of the indicators listed in this methodology have to be made, on a basis of the experience acquired in their use.

The total score of each group of indicators is calculated as average of scores for available indicators included referred to the specific marine sub-type ecosystem. The final number should be presented as integer.

The values of calculated scores of both structural and functional indicators is representative for the condition of specific ecosystem type. The value obtained must be rounded to the nearest first decimal place, and for the purpose of mapping to an integer.

Step 5: Fill up the matrix– Indicators of Ecosystem Condition

After obtaining the scores of each indicator the matrix of calculation presented in Table 6 should be fulfilled. The matrix presented here is an example, which should be verified with in-situ measurements and data collection (see Guide for in-situ verification).

Table 6. Ecosystem condition indicator assessment template and calculation – example relates to Sub-type "Sublittoral sediment" (EUNIS- A5)

Indicator type	Indicator group	Indicator	Parameter	Units	Real data measured	Score
Structural			Water Transparency	m	3.7	4 Good
	Abiotic	*Water column heterogeneity*	TRIX index	Index units	5.4	4 Good
			P-PO_4, summer	mg.l-1	0.009	4 Good
			N-NH_4, summer	mg.l-1	0.010	4 Good
			N-NO_3, summer	mg.l-1	0.008	5 Very good
			N-NO_2 summer	mg.l-1	0.003	5 Very good
			BOD-$_5$, summer	mg.l-1	3.2	4 Good
			O_2 concentration summer	mg.l-1	8.5	5 Very good
		Bottom heterogeneity	O_2 saturation summer	%	65	2 Bad
	Biotic	*Plant diversity*	Phytoplankton numbers (in summer)	cell/l	800	4 Good
		Plant diversity	Macroalgae and Angiosperms Ecological Index (EI)	EQR	0.47- 0.25	3 Moderate
		Animal diversity	Macrozoobentos M-AMBI index	EQR	0.39-0.20	2 Bad
						Σn_i = 46
						IP =0.77

Explanation: for each indicator, based on experts' assessments, the scores from 1 to 5 are assigned, according to the scale: 1 – very bad; 2 – bad; 3 – moderate; 4 – good; 5 – very good. The scores of each indicator measured are then summed up (∑ni).

An **Index of ecosystem Performance (IP)** is then calculated, as ratio of the sum of the indicators scores and the maximum possible indicator sum: Thus,

$$\mathbf{IP = \sum n_i / \sum n_i(max),}$$

Where:

$\sum n_i$ – sum of the scores of the individual indicators assessment;

$\sum n_i(max)$ – maximum possible indicator score, obtained by multiplication of number of indicators and the maximum possible score (in this case 12 x 5=60);

and belongs to the range (0 and 1).

The **IP** assessment scores for the different conditionss of the ecosystem are as follows:

IP 0-0.20 – very bad; 0.21-0.40 – bad; 0.41-0.60 – moderate; 0.61-0.80 – good; 0.81-1.00 – very good; In this case the EUNIS A5 ecosystem conditions is 0.77 – good.

The IP index is not obligatory, but recommended if requested for fulfillment specific tasks in strategy development by different stakeholders.

5.2. Mapping of Ecosystem condition

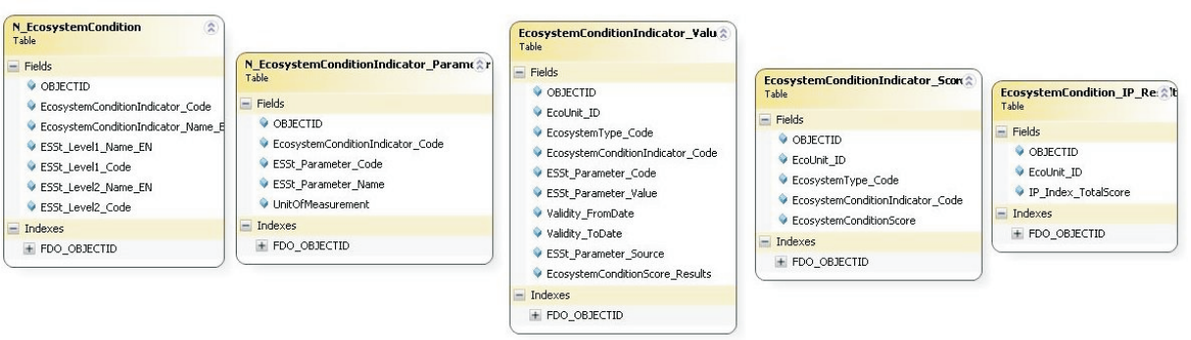
5.2.1. Description of the mapping procedure

The workflow for mapping of ecosystem condition follows the steps described in section 5.1. The technical characteristics of the geodatabase are provided in section 4 and should be applied also for mapping procedures in this section.

5.2.2. Data structure/schema

The data structure should follow the one provided in the Annex 9.00.

The schema of the database for the ecosystem states is the following:



The detailed technical description of the classes and tables of the ecosystem condition database is provided in Annex 9.01_Schema_Report_ES_Database/ 9.01_1_Schema_Report_ES_Database.htm

The main steps of generation of the geodatabase should follow the steps described in section 5.1.

- Table **"N_EcosystemCondition"**: Nomenclature table for ecosystem condition indicators. This table should not be changed. The nomenclatures are given in Annex 9.02_NOMENCLATURES_XLS / N_EcosystemCondition.xls. It has the following fields:
  - EcosystemConditionIndicator_Code: integer codes for ecosystem condition indicators at level 3;
  - EcosystemConditionIndicator_Name_EN: names in English of ecosystem condition indicators at level 3;
  - ESSt_Level1_Name_EN: names in English of ecosystem condition indicators at level 1;
  - ESSt_Level1_Code: integer code of ecosystem condition indicators at level 1;
  - ESSt_Level2_Name_EN: names in English of ecosystem condition indicators at level 2;
  - ESSt_Level2_Code: integer code of ecosystem state indicators at level 2;
- Table **"N_EcosystemConditionIndicator_Parameters"**: Nomenclature table of parameters used to determine the ecosystem condition indicator. The nomenclatures are given in Annex 9.02_NOMENCLATURES_XLS / N_EcosystemConditionIndicator_Parameter.xls. It has the following fields:
  - EcosystemConditionIndicator_Code: integer codes for ecosystem state indicators at level 3;
  - ESSt_Parameter_Code: integer codes for parameters used to assess the ecosystem indicators at level 3;
  - ESSt_Parameter_Name: name of parameters used to assess the ecosystem indicators at level 3;
  - UnitOfMeasurement: units of measurement for each parameter.

This nomenclature table should be generated using the example provided in Annex 9.02_NOMENCLATURES_XLS / N_EcosystemConditionIndicator_Parameter.xls, as well as the Table 5. *Ecosystem condition indicator assessment for XXX ecosystems*.

- Table **"EcosystemConditionIndicator_Values"**: This table is the resulting table from the assessment of the ecosystem indicators. How to perform the work on assessment of the indicators is described in Step 4 in section 5.1:
  - EcoUnit_ID: field to relate with the feature class;
  - EcosystemType_Code: integer codes for ecosystem types at level 3;
  - EcosystemConditionIndicator_Code: integer codes for ecosystem condition indicators at level 3;
  - ESSt_Parameter_Code: integer codes for parameters used to assess the ecosystem indicators at level 3;
  - ESSt_Parameter_Value: value of calculated parameter used to assess the ecosystem indicators at level 3;
  - Validity_FromDate: starting date for validity of the parameter;
  - Validity_ToDate: end date for validity of the parameter;
  - ESSt_Parameter_Source: free text to describe the source of the data used to calculate the value of the parameter;
  - EcosystemConditionScore_Results: final score for each parameter calculated using the guidelines provided in Table 5. The values here should be between 1 and 5;

As this resulting table could contain enormous number of records which some GIS software could not support it is acceptable to separate it into smaller tables. In this case the records in the table should be separated based on the ecosystem types at level 3. The naming of the table should be done in the following way:

"EcosystemConditionIndicator_Values_XXX" – where XXX is the code of the ecosystem type at level 3.

- Table **"EcosystemConditionIndicator_Score"**: As for some indicator more than one parameter could be selected for measurement, additional table is required which represents the total score for each condition indicator calculated from the total score of parameters measured. Because some of the parameters could be more important than others, it is of responsibility of the expert to choose what will be the final score based on the values of the parameters calculated:
  - EcoUnit_ID: field to relate with the feature class;
  - EcosystemType_Code: integer codes for ecosystem types at level 3;
  - EcosystemConditionIndicator_Code: integer codes for ecosystem condition indicators at level 3;
  - EcosystemConditionScore: final score for each indicator calculated on the base of all parameters selected for its evaluation. The values here should be between 1 and 5;

In order the database to be more informative, one table for each condition indicator at level 3 should be prepared and named as follows: **"EcosystemConditionIndicator_Score_YYY"** where YYY is the code for condition indicators at level 3.

- Table **"EcosystemCondition_IP_Results"**: This table is the resulting table from the assessment of the ecosystem indicators and calculation of the IP for each ecosystem type at level 3. How to perform the work on assessment of the indicators is described in Step 4 in section 5.1:
  - EcoUnit_ID: field to relate with the feature class;
  - IP_Index_TotalScore: value for the index of ecosystem performance (IP) for each polygon representing ecosystem type at level 3. How to calculate the value is described in Step 4 in section 5.1 and an example is given in Table 7 *Ecosystem condition indicator assessment template and calculation – example*.

5.2.3. Accuracy and validation

The validation should be based on scientifically sound approach being able to assess the accuracy reached for each ecosystem condition parameter. For each validation accuracy reports should be generated and provided.

5.2.4. Digital Maps for Ecosystem Condition

Maps in scale 1:125 000 for the ecosystem condition should be delivered in PDF at size A2 presenting the results from calculation of the IP index. In addition the maps could also be prepared in paper format in the same size.

Each data frame should contain one cell from the EEA reference grid at 50 km, hence up to 77 maps could be produced for all the cells from the 50 km EEA gird for Bulgaria. In case that no objects from Feature Class **"EcoUnit"** fall in certain cell, map for this cell should not be delivered. Therefore, the actual number of maps to be delivered will depend on the number of cells that contain at least one

object from Feature “Class **EcoUnit**”. The EEA reference grid is available at:

http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids/

For visualization of the IP index graduated colours should be used. Five classes should be generated as follows: 1 – very bad (values > 0 to 0.20); 2 - bad (values > 0.20 to 0.40); 3 – moderate (values > 0.40 to 0.60); 4 – good (values > 0.60 to 0.80); 5 – very good (values > 0.80 to 1).

The colour ramp should use for class 1 blue colour (CMYK:50;100;5), class 2 violet colour (CMYK:18;100;0), class 3 pink colour (CMYK:0;70;40), class 4 orange colour (CMYK:0;30;100), and for class 5 green colour (CMYK:40;5;100).

The layout of the maps of the ecosystem types should follow the guidelines of EEA:

http://www.eionet.europa.eu/gis/docs/GISguide_v4_EEA_Layout_for_map_production.pdf

5.2.5. Metadata

Each dataset should be accompanied by INSPIRE conformal metadata. The minimum requirement is the metadata to be generated using the INSPIRE MetadataEditor:

http://inspire-geoportal.ec.europa.eu/editor/

6. Assessment of ecosystem services

6.1. Identification of indicators, parameters, data

Marine ecosystem services refer to benefits that people obtain from marine ecosystems, including the open ocean, coastal seas, and saline coastal lagoons. To effectively integrate ecosystem services into planned or existing marine environment use, the spatial concordance between areas that support ecosystem functions and biodiversity and those that supply ecosystem services have to be identified and more broadly evaluated. Such evaluation will require the best available data on the distribution of ecosystem functions, biodiversity and ecosystem services.

Ecosystem service assessments on various temporal and spatial scales in marine ecosystems can support generation of maps of where ecosystem services are supplied and/or demand, quantify the likelihood of marine use and its probable impact on ecosystem functions and service supply/demand, and understand the value and flow of benefits to human populations.

Assessment of ecosystem services in marine ecosystems focuses on indicators of final ecosystem services as developed in MAES initiative, MAES WG (2013). Additional indicators and relevant parameters are listed in table 7 in order to support more detailed assessment if needed for specific case-studies.

The indicators for most provisioning services provide for a more complete understanding of the service than for most regulating and cultural services. Data availability for some of the parameters needed for marine ecosystems significantly limits the state of knowledge for all services, but is particularly acute for regulating and cultural services. International and national database can be used, having into consideration that those indicators with institutional support have better data availability overall.

The indicators and parameters for assessing the ecosystem services of Marine ecosystems are listed in Table 7 below. The complete list of ES indicators which are relevant in each subtype of marine ecosystems could be found Annex 7. The indicators were chosen with aim to assess these services as developed in CICES, the classification scheme accepted by the MAES-initiative. Concerning the

ecosystem condition indicators, after using the indicators for ecosystem services assessment listed in this methodology, the experts involved in the assessment may propose other new indicators for assessment of the services, considered by them useful or more adequate for the purpose to comprehensively assess the ecosystem services that this ecosystem type provide. Such indicators, if any, must be used by the same methodological manner, as described in this methodology, and, after being tested, must be described and motivated proposals have to be made for their use in future assessment. Also comments and estimations regarding the usefulness and applicability of the indicators listed in this methodology have to be made, on a basis of the experience acquired in their use by the experts performing the assessment.

The most frequent indicator for the cultural services is the number of visitors to the marine environments. Then the specific reason of the visit can describe the service at a higher level of detail of the CICES classification. However, it is often impossible to distinguish between several services, such as entertainment and aesthetic, or cultural and educational, and in many case the motivation of the visit is a mix of several reasons. As the information on the number of visitors is often not available, mapping the areas of interest for different cultural services can be used as proxy.

Table 7. List of Ecosystem Services provided by marine ecosystems

Section	Division	Group	Class (CICES codes)	Indicator *Measuring method*	Parameters and units	*Data sources*	*% error*
Provisioning	Nutrition	Biomass	P1.Wild plants, algae and their outputs (1113)	Harvests, Ecosystem condition	Tons/a; Condition unit	Statistic, scientific publications, project reports	
			P2.Wild animals and their outputs (1114)	Fish Catch-Landings, Ecosystem condition	Tons/a; Condition unit	Official EAFA statistic and reports	
			P3. Animals from in-situ aquaculture (1116)	Harvests, Ecosystem condition	Tons/a; Condition unit	Official EAFA statistic and reports	
		Mineral	P4. Salt production	Yield	Tons/a	Statistic	
	Materials	Biomass	P5. Materials from plants, algae and animals for direct use or processing use (1212)	Harvests, Ecosystem condition	Tons/a; Condition unit	Statistic, scientific publications, project reports	
			P6. Genetic materials from all biota (1213)	Patents, publications	Number	Statistic, scientific publications, project reports	
		Water	P7. Surface water for non-drinking purposes (1221)	Number of bathing waters	Area	Official year reports of BSBD	
	Energy	Renewable abiotic energy sources	P8. Wave-based energy, Off-shore windfarms	Production	amount/ source	scientific publications, project reports	
		Non-renewable energy sources	P9. Oil, gas, H_2S and CH_4 based fuel cells	Production	amount/ source	Statistic, scientific publications, project reports	
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	R1. Bio-remediation by micro-organisms, algae, plants, and animals (2111)	Nutrient/ polutant from point and diffusive sources	Ton/area/year	scientific publications, project reports	
			R2.Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals (2112)	Number of filtering organisms, nutrients uptake area, seagrass beds	Ton (Number)/area/ year	scientific publications, project reports	

Section	Division	Group	Class (CICES codes)	Indicator *Measuring method*	Parameters and units	*Data sources*	*% error*
Regulation & Maintenance	Mediatio of waste, toxics and other nuisances	Mediation by ecosystems	R3.Filtration/sequestration/storage/accumulation by marine ecosystems (2121)	Water filtrated by blue mussel, Carbon storage & Nutrients uptake by marine phytoplankton & plants	Ton (liter)/area/ year	scientific publications, project reports	
			R4. Dilution by marine ecosystems (2122)	Nutrient/ polutant gradients	Concentrations	Statistic, scientific publications, project reports	
			R5. Mediation of smell/noise/visual impacts (2123)	Gradients of smell/noise/visual impact	Concentrations, dB attenuation	scientific publications, project reports	
	Mediation of flows	Mass flows	R6. Mass stabilization and control of coastal/sediments erosion rates (2211)	Area	ha	scientific publications, project reports	
			R7. Buffering and attenuation of mass flows (2212)	Sedimentation rate	Ton/area/year	scientific publications, project reports	
		Liquid flows	R8. Hydrological cycle and water flow maintenance (2221)	Salinity gradients	By depth/volumes	scientific publications, project reports	
			R9. Flood protection (2222)	Area	ha	scientific publications, project reports	
		Gaseous / air flows	R10. Storm protection (2231)	Area	ha	scientific publications, project reports	
			R11. Gas exchange and balance (2232)	Temperature, O_2, CO_2 exchange	T°C and gas air/water spatial concentration gradients	scientific publications, project reports	
	Maintenance of physical, chemical, biological states	Lifecycle maintenance habitat and gene - pool protection	R12. Maintaining nursery populations and habitats (2112)	Biodiversity WFD BQE Marine Protected Areas, Nursery areas	By amount and source, Area (ha)	scientific publications, project reports	
		Pest and disease control	R13. Pest control (2321)	Number of invasive alien species	By reduction in incidence, risk, area protected	scientific publications, project reports	
			R14. Disease control (2322)		By reduction in incidence, risk, area protected	scientific publications, project reports	
		Soil/Sediment formation and composition	R15. Weathering processes (2331)	Availability of Seagrass habitats	Area	scientific publications, project reports	
			R16.Decomposition and fixing processes (2332)	Nitrogen fixing rates in different habitats, Denitrification rates, Decomposition processes occuring in seagrass meadows and seafloor sediments	tonN/m2/day (year)	scientific publications, project reports	
		Water states	R17. Chemical condition of salt waters (2342)	WFD/MSFD physico-chemical Quality Elements	Concentrations	scientific publications, project reports, monitoring data	

Section	Division	Group	Class (CICES codes)	Indicator *Measuring method*	Parameters and units	*Data sources*	*% error*
Regulation & Maintenance	Maintenance of physical, chemical, biological states	Atmospheric composition and climate regulation	R18. Global climate regulation by reduction of greenhouse gas concentrations (2351)	H_2S, CO_2 and CH_4 emissions reduction	By amount, concentration or climatic parameter	scientific publications, project reports	
			R19. Micro and regional climate regulation (2352)	Temperature variation, precipitation	T^oC, l/m2		
Cultural	Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environ-mental settings]	Physical and experiential interactions	C1. Experiential use of plants, animals and land-/seascapes in different environmental settings (3111)	Visitors	Number By visits/use data, plants, animals, ecosystem type	statistic	
			C2. Physical use of seascapes in different environmental settings (3112)	Visitors	Number	statistic	
		Intellectual and representa-tive interactions	C3. Scientific (3121)	publications/citations	Number	Statistic, scientific publications	
			C4. Educational (3122)	publications/citations	Number	statistic	
			C5. Heritage, cultural (3123)	Available objects/ visitors	Number/year	statistic	
			C6. Entertainment (3124)	Available objects/ visitors	Number/year	statistic	
			C7. Aesthetic (3125)	Available objects/ visitors	Number/year	statistic	
	Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes [environ-mental settings]	Spiritual and/or emblematic	C8. Symbolic (3211)	Endemic plants and animals	Number By use, plants, animals, ecosystem type	statistic	
			C9. Sacred and/or religious (3212)	Number of visitors	Number of visits	statistic	
		Other cultural outputs	C10. Existence (3221)	Existance of marine protected areas	ha/km2	statistic	
			C11. Bequest (3222)	Existance of marine protected areas	ha/km2	statistic	

6.2. Steps for assessment of ESS

Step 1. Indicators for Ecosystem services assessment for marine ecosystems

The benefits for ecosystems are referred to as ecosystem services, a concept which includes 'provisioning services such as food, water, timber, and fibre; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide for example recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling' (Millennium Ecosystem Assessment, MA 2005). Ecosystem services describe the relationship between nature and human beings and refer broadly to the benefits people can obtain from ecosystems and thereby linking the social and the ecological systems.

The ecosystem approach in assessment ESS can be important for sustainable management of the marine environment as it accounts not only for the obvious benefits (i.e. provisioning services), but also for the relationship between the change of environment use and shift in ecosystem functions and services in a quantitative manner. However, so far, only few regulating, maintenance, and cultural ecosystem services can be valued directly. Not all services are synergistic and many may display trade-offs; e.g., enhancing provisioning services can lead to a reduction in cultural services.

This indicator set is designed in such a way that they assess ecosystem services delivered by the ecosystems and experts should assess their relevance to the specific marine ecosystem type. Depending on the availability of the data, a rapid assessment of ecosystem services based on expert opinion at national and/or regional scale could be applied in accordance with the specifics of sub-types of marine ecosystems.

Herewith we provide short explanations of the scope of the main ESS classes.

Provisioning services: The sea and its coastal interface provide: seafood; minerals (salt); habitats; energy sources (oil and gas, wind, wave, tidal, thermal); wetland protection; and genetic resources.

Regulating and maintenance services: The sea regulates weather and climate; protects coasts; detoxifies; and traps matter in sediments; mitigate storm damage. Marine environment maintains economic activity, including jobs, fisheries, food, maritime transportation, trade, fuel, and energy. Supports nutrient cycling and primary production. Maintains nursery populations and habitats

Cultural services: The sea provides cultural services, including recreational; educational; aesthetic; and spiritual.

Step 2: Collect data – national datasets - *Annex 5*

Most of the data should be derived from existing national and sub-national data sources. Methods that can quantify the uncertainty and validity of ES maps should be further explored.

The following data sources are to be considered:

- *MOEW - ExEA - CORINE project, national data bases*
- *Natura 2000 standard data forms*
- *Black Sea Basin Directorate data and reports*
- *Scientific publications*
- *In-situ data*
- *EU data sources*
- *Remote sensing data*

Step 3: How to assess

The assessment of ecosystem services is a further step in valuation process. There are various methods for ecosystem services assessment but common standards require to be quantifiable, replicable and affordable. Burkhard et al. (2012) propose general matrix for ecosystem service demands and provisions including all main ecosystem types. This matrix could be applied at national or regional level for decision making. For more accurate estimation, also for valuation economic potential, it should be considered that each ecosystem service type is dependent on two factors: *ecosystem area and condition*. For the most of the cases the better state and larger the area the higher value of service could be provided. However, on some cases the provided ecosystem service doesn't depend strictly on state of the ecosysytem. Some ecosystems in relatively bad state may provide high value service. It is not appropriate to compare between services as they are represented by different measurements. The experts should collect available data by relevant parameter or indicator, including ecosystem condition assessment for the defined class of ecosystem service. Depending on the specific case and availability of data, each ecosystem services class could be assessed by a different number of indicators and parameters respectively or complex of indictors, defined by the experts. Additional (optional) parameters and/or indicators could be proposed for the specific case-study if enough informative. Some of the indicators are easely parametrized and their ecosystem capacity is based on measerable data.

The assignments in Table 8 are based on first expert evaluations and can be seen as research hypotheses which are to be tested in further case study applications with data from measurements, modeling or additional expert assessments. Burkhard et al. (2012) gives the opportunity to transform all assessment scores into one unified system applicable for all ecosystems. Thus, it is necessary to develop a procedure for transformation of quantitative data from different sources and different units into such unified scoring system. The assessment scale consists of six scores- from 0 to 5, where: 0-score indicates that there is no relevant capacity to supply particular services and a 5-score indicates the highest relevant capacity for the supply of these services. Scores of 2, 3 and 4 represent respective intermediate capacities.

The assessment of ecosystem services is based on real parameters (measurable and available) and is presented by a Real (expert assessed) ESs Capacity (RESsC) for selected ecosystem type. Based on the Index of Ecosystem Performance (**IP**), obtained in assessing the ecosystem condition, the Ecosystem Services Potential Capacity (ESsPC) could be also estimated. ESsPC is defined as "the desirable and possible supply of ecosystem service for specific type of ecosystem if this ecosystem is managed by an appropriate way". The value is informative for future sea planning and development. However, for the current mapping purposes the **RESsC** value will be applied.

Step 4: Full up the matrix

Table 8. Scoring table for ecosystem service assessment

Section	Division	Group	Class	Indicator	Parameters and units	Measurement approach	Assessment scale and Score				
							Score 1	Score 2	Score 3	Score 4	Score 5
Provisioning	Nutrition	Biomass	P1	Harvests, Ecosystem condition	Tons/a; Condition unit		NA	NA	NA	NA	NA
			P2	Fish Catch-Landings, Ecosystem condition	Tons/a; Condition unit		Lan≤18	54>Lan⩾18.1	107>Lan⩾54.1	270>Lan⩾107	⩾270.1
			P3	Harvests, Ecosystem condition	Tons/a; Condition unit		Pm≤67	95>Pm⩾67.1	298>Pm⩾95.1	554>Pm⩾298.1	⩾554.1
		Mineral	P4	Yield	Tons/a		5000-10000	11000-20000	21000-30000	31000-40000	>40000
	Materials	Biomass	P5	Harvests, Ecosystem condition	Tons/a; Condition unit		NA	NA	NA	NA	NA
			P6	Patents, publications	Number		1	2	3	4	>= 5
		Water	P7	Number of bathing waters	Area		0.5-20	21-120	121-220	221-320	>320
	Energy	Renewable abiotic energy sources	P8	Production	amount/ source		20-50	50-80	80-100	-	-

Section	Division	Group	Class	Indicator	Parameters and units	Measurement approach	Assessment scale and Score				
							Score 1	Score 2	Score 3	Score 4	Score 5
Provisioning	Energy	Non-renewable energy sources	P9	Production	amount/ source		0-0.4	0.5-0.9	1.0-1.4	1.5-1.9	>1.91
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	R1	Nutrient/ polutant from point and diffusive sources	Ton/area/ year						
			R2	Number of filtering organisms, nutrients uptake area, seagrass beds	Ton (Number)/ area/ year						
		Mediation by ecosystems	R3	Water filtrated by blue mussel, Carbon storage & Nutrients uptake by marine phytoplankton & plants	Ton (liter)/area/ year	Coastal zone	80 - 120	121-200	201-280	281-360	>360
						Shelf	50 - 90	91-130	131-170	171-230	>230
						Open waters	40 - 80	81-120	121-160	161-200	>200
			R4	Nutrient/ polutant gradients	Concentrations						
			R5	Gradients of smell/noise/ visual impact	Concentrations dB attenuation						
	Mediation of flows	Mass flows	R6	Area	ha						
			R7	Sedimentation rate	Ton/area/year						
		Liquid flows	R8	Salinity gradients	By depth/volumes						
			R9	Area	ha						
		Gaseous / air flows	R10	Area	ha						
			R11	Temperature, O_2, CO_2 exchange	T°C and gas air/water spatial concentration gradients						
	Maintenance of physical, chemical, biological states	Lifecycle maintenance, habitat and gene pool protection	R12	Biodiversity WFD BQE Marine Protected Areas, Nursery areas	By amount and source, Area (ha)		0-0.2	0.2-04	0.4-0.6	0.8-1	1

Section	Division	Group	Class	Indicator	Parameters and units	Measurement approach	Assessment scale and Score				
							Score 1	Score 2	Score 3	Score 4	Score 5
Regulation & Maintenance	Maintenance of physical, chemical, biological states	Pest and disease control	R13	Number of invasive alien species	By reduction in incidence, risk, area protected		0	1÷5	6÷9	10÷15	⩾16
			R14		By reduction in incidence, risk, area protected		closed	poor	Sufficient	Good	excellent
		Soil/Sediment formation and composition	R15	Availability of Seagrass habitats	Area		0.5-9	10-19	20-29	30-39	40-50
			R16	Nitrogen fixing rates in different habitats, Denitrification rates, Decomposition processes occuring in seagrass meadows and seafloor sediments	tonN/m2/day (year)						
		Water states	R17	WFD/MSFD physico-chemical Quality Elements	Concentrations						
		Atmospheric composition and climate regulation	R18	H_2S, CO_2 and CH_4 emissions reduction	By amount, concentration or climatic parameter	cells/l x10^6	1-1.9	2-2.9	3-3.9	4-4.9	>5
			R19	Temperature variation, precipitation	T^oC, l/m2						
	Physical and intellectual interactions with biota, ecosystems, and land-/seascapes	Physical and experiential interactions	C1.	Visitors	Number By visits/use data, plants, animals, ecosystem type		⩽999	1000 – 9999	10000 – 49999	50000 – 99999	⩾ 100000
			C2.	Visitors	Number		⩽ 999	1000 – 9999	10000 – 49999	50000 – 99999	⩾ 100000
		Intellectual and representative interactions	C3.	publications /citations	Number		< 5	5-19	20-34	35-49	>= 50
			C4.	publications /citations	Number		< 5	5-19	20-34	35-49	>= 50
			C5.	Available objects/ visitors	Number/a	Expert assessment/ scale	1	2	3	4	5

Section	Division	Group	Class	Indicator	Parameters and units	Measurement approach	Assessment scale and Score				
							Score 1	Score 2	Score 3	Score 4	Score 5
Regulation & Maintenance	Physical and intellectual interactions with biota, ecosystems, and land-/seascapes	Intellectual and representative interactions	C6.	Available objects/ visitors	Number/a		⩽999	1000 – 9999	10000 – 49999	50000 – 99999	⩾ 100000
			C7.	Available objects/ visitors	Number/a		⩽999	1000 – 9999	10000 – 49999	50000 – 99999	⩾ 100000
	Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes	Spiritual and/or emblematic	C8.	Endemic plants and animals	Number By use, plants, animals, ecosystem type						
			C9.	Number of visitors	Number of visits		⩽999	1000 – 9999	10000 – 49999	50000 – 99999	⩾ 100000
		Other cultural outputs	C10.	Existance of marine protected areas	ha/km2						
			C11.	Existance of marine protected areas	ha/km2						

1 = low relevant capacity, 2 = relevant capacity, 3 = medium relevant capacity, 4 = high relevant capacity and 5 = very high relevant capacity

The assessment score of relevant class of ecosystem service is the basis for further mapping of the real capacity of marine ecosystem to supply specific ES at national level as shown in Table 9.

Table 9. Matrix of scores given to each Class of ESs presented by ES/ES subtype – Example of scoring a representative ES- "Sublittoral sediment" (EUNIS- A5), as in Table 6.

Marine ecosystems								
ESs Class (code)	***Subtype***							
	A1	***A2***	***A3***	***A4***	***A5***	***A6***	***B3***	***X2***
P1.Wild animals and their outputs (1114)					*3*			
P2. Animals from in-situ aquaculture (1116)					*4*			
P3. Salt production					*2*			
P4. Materials from plants, algae and animals for direct use or processing use (1212)					*3*			
P5. Genetic materials from all biota (1213)					*1*			
P6. Surface water for non-drinking purposes (1221)					*1*			

Marine ecosystems								
ESs Class (code)	***Subtype***							
	A1	***A2***	***A3***	***A4***	***A5***	***A6***	***B3***	***X2***
P7. Wave-based energy, Off-shore windfarms					*2*			
P8. Oil, gas, H_2S and CH_4 based fuel cells					*0*			
R1. Bio-remediation by micro-organisms, algae, plants, and animals (2111)					*5*			
R2.Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals (2112)					*4*			
R3. Filtration/sequestration/storage/accumulation by marine ecosystems (2121)					*4*			
R4. Dilution by marine ecosystems (2122)					*5*			
R5. Mediation of smell/noise/visual impacts (2123)					*3*			
R6. Mass stabilization and control of coastal/sediments erosion rates (2211)					*2*			
R7. Buffering and attenuation of mass flows (2212)					*2*			
R8. Hydrological cycle and water flow maintenance					*2*			
R9. Flood protection (2222)					*1*			
R10. Storm protection (2231)					*1*			
R11. Gas exchange and balance (2232)					*1*			
R12. Maintaining nursery populations and habitats (2112)					*4*			
R13. Pest control (2321)					*2*			
R14. Disease control (2322)					*2*			
R15. Weathering processes (2331)					*2*			
R16.Decomposition and fixing processes (2332)					*3*			
R17. Chemical condition of salt waters (2342)					*4*			
R18. Global climate regulation by reduction of greenhouse gas concentrations (2351)					*1*			
R19. Micro and regional climate regulation (2352)					*2*			
C1. Experiential use of plants, animals and land-/seascapes in different environmental settings (3111)					*4*			
C2. Physical use of land-/seascapes in different environmental settings (3112)					*2*			

Marine ecosystems								
ESs Class (code)	***Subtype***							
	A1	***A2***	***A3***	***A4***	***A5***	***A6***	***B3***	***X2***
C3. Scientific (3121)					*4*			
C4. Educational (3122)					*4*			
C5. Heritage, cultural (3123)					*4*			
C6. Entertainment (3124)					*5*			
C7. Aesthetic (3125)					*4*			
C8. Symbolic (3211)					*4*			
C9. Sacred and/or religious (3212)					*1*			
*C10. Existence (3221)					*0*			
*C11. Bequest (3222)					*0*			

*The assessment scale reaches: 0 = no relevant capacity of the subtype to provide this particular ecosystem service, 1 = low relevant capacity, 2 = relevant capacity, 3 = medium relevant capacity, 4 = high relevant capacity and 5 = very high relevant capacity. * ES is not supported by data at national level and value 0 is additionally attributed and indicates the lack of data*.

The ecosystem service matrix at national level consists of relevant ecosystem services (extracted from the table in annex 7) on the y-axis and each marine ecosystem sub-type on the x-axis. At the intersections, the different sub-type for realized ecosystem service supply should be assessed on a scale from 0 (no relevant supply) to 5 (maximum relevant supply) for a hypothetical 'normal' marine ecosystem defined by the experts at regional (national) level after completing step 3, having into consideration the complexity of marine ecosystems and their specifics. The score (1 to 5) obtained in Table 9 should be used as a basis to define the scores for each ecosystem service and the relevant ecosystem subtypes and the results should be filled in table 9. All services which are defined as not relevant for particular marine ecosystem subtypes (see annex 7) will have 0 score in Table 9. Furthermore, the ecosystem services marked as "not supported by data'' in annex 7 will have 0 score. This indicates that they have no relevant capacity at the time of the assessment due to the lack of data but could have higher scores in future assessments. The normalization to this relative 0-5 scale aims at making different ecosystem services (measured and assessed by various indicators and units) comparable with each other. The values obtained in the matrix are useful for detailed mapping of pilots and monitored regions (see Monitoring Guide). It should be underlined that these values are indicative only for marine ecosystems.

6.3. Mapping of Ecosystem services

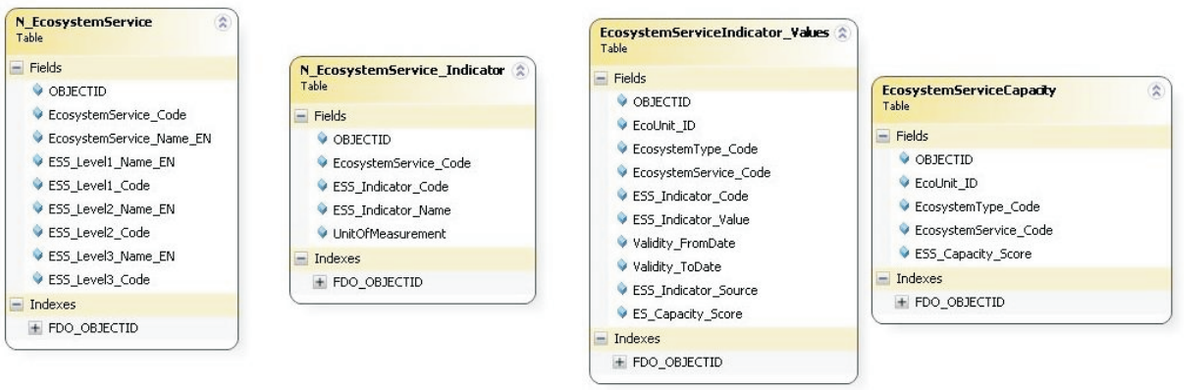
6.3.1. Description of the mapping procedure

The workflow for mapping of ecosystem services follows the steps described in section 6.2. The technical characteristics of the geodatabase are provided in section 4 and should be applied also for mapping procedures in this section.

6.3.2. Data structure/schema

The data structure should follow the one provided in the Annex 9.00.

The schema of the database for the ecosystem services is the following:



The detailed technical description of the classes and tables of the ecosystem services database is provided in Annex 9.01_Schema_Report_ES_Database

/ 9.01_1_Schema_Report_ES_Database.htm

The main steps of generation of the geodatabase should follow the steps described in section 6.2.:

- Table **"N_EcosystemService"**: Nomenclature table for ecosystem services. This table should not be changed. The nomenclatures are given in Annex 9.02_NOMENCLATURES_XLS / N_EcosystemService.xls. It has the following fields:
  - EcosystemService_Code: integer codes for ecosystem services at level 4;
  - EcosystemService_Name_EN: names in English of services at level 4;
  - ESS_Level1_Name_EN: names in English of ecosystem services at level 1;
  - ESS_Level1_Code: integer code of ecosystem services at level 1;
  - ESS_Level2_Name_EN: names in English of ecosystem services at level 2;
  - ESS_Level2_Code: integer code of ecosystem services at level 2;
  - ESS_Level3_Name_EN: names in English of ecosystem services at level 3;
  - ESS_Level3_Code: integer code of ecosystem services at level 3;
- Table **"N_EcosystemService_Indicator"**: Nomenclature table of indicators used to determine the ecosystem services. The nomenclatures are given in Annex 9.02_NOMENCLATURES_XLS / N_EcosystemService_Indicator.xls. It has the following fields:
  - EcosystemService_Code: integer codes for ecosystem service at level 4;
  - ESS_Indicator_Code: integer codes for indicators used to assess the ecosystem services at level 4;
  - ESS_Indicator_Name: name of indicators used to assess the ecosystem services at level 4;

- UnitOfMeasurement: units of measurement for each indicator.

This nomenclature table should be generated using the example provided in Annex 9.02_NOMENCLATURES_XLS / N_EcosystemService_Indicator.xls, as well as the table 7 *Additional optional indicators, which could be applied in assessing and mapping ESs in XXX ecosystems* from this methodology.

- Table **"EcosystemServiceIndicator_Values"**: This table is the resulting table from the assessment of the ecosystem services. How to perform the work on assessment of the indicators is described in Step 3 in section 6.2:
  - EcoUnit_ID: field to relate with the feature class;
  - EcosystemType_Code: integer codes for ecosystem types at level 3;
  - EcosystemService_Code: integer codes for ecosystem service at level 4;
  - ESS_Indicator_Code integer codes for indicators used to assess the ecosystem services at level 4;
  - ESS_Indicator _Value: value of calculated indicator used to assess the ecosystem service at level 4;
  - Validity_FromDate: starting date for validity of the indicator;
  - Validity_ToDate: end date for validity of the indicator;
  - ESS_Indicator_Source: free text to describe the source of the data used to calculate the value of the indicator;
  - ES_Capacity_Score: calculated value for ES; how to define the score for each indicator is explained in Chapter 6.2. / Step 1;

As this resulting table could contain enormous number of records which some GIS software could not support it is acceptable to separate it into smaller tables. In this case the records in the table should be separated based on the ecosystem types at level 3. The naming of the table should be done in the following way:

"EcosystemServiceIndicator_Values_XXX" – where XXX is the code of the ecosystem type at level 3.

- Table **"EcosystemServiceCapacity"**: As for some services more than one indicator could be selected for measurement, additional table is required which represents the total score for each service calculated from the total score of indicators measured. Because some of the indicators could be more important than others, it is of responsibility of the expert to choose what will be the final score based on the values of the indicators calculated:
  - EcoUnit_ID: field to relate with the feature class;
  - EcosystemType_Code: integer codes for ecosystem types at level 3;
  - EcosystemService_Code: integer codes for ecosystem service at level 4;
  - ESS_Capacity_Score: final score for each service calculated on the bases of all indicators selected for its evaluation. The values here should be between 1 and 5 and 0 for not relevant capacity;

In order the database to be more informative, one table for each service at level 4 should be prepared and named as follows: **"EcosystemServiceCapacity_ZZZ"** where ZZZ is the code for services at level 4.

6.3.3. Accuracy and validation

The applicant should provide scientifically sound approach to describe the accuracy reached for each ecosystem service indicator; hence validation approach should be applied. For each validation, accuracy reports should be generated and provided.

6.3.4. Digital Maps for Ecosystem Services

Maps in scale 1:125 000 for the ecosystem types should be delivered in PDF at size A2 presenting the results from calculation for Ecosystem Capacity. In addition the maps could also be prepared in paper format in the same size

Each data frame should contain one cell from the EEA reference grid at 50km, hence up to 77 maps could be produced for all the cells from the 50km EEA gird for Bulgaria. In case that no polygons from Feature Class **"EcoUnit"** fall in certain cell, map for this cell should not be delivered. Therefore, the actual number of maps to be delivered will depend on the number of cells that contain at least one polygon from Feature **"Class EcoUnit"**. The EEA reference grid is available at:

http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids/

The Applicant should deliver at least one set of maps for the ecosystem services. The maps representing the results for calculating the ecosystem services capacity using the approach 1 is mandatory. For visualization of the capacity graduated colours corresponding to the colours in example matrix table (table 10) should be used. Six classes should be generated as follows: 0 - no relevant capacity of the urban sub-type type to provide this particular ecosystem service, 1 - low relevant capacity, 2 - relevant capacity, 3 - medium relevant capacity, 4 - high relevant capacity and 5 - very high relevant capacity.

The layout of the maps of the ecosystem services should follow the guidelines of EEA:

http://www.eionet.europa.eu/gis/docs/GISguide_v4_EEA_Layout_for_map_production.pdf

Each applicant should prepare map layout containing all the attributes for the Map of Ecosystem Services and deliver it for discussion. The final map layout which to be used for all the ecosystem mapping projects will be prepared and will be mandatory to be used for map generation.

6.3.1. Metadata

Each dataset should be accompanied by INSPIRE conformal metadata. The minimum requirement is the metadata to be generated using the INSPIRE MetadataEditor:

http://inspire-geoportal.ec.europa.eu/editor/

7. Annexes

Annex 1-B9

Terms and definitions

Marine ecosystems	
Term	**Definition**
Animal diversity	The diversity of heterotrophic organisms (consumers) measured by number of species, taxonomic and/or functional groups.
Assessment	The analysis and review of information derived from research for the purpose of helping someone in a position of responsibility to evaluate possible actions or think about a problem. Assessment means assembling, summarising, organising, interpreting, and possibly reconciling pieces of existing knowledge and communicating them so that they are relevant and helpful to an intelligent but inexpert decision-maker (Parson, 1995).
Benefits	In biology, benefit is enhancement of growth, maintenance, or reproduction of an organism, population, community or ecosystem. It is also accepted as a positive change in wellbeing from the fulfilment of needs and wants (TEEB, 2010) with respect to production, distribution, and consumption of goods and services
Biodiversity	The variability among living organisms from all sources, including inter alia terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part, this includes diversity within species, between species, and of ecosystems (cf. Article 2 of the Convention on Biological Diversity, 1992).
Biological Quality Elements (BQEs)	Biological Quality Elements for classification of the ecological status are defined for each of the categories of water bodies defined under the WFD, Annex V: transitional (brackish) water (1.1.3) and (marine) coastal waters (1.1.4).
Biophysical valuation	A method that derives values from measurements of the physical costs (e.g., surface requirements, labour, biophysical processes, material inputs).
Density of vegetation cover	Density of macroalgae/vascular plant covering on the bottom surface of a water body.
Descriptors (of Good Environmental Status-GES)	Set of criteria and indicators to assess and report on the physical and ecological status of marine environment under the Marine Strategy Framework Directive (EC, 2008a), which aims to achieve 'good environmental status' (GES) for all European marine waters by 2020. GES is based on 11 descriptors- biodiversity (species and habitats), non-indigenous species, commercial fish stocks, marine food webs, eutrophication, sea-floor integrity, hydrographic conditions, pollution, contaminants in seafood, marine litter and underwater noise.

Marine ecosystems	
Term	**Definition**
Drivers of change	Any natural or human-induced factor that directly or indirectly causes a change in an ecosystem. A direct driver of change unequivocally influences ecosystem processes and can therefore be identified and measured by different degrees of accuracy; an indirect driver of change operates by altering the level or rate of change of one or more direct drivers (MA, 2005).
Ecological status	An expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters, classified in accordance with Annex V of the WFD 2000/60/EPC.
Ecological quality ratio (EQR)	Used for classification of the ecological status. Represents the mathematical ratio between the value of a biological parameter observed in a given coastal water body and the value for that parameter under reference conditions. The ratio is expressed as a numerical value between 0 and 1, with good ecological status represented by values close to 1 and bad ecological status by values close to 0 (see WFD, Annex V, 1.4.11ii).
Economic valuation	The process of expressing a value for a particular good or service in a certain context (e.g., of decision-making) in monetary terms (TEEB, 2010).
Ecosystem	A dynamic complex of plant, animal, and microorganism communities and their non-living environment interacting as a functional unit (MA, 2005). For practical purposes it is important to define the spatial dimensions of concern.
Ecosystem assessment	A social process through which the findings of science concerning the causes of ecosystem change, their consequences for human well-being, and management and policy options are brought to bear on the needs of decision-makers (UK NEA, 2011).
Ecosystem function	Subset of the interactions between biophysical structures, biodiversity and ecosystem processes that underpin the capacity of an ecosystem to provide ecosystem services (TEEB, 2010).
Ecosystem process	Any change or reaction, which occurs within ecosystems, physical, chemical or biological. Ecosystem processes include decomposition, production, nutrient cycling, and fluxes of nutrients and energy (MA, 2005).
Ecosystem service	The benefits that people obtain from ecosystems (MA, 2005). The direct and indirect contributions of ecosystems to human well-being (TEEB, 2010). The concept 'ecosystem goods and services' is synonymous with ecosystem services. The service flow in MAES conceptual framework refers to the actually used service.
Ecosystem condition	The physical, chemical and biological condition of an ecosystem at a particular point in time which can also be referred to as its quality.
Eutrophication	The process by which a coastal water body becomes enriched in dissolved nutrients (as nitrates, nitrites, ammonium and phosphates) that stimulate the growth of aquatic higher and lower plants (vascular plants and algae) usually resulting in the depletion of dissolved oxygen.
Floods	Number of recorded floods per year and % damaged areas of the total area.

Marine ecosystems	
Term	**Definition**
Good environmental status (GES)	The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations. See Directive 2008/56/EC.
Habitat	The physical location or type of environment in which an organism or biological population lives or occurs. Terrestrial or aquatic areas distinguished by geographic, abiotic and biotic features, whether entirely natural or seminatural.
Habitat diversity	Number of natural habitats for specified area incl. protected habitats - Habitats Directive in 1992 (Council Directive 92/43/EEC of 21 May 1992)
Indicator	Observed value representative of a phenomenon to study. In general, indicators quantify information by aggregating different and multiple data. The resulting information is therefore synthesised.
Invasive species	Invasive alien species (IAS) are non-native species that are deliberately or unintentionally introduced by human action outside their natural habitats where they establish, proliferate and spread in ways that cause damage to biological diversity.
Land cover	Land cover is the observed (bio) physical cover on the earth's surface.
Leaf area index (LAI)	The sum of all the upper or all-sided leaf surface areas projected downward per unit area of ground beneath the canopy
Macrozoobenthos	Invertebrate bottom fauna living on, or in the bottom, which is retained on a sieve with a mesh size of 1 mm x 1 mm
Management plan	A predetermined course of action and direction to achieve a set of results, usually specified as goals, objectives, and policies
Marine waters	a) waters, the seabed and subsoil on the seaward side of the baseline from which the extent of territorial waters is measured extending to the outmost reach of the area where the State has and/or exercises jurisdictional rights, in accordance with the UNCLOS (United Nations Convention on the Law of the Sea); b) coastal waters as defined by Directive 2000/60/EC, their seabed and their subsoil, in so far as particular aspects of the environmental status of the marine environment are not already addressed through that Directive or other Community legislation.
Nutrients	Refers to inorganic chemical elements consumed by plants in large quantities, primarily carbon, nitrogen and phosphorus.
Phytoplankton	Autotrophic, mostly unicellular components of the plankton community and a key primary producer in marine ecosystems. Mass development (known as phytoplankton “bloom”) under favorable conditions (excess of nutrients and light) may cause discoloration (green, brownish to red) of the coastal waters known as “red tide”.
Plankton	A group of diverse organisms that live in the water column and cannot swim against a current. They provide a crucial source of food to many large aquatic organisms, such as fish, jellyfish etc.

Marine ecosystems	
Term	**Definition**
Plant diversity	The diversity of autotrophic/photosynthetic organisms, both vascular and algae, measured by number of species, taxonomic and/or functional groups in a specified area/volume.
Pollution/Pollutant	Direct or indirect introduction into the marine environment, as a result of human activity, of substances or energy, including human -induced marine underwater noise, which results or is likely to result in deleterious effects such as harm to living resources and marine ecosystems, including loss of biodiversity, hazards to human health, the hindering of marine activities, including fishing, tourism and recreation and other legitimate uses of the sea, impairment of the quality for use of sea water and reduction of amenities or, in general, impairment of the sustainable use of marine goods and services.
Primary productivity	Process by which inorganic forms of carbon are synthesized by living organisms into organic compounds. In almost all cases these are photosynthetically active organisms (plants, cyanobacteria and other unicellular organisms like phytoplankton).
Protected species and habitats	See Habitats Directive in 1992 (Council Directive 92/43/EEC of 21 May 1992), and Marine Strategy Framework Directive (Council Directive 2008/56/EC of 15 July 2008).
Restoration	Refers to the process of actively managing the recovery of an ecosystem that has been degraded, damaged or destroyed as a means of sustaining ecosystem resilience and conserving biodiversity (CBD, 2012).
Seagrasses	Marine flowering (angiosperm) vascular plants that live in coastal and estuarine areas of the world. Usually, they are totally submerged in the water, possess a root system with stems buried within a soft-bottom substrate, have vegetative and sexual reproduction, have flowers fertilized by water-borne pollen.
Macroalgae	Macroscopic, multicellular marine algae that lives near the seabed. The term includes some members of the red, brown and green algae. Seaweeds can also be classified by use (as food, medicine, fertilizer, filtration, industrial, etc.).
Species diversity	Number of plant or/and animal species for specified area incl. protected species - Habitats Directive in 1992 (Council Directive 92/43/EEC of 21 May 1992) and Birds Directive (Directive 2009/147/EC)
Value	The contribution of an action or object to user-specified goals, objectives, or conditions (MA, 2005).
Water body	A body of surface water as a discrete and significant element of surface water such as a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, a transitional water or a stretch of coastal water (WFD 2000/60/EPC)
Waters for shellfish farming	BG Ordinance № 4/20.10.2000 r. on the quality of waters used for fish- and shellfish cultures

Annex 2-B9

List of acronyms

BQE	Biological Quality Element(s)
BSBD	Black Sea Basin Directorate
CICES	Common International Classification of Ecosystem Services
CLC	CORINE Land Cover
CORINE	Coordination of Information on the Environment
EAFA	Executive Agency of Fisheries and aquaculture
EAMA	Executive Agency Maritime Administration
EC	European Commission
EEA	European Environment Agency
EEI-c	Ecological Evaluation Index continuous formula
EQR	Ecological Quality Ratio
ES	Ecosystem
ESC	Ecosystem Capacity
ESS	Ecosystem Services
ETRS89-LAEA	European Terrestrial Reference System 1989- Lambert Azimuthal Equal-Area projection
EU	European Union
EUNIS	European University Nature Information System
ExAE	Executive Environment Agency
GIS	Geographic Information System
HD	Habitats Directive
INSPIRE	Infrastructure for Spatial Information in the European Community; Directive 2007/2/EC of the European Parliament
IP	Index of ecosystem Performance
ISO	International Organisation for Standardisation
MA	Millennium Ecosystem Assessment
MAES	Mapping and Assessment of Ecosystems and their Services
MAF	Ministry of Agriculture and Food
ME	Ministry of Economy
M-AMBI	AZTI Biotic Index
MOEW	Ministry of Environment and Water
MRDPW	Ministry of Regional Development and Public Works

MSFD	Marine Strategy Framework Directive
NGOs	Non-Governmental Organization(s)
OGC	The Open Geospatial Consortium
TOM	Total Organic Matter
RIEW	Regional Inspectorate of Environment and Water
TEEB	The Economics of Ecosystems and Biodiversity
TRIX	Trophic index
WFD	Water Framework Directive
WG	Working Group

Annex 3-B9

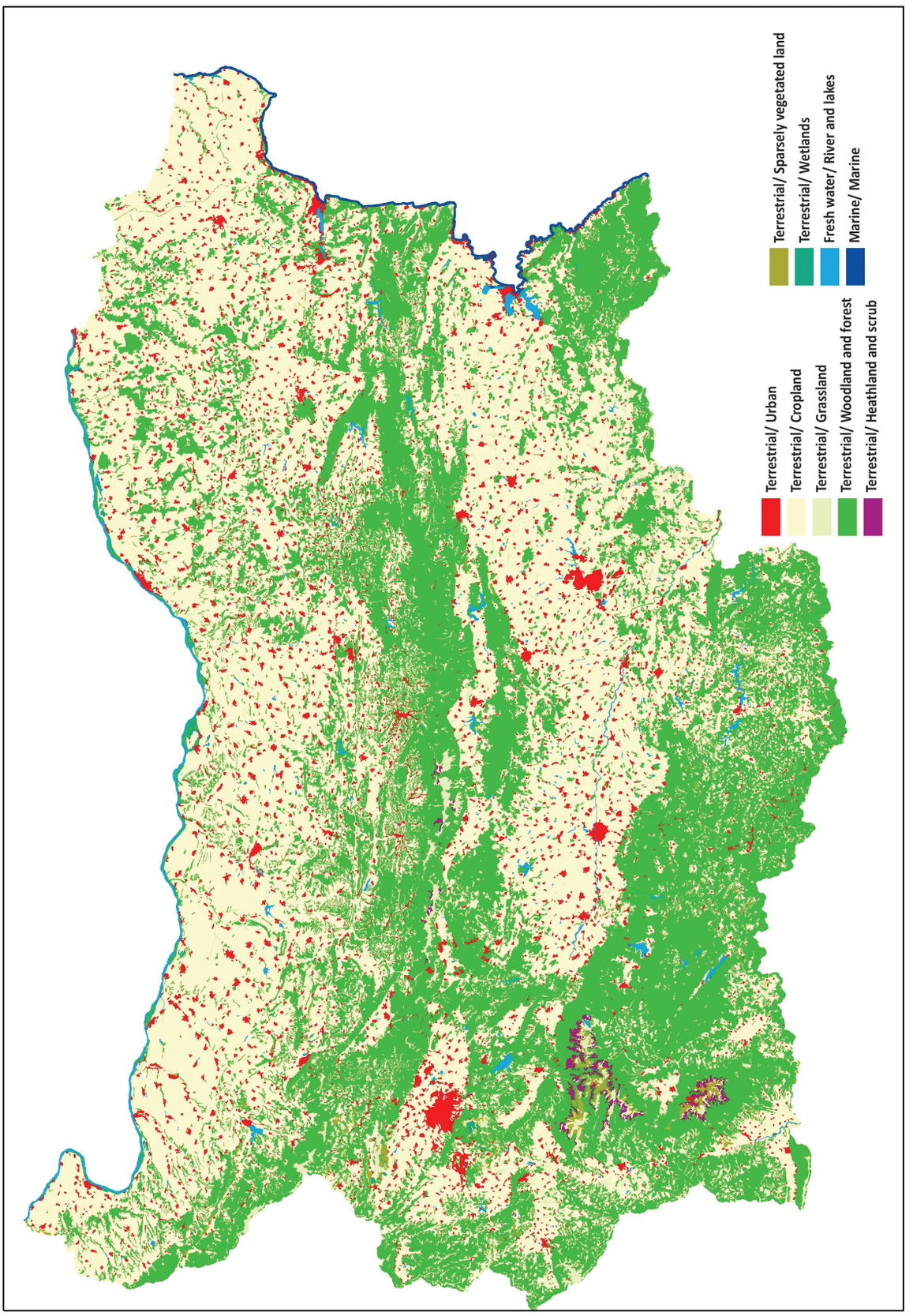
Table of ecosystem types

The typology of Marine ecosystems of Bulgaria

Level 1 Major ecosystem category	Level 2 Sub-classes	Level 3 Ecosystem types
MARINE	Marine inlets and transitional waters	X2. Saline coastal lagoons
	Coastal areas	A1. Littoral rock and other hard substrate A2. Littoral sediment A3. Infralittoral rock and other hard substrate A4. Circalittoral rock and other hard substrate A5. Sub-littoral sediment B3. Rock, cliffs, ledges and shores, incl. Supralittoral
	Shelf	A6. Deep sea-bed
	Open ocean	A6. Deep sea-bed

Annex 4-B9

Map of ecosystem types



Annex 5-B9

National data sets

Sources of spatial and quantitative/qualitative database on Marine Ecosystems

	DATABASE Sources – main stakeholders	
Subclases Level 2	**Spatial**	**Quantitative/Qualitative**
Marine inlets and transitional waters	Database EUNIS Level 2; NATURA-2000 mapping; National monitoring program for WFD; National Concept for Spatial Development 2013-2025; Rivers Basins Management Plans 2009-2015 and next issues; Preliminary Flood Risk Assessments (MOEW/RBDs);	National Monitoring of Biodiversity + NATURA 2000; Action Plans for Programs of Environmental protection; National Concept for Spatial Development 2013-2025; National Statistical Institute; Monitoring reports and data bases (MOEW/ExEA/BSBD/ RIEW, MRDPW, EAFA); Publications, Reports of Research Projects;
Coastal areas	Database EUNIS Level 2 NATURA-2000 mapping, National monitoring program for WFD; National monitoring program for MSFD; National Concept for Spatial Development 2013-2025 Preliminary Flood Risk Assessments (MOEW/BSBD) Initial Assessment of the Marine Environment according to MSFD (BSBD)	National Monitoring of Biodiversity + NATURA 2000; Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, Coastal Water bodies Monitoring reports and data bases (MOEW/ExEA/BSBD/RIEW, MRDPW, EAFA), Publications, Reports of Research Projects, Initial Assessment of the Marine Environment according to MSFD (BSBD)

	DATABASE Sources – main stakeholders	
Subclases Level 2	**Spatial**	**Quantitative/Qualitative**
Shelf	Database EUNIS Level 2 Initial Assessment of the Marine Environment according to MSFD (BSBD)	National Monitoring program of Marine waters for MSFD; Initial Assessment of the Marine Environment according to MSFD
Open waters	Database EUNIS Level 2; Initial Assessment of the Marine Environment according to MSFD	National Monitoring of Biodiversity + NATURA 2000; Action Plans for Programs of Environmental protection, National Concept for Spatial Development 2013-2025, National Statistical Institute, Monitoring reports and data bases (MOEW/ExEA/BSBD/ RIEW, MRDPW, EAFA), Publications, Reports of Research Projects.

Available as a spreadsheet at:
http://www.metecosmap-sofia.org/methodological-framework/

Annex 6-B9

Table of Ecosystem condition indicators

Ecological condition indicandum		A1-A5 Littoral substrates					A6 Deep sea-bed				
Orientor	Indicandum	Parameters	Dimentions (units)	Available data (Y/N)	New data needed (tick by "v")	Periodisity of measurring (years etc.)	Parameters	Dimentions (units)	Available data (Y/N)	New data needed (tick by "v")	Periodicity of measurring (years etc.)
Ecosytem structure	Biotic diversity: plant diversity	phytoplankton	Diversity index	Y	V	1/2y	phytoplankton	Diversity index	Y	V	1/2y
		Macroalgae	Number of species	Y	V	1/2y	NA	NA	NA	NA	NA
		Angiosperms	Number of species	Y	V	1/y	NA	NA	NA	NA	NA
		Invasives	Number	Y	V	1/y	Invasives	Number	Y	V	1/y
	Biotic diversity: animal diversity	Zooplankton	Diversity index	Y	V	1/y	Zooplankton	Diversity index	Y	V	1/y
		Fish	Number of species	Y	V	1/y	Fish	Number of species	Y	V	1/y
		Mammals	Number	Y	V	1/y	Mammals	Number	Y	V	1/y
		macrozoobenthos	Diversity index	Y	V	1/y	NA	NA	NA	NA	NA
		Birds	NA	NA	NA	NA	Birds	NA	NA	NA	NA
		Invasive species	Number	Y	V	1/y	NA	NA	NA	NA	NA
	Biotic diversity: habitat diversity	Number of habitats	Number	Y	V	1/y	Number of habitats	Number	Y	V	1/y
		distribution range	Area (ha)	Y	V	1/y	distribution range	Area (ha)	Y	V	1/y
		distribution pattern	patchy, rare/ description	Y	V	1/y	distribution pattern	patchy, rare/ description	Y	V	1/y
	Biotic diversity: other biotic diversity indicators (naturalness etc.)	Ecological state	WFD BQE	Y	V	1/y	Ecological state	WFD BQE	Y	V	1/y
		Environmental state	MSFD descriptors 1, 2, 3, 4, 6	Y	V	1/y	Environmental state	MSFD descriptors 1, 2, 3, 4, 6	Y	V	1/y
	Abiotic heterogeneity: sediment heterogeneity	type of substrate	simbol/ description	Y	V	1/y	type of substrate	simbol/ description	Y	V	1/y
		granulometry	% gravel, silt, clay	Y	V	1/y	granulometry	% gravel, silt, clay	Y	V	1/y
	Abiotic heterogeneity: water column heterogeneity	salinity	PSU	Y	V	1/4y	salinity	PSU	Y	V	1/4y
		pH	units	Y	V	1/4y	pH	units	Y	V	1/4y
		Temperature	T°C	Y	V	1/4y	Temperature	T°C	Y	V	1/4y
		Transparency	m	Y	V	1/4y	Transparency	m	Y	V	1/4y
		Light	Kd	Y	V	1/4y	Light	Kd	Y	V	1/4y

Ecological condition indicandum			A1-A5 Littoral substrates					A6 Deep sea-bed				
Orientor	Indicandum		Parameters	Dimentions (units)	Available data (Y/N)	New data needed (tick by "V")	Periodisity of measurring (years etc.)	Parameters	Dimentions (units)	Available data (Y/N)	New data needed (tick by "V")	Periodicity of measurring (years etc.)
Ecosytem structure	Abiotic heteroge-neity	air heterogeneity	Temperature	T°C	Y	V	1/2y	NA	NA	NA	NA	NA
			Pollution	concentrations	Y	V	1/2y	NA	NA	NA	NA	NA
		disturbance regime	human affected seabed	%, area (ha)	Y	V	1/4y	human affected seabed	%, area (ha)	Y	V	1/y
			floods (change of salinity)	PSU	Y	V	1/4y	NA	NA	NA	NA	NA
			acidification	pH	Y	V	1/4y	acidification	pH	Y	V	1/4y
			temperature rise	$\Delta T^{o}C$	Y	V	1/4y	temperature rise	$\Delta T^{o}C$	Y	V	1/4y
		other abiotic heterogeneity indicators	WFD Ph-ChQE	concentrations	Y	V	1/4y	WFD Ph-ChQE	concentrations	Y	V	1/4y
			MSFD descriptors 8, 10, 11	concentrations, amounts	Y	V	1/4y	MSFD descriptors 8, 10, 11	concentrations, amounts	Y	V	1/4y
Ecosystem processes	Energy budget	energy balance (capture, storage)	Leaf area	LAI	Y	V	1/2y	NA	NA	NA	NA	NA
			primary productivity	$gC.m^{-2}.day^{-1}$	Y	V	1/2y	primary productivity	$gC.m^{-2}.day^{-1}$	Y	V	1/2y
			biomass	mass per area	Y	V	1y	biomass	mass per area	Y	V	1/y
		entropy production	Shannon-Weaver's Diversity index of BQEs	number	Y	V	1/2y	Shannon-Weaver's Diversity index of BQEs	number	Y	V	1/y
		metabolic efficiency	primary production/ respiration ratio	ratio number	Y	V	1/2y	primary production/respiration ratio	ratio number	Y	V	1/y
		other energy budget indicators	biomass production/ destruction ratio	ratio number	Y	V	1y	biomass production/destruction ratio	ratio number	Y	V	1/y

Ecological condition indicandum			A1-A5 Littoral substrates					A6 Deep sea-bed				
Orientor	Indicandum		Parameters	Dimentions (units)	Available data (Y/N)	New data needed (tick by "V")	Periodisity of measurring (years etc.)	Parameters	Dimentions (units)	Available data (Y/N)	New data needed (tick by "V")	Periodicity of measurring (years etc.)
Ecosystem processes	Matter budget	matter balance (input, output)	biomass production/ destruction ratio	ratio number	N	V	1/y	biomass production/destruction ratio	ratio number	N	V	1y
		matter storage	biomass	weight.m^{-2}	Y	V	1/2y	biomass	weight.m^{-2}	Y	V	1y
		matter storage	organic matter content	%	Y	V	1/2y	organic matter content	%	Y	V	1y
			total organic carbon content	weight.m^{-2}	Y	V	1/2y	total organic carbon content	weight.m^{-2}	Y	V	1y
		element concentrations (other matter budjet variables)	dissolved inorganic nutrients	concentrations	Y	V	1/2y	dissolved inorganic nutrients	concentrations	Y	V	1y
			dissolved organic N,C,P	concentrations	Y	V	1/2y	dissolved organic N,C,P	concentrations	Y	V	1y
		efficiency measures	carbon burial efficiency	%	Y	V	1y	carbon burial efficiency	%	Y	V	1y
	Water budget	water balance (input, output)	rivers inflow	m3.y-1	Y	V	1y	rivers inflow	m3.y-1	Y	V	1y
			outflow	m3.y-1	Y	V	1y	outflow	m3.y-1	Y	V	1y
			evaporation	mm.day-1	Y	V	1y	evaporation	mm.day-1	Y	V	1y
			precipitation	mm.day-1	Y	V	1y	precipitation	mm.day-1	Y	V	1y
		water storage	volume	m3	Y	V	1y	volume	m3	Y	V	1y
		other water budget indicators	suspended matter content	weight.m-3	Y	V	1/2y	suspended matter content	weight.m-3	Y	V	1y
			turbidity	NTU	Y	V	1/2y	turbidity	NTU	Y	V	1y

Ecological condition indicandum			B3 Rock, cliffs, ledges and shores, inl. Supralittoral					X2 Saline Coastal Lagoons				
Orientor	Indicandum		Parameters	Dimentions (units)	Available data (Y/N)	New data needed (tick by "V")	Periodicity of measurring (years etc.)	Parameters	Dimentions (units)	Available data (Y/N)	New data needed (tick by "V")	Periodicity of measurring (years etc.)
Ecosytem structure	Biotic diversity	plant diversity	NA	NA	NA	NA	NA	phytoplankton	Diversity index	Y	V	1/2y
			Macroalgae	Number of species	Y	V	1/2y	Macroalgae	Number of species	Y	V	1y
			NA	NA	NA	NA	NA	Angiosperms	Number of species	Y	V	1/y
			Invasives	Number	Y	V	1/y	Invasives	Number	Y	V	1/y
		animal diversity	NA	NA	NA	NA	NA	Zooplankton	Diversity index	Y	V	1/y
			NA	NA	NA	NA	NA	Fish	Number of species	Y	V	1/y
			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			macrozoobenthos	Diversity index	Y	V	1/y	macrozoobenthos	Diversity index	Y	V	1/y
			Birds	Number of species per sample plot area	Y	V	1/y	Birds	Number of species per sample plot area	Y	V	1/y
			Invasive species	Number	Y	V	1/y	Invasive species	Number	Y	V	1/y
		habitat diversity	Number of habitats	Number	Y	V	1/y	Number of habitats	Number	Y	V	1/y
			distribution range	Area (ha)	Y	V	1/y	distribution range	Area (ha)	Y	V	1/y
			distribution pattern	patchy, rare/ description	Y	V	1/y	distribution pattern	patchy, rare/ description	Y	V	1/y
		other biotic diversity indicators (naturalness etc.)	Ecological state	WFD BQE	N	V	1/y	Ecological state	WFD BQE	N	V	1/y
			Environmental state	MSFD descriptors 1, 2, 3, 4, 6	N	V	1/y	NA	NA	NA	NA	NA
	Abiotic heteroge-neity	sediment heterogeneity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		water column heterogeneity	NA	NA	NA	NA	NA	salinity	PSU	Y	V	1/4y
			NA	NA	NA	NA	NA	pH	units	Y	V	1/4y
			NA	NA	NA	NA	NA	Temperature	T°C	Y	V	1/4y
			NA	NA	NA	NA	NA	Transparency	m	Y	V	1/4y
			NA	NA	NA	NA	NA	Light	Kd	Y	V	1/4y

Ecological condition indicandum			B3 Rock, cliffs, ledges and shores, inl. Supralittoral					X2 Saline Coastal Lagoons				
Orientor	Indicandum		Parameters	Dimentions (units)	Available data (Y/N)	New data needed (tick by "V")	Periodicity of measurring (years etc.)	Parameters	Dimentions (units)	Available data (Y/N)	New data needed (tick by "V")	Periodicity of measurring (years etc.)
Ecosytem structure	Abiotic heteroge-neity	air heterogeneity	NA	NA	NA	NA	NA	Temperature	ToC	Y	V	1/2y
			NA	NA	NA	NA	NA	Pollution	concentrations	Y	V	1/2y
		disturbance regime	human affected seabed	%, area (ha)	Y	V	1/y	human affected seabed	%, area (ha)	Y	V	1/4y
			NA	NA	NA	NA	NA	floods (change of salinity)	PSU	Y	V	1/4y
			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			temperature rise	$\Delta T^{o}C$	Y	V	1/4y	temperature rise	$\Delta T^{o}C$	Y	V	1/4y
		other abiotic heterogeneity indicators	NA	NA	NA	NA	NA	WFD Ph-ChQE	concentrations	Y	V	1/4y
			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ecosystem processes	Energy budget	energy balance (capture, storage)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			primary productivity	$gC.m^{-2}.day^{-1}$	Y	V	1/2y	primary productivity	$gC.m^{-2}.day^{-1}$	Y	V	1/2y
			biomass	mass per area	Y	V	1/y	biomass	mass per area	Y	V	1/y
		entropy production	Shannon-Weaver's Diversity index of BQEs	number	Y	V	1/y	Shannon-Weaver's Diversity index of BQEs	number	Y	V	1/y
		metabolic efficiency	primary production/respiration ratio	ratio number	Y	V	1/y	primary production/respiration ratio	ratio number	Y	V	1/y
		other energy budget indicators	biomass production/destruction ratio	ratio number	Y	V	1/y	biomass production/destructio n ratio	ratio number	Y	V	1/y

Ecological condition indicandum			B3 Rock, cliffs, ledges and shores, inl. Supralittoral					X2 Saline Coastal Lagoons				
Orientor	Indicandum		Parameters	Dimentions (units)	Available data (Y/N)	New data needed (tick by "V")	Periodicity of measurring (years etc.)	Parameters	Dimentions (units)	Available data (Y/N)	New data needed (tick by "V")	Periodicity of measurring (years etc.)
Ecosystem processes	Matter budget	matter balance (input, output)	NA	NA	NA	NA	NA	biomass production/destruction ratio	ratio number	N	V	1/y
		matter storage	NA	NA	NA	NA	NA	biomass	weight.m^{-2}	Y	V	1/2y
		matter storage	NA	NA	NA	NA	NA	organic matter content	%	Y	V	1/2y
			NA	NA	NA	NA	NA	total organic carbon content	weight.m^{-2}	Y	V	1/2y
		element concentrations (other matter budjet variables)	NA	NA	NA	NA	NA	dissolved inorganic nutrients	concentrations	Y	V	1/2y
			NA	NA	NA	NA	NA	dissolved organic N,C,P	concentrations	Y	V	1/2y
		efficiency measures	NA	NA	NA	NA	NA	carbon burial efficiency	%	N	V	1y
	Water budget	water balance (input, output)	NA	NA	NA	NA	NA	rivers inflow	m3.y-1	Y	V	1y
			NA	NA	NA	NA	NA	outflow	m3.y-1	Y	V	1y
			NA	NA	NA	NA	NA	evaporation	mm.day-1	Y	V	1y
			NA	NA	NA	NA	NA	precipitation	mm.day-1	Y	V	1y
		water storage	NA	NA	NA	NA	NA	volume	m3	Y	V	1y
		other water budget indicators	NA	NA	NA	NA	NA	suspended matter content	weight.m-3	Y	V	1/2y
			NA	NA	NA	NA	NA	turbidity	NTU	N	V	1/2y

Available as a spreadsheet at:
http://www.metecosmap-sofia.org/methodological-framework/

Annex 7-B9

Indicators - marine ecosystem services

Section	Division	Group	Class	CICES Code	Indicators	Measurement	B3. Rock, cliffs, ledges and shores, inl. Supralittoral	X2. Saline Coastal Lagoons	A1. Littoral rock and other hard substrate	A2. Littoral sediment
Provisioning	Nutrition	Biomass	Wild animals and their outputs	1114	Fish Catch- Landings	Tons/year	N	Y	Y	Y
			Animals from in-situ aquaculture	1116	Harvests	Tons/year	N	Y	Y	N
		Mineral	Salt production		Yield	Tons/year	N	Y	N	N
	Materials	Biomass	Materials from plants, algae and animals for direct use or processing use	1212	Harvests	Tons/year	N	Y	Y	Y
			Genetic materials from all biota	1213	Biodiversity	Number of species, biodiversity indices	N	Y	Y	Y
		Water	Surface water for non-drinking purposes	1221	Number of bathing waters	Area	N	Y	Y	Y
	Energy	Renewable abiotic energy sources	Wave-based energy, Off-shore windfarms		Production	amount/ source	Y	N	N	Y
		Non-renewable energy sources	Oil, gas, H_2S and CH_4 based fuel cells		Production	amount/ source	N	N	N	N
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	Bio-remediation by micro-organisms, algae, plants, and animals	2111	Nutrient/polutant from pointand diffusive sources	Ton/area/year	Y	Y	Y	Y
			Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and	2112	Number of filtering organisms, nutrients uptake area, seagrass	Ton (Number)/area/year	N	Y	Y	Y
		Mediation by ecosystems	Filtration/sequestration/storage/accumulation by marine ecosystems	2121	Water filtrated by blue mussel, Carbon storage & Nutrients uptake my marine phytoplankton & plants	Ton (liter)/area/year	N	Y	Y	Y
			Dilution by marine ecosystems	2122	Nutrient/ polutant gradients	Concentrations	N	Y	N	Y
			Mediation of smell/noise/visual impacts	2123	Gradients of smell/noise/visual impact	?	Y	Y	?	N

Section	Division	Group	Class	CICES Code	Indicators	Measurement	B3. Rock, cliffs, ledges and shores, inl. Supralittoral	X2. Saline Coastal Lagoons	A1. Littoral rock and other hard substrate	A2. Littoral sediment
Regulation & Maintenance	Mediation of flows	Mass flows	Mass stabilisation and control of coastal/sediments erosion rates	2211	Area	ha	Y	Y	Y	Y
			Buffering and attenuation of	2212	Sedimentation rate	Ton/area/year	Y	Y	Y	Y
		Liquid flows	Hydrological cycle and water flow maintenance	2221	Salinity gradients	By depth/volumes	Y	Y	N	N
			Flood protection	2222	Area	ha	Y	Y	Y	N
		Gaseous / air flows	Storm protection	2231	Area	ha	Y	Y	Y	N
			Gas exchange and balance	2232	Temperature, O_2, CO_2 exchange	$T^{o}C$ and gas air/water spatial concentration gradients	Y	Y	Y	Y
	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	Maintaining nursery populations and habitats	2112	Biodiversity, WFD BQE MarineProtectedAreas	By amount and source, Area (ha)	N	Y	Y	Y
		Pest and disease control	Pest control	2321	Number of invasive alien species	By reduction in incidence, risk, area protected	N	Y	Y	Y
			Disease control	2322		By reduction in incidence, risk, area protected	Y	Y	Y	Y
		Soil/sediment formation and composition	Weathering processes	2331	Availability of Seagrass habitats	Area	N	N	N	Y
			Decomposition and fixing processes	2332	Nitrogen fixing rates in different habitats, Denitrification rates, Decomposition processes	tonN/m2/day (year)	N	Y	Y	Y
		Water conditions	Chemical condition of salt waters	2342	WFD/MSFD physico-chemical Quality Elements	Concentrations	Y	Y	Y	Y
		Atmospheric composition and climate regulation	Global climate regulation by reduction of greenhouse gas concentrations	2351	H2S, CO2 and CH4 emissions reduction	By amount, concentration or climatic parameter	Y	Y	Y	Y
			Micro and regional climate regulation	2352	Temperature variation, precipitation	$T^{o}C$, l/m2	Y	Y	Y	Y

Section	Division	Group	Class	CICES Code	Indicators	Measurement	B3. Rock, cliffs, ledges and shores, inl. Supralittoral	X2. Saline Coastal Lagoons	A1. Littoral rock and other hard substrate	A2. Littoral sediment
Cultural	Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Physical and experiential interactions	Experiential use of plants, animals and land-/seascapes	3111	Visits	Number, By visits/use data, plants, animals, ecosystem	Y	Y	Y	Y
			Physical use of land-/seascapes in different	3112	Visits	Number	Y	Y	Y	Y
		Intellectual and representative interactions	Scientific	3121	publications/citations	Number	Y	Y	Y	Y
			Educational	3122	publications/citations	Number	Y	Y	Y	Y
			Heritage, cultural	3123	Available objects/ visits	Number/year	Y	Y	Y	Y
			Entertainment	3124	Available objects/ visits	Number/year	Y	Y	Y	Y
			Aesthetic	3125	Available objects/ visits	Number/year	Y	Y	Y	Y
	Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Spiritual and/or emblematic	Symbolic	3211	Endemic plants and animals	Number By use, plants, animals,	Y	Y	Y	Y
			Sacred and/or religious	3212	Number of visits	Number of visits	Y	Y	N	N
		Other cultural outputs	Existence	3221	Existance of marine protected areas	ha/km2	Y	Y	Y	Y
			Bequest	3222	Existance of marine protected areas		Y	Y	Y	Y
Supporting services	Nutrients Cycling Rate					tN(P)/km2/year	N	Y	Y	Y
	Primary production rate					tC/km2/year	N	Y	Y	Y
	Solar energy capture and transformation						N	Y	Y	Y

Section	Division	Group	Class	CICES Code	A3. Infralittoral rock and other hard substrate	A4. Circalittoral rock and other hard substrate	A5. Sub-littoral sediment	A6. Deep sea-bed	Examples
Provisioning	Nutrition	Biomass	Wild animals and their outputs	1114	Y	Y	Y	N	marine fish (plaice, sea bass etc.) and shellfish (i.e. crustaceans, molluscs; Includes commercial and subsistence fishing and hunting for food
			Animals from in-situ aquaculture	1116	N	N	N	N	In-situ farming of marine fish (e.g. salmon, tuna) also in floating cages; shellfish aquaculture (e.g. oysters or crustaceans) in e.g. poles
		Mineral	Salt production		N	N	N	N	Freshwater abstracted from (non-fossil) groundwater layers or via ground water desalination for drinking
	Materials	Biomass	Materials from plants, algae and animals for direct use or processing use	1212	Y	Y	Y	N	chemicals extracted or synthesised from algae, natural remedies and medicines (e.g. chondritin from sharks), dyes and colours, ambergris (from sperm whales used in perfumes); Includes consumptive ornamental uses.
			Genetic materials from all biota	1213	Y	Y	Y	Y	Genetic material (DNA) from wild plants, algae and animals for biochemical industrial and pharmaceutical processes e.g. medicines, fermentation, detoxification; bio-prospecting activities e.g. wild species used in breeding programmes etc.
		Water	Surface water for non-drinking purposes	1221	Y	N	Y	N	Collected precipitation, abstracted surface water from rivers, lakes and other open water bodies for domestic use (washing, cleaning and other non-drinking use), irrigation, livestock consumption, industrial use (consumption and cooling) etc.
	Energy	Renewable abiotic energy sources	Wave-based energy, Off-shore windfarms		N	N	Y	N	Dung, fat, oils, cadavers from land, water and marine animals for burning and energy production
		Non-renewable energy sources	Oil, gas, H_2S and CH_4 based fuel cells		N	N	N	Y	Physical labour provided by animals (horses, elephants etc.)
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	Bio-remediation by micro-organisms, algae, plants, and animals	2111	Y	Y	Y	Y	Bio-chemical detoxification/decomposition/ mineralisation in land/soil, freshwater and marine systems including sediments; decomposition/detoxification of waste and toxic materials e.g. waste water cleaning, degrading oil spills by marine bacteria, (phyto)degradation, (rhizo)degradation etc.
			Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and	2112	Y	Y	Y	Y	Biological filtration/sequestration/storage/accumulation of pollutants in land/soil, freshwater and marine biota, adsorption and binding of heavy metals and organic compounds in biota
		Mediation by ecosystems	Filtration/sequestration/storage/accumulation by marine ecosystems	2121	Y	Y	Y	Y	Bio-physicochemical filtration/sequestration/storage/accumulation of pollutants in land/soil, freshwater and marine ecosystems, including sediments; adsorption and binding of heavy metals and organic compounds in ecosystems (combination of biotic and abiotic factors)
			Dilution by marine ecosystems	2122	Y	Y	Y	Y	Bio-physico-chemical dilution of gases, fluids and solid waste, wastewater in sea and sediments
			Mediation of smell/noise/visual impacts	2123	N	N	Y	Y	Visual screening of transport corridors e.g. by trees; Green infrastructure to reduce noise and smells

Section	Division	Group	Class	CICES Code	A3. Infralittoral rock and other hard substrate	A4. Circalittoral rock and other hard substrate	A5. Sub-littoral sediment	A6. Deep sea-bed	Examples
Regulation & Maintenance	Mediation of flows	Mass flows	Mass stabilisation and control of coastal/sediments erosion rates	2211	Y	Y	Y	N	Erosion / landslide / gravity flow protection; vegetation cover protecting/stabilising terrestrial, coastal and marine ecosystems, coastal wetlands, dunes; vegetation on slopes also preventing avalanches (snow, rock), erosion protection of coasts and sediments by mangroves, sea grass, macroalgae, etc.
			Buffering and attenuation of	2212	Y	Y	Y	N	Transport and storage of sediment by rivers, lakes, sea
		Liquid flows	Hydrological cycle and water flow maintenance	2221	N	N	N	Y	Capacity of maintaining baseline flows for water supply and discharge; e.g. fostering groundwater; recharge by appropriate land coverage that captures effective rainfall; includes drought and water scarcity aspects.
			Flood protection	2222	N	N	N	N	Flood protection by appropriate land coverage; coastal flood prevention by mangroves, sea grass, macroalgae, etc. (supplementary to coastal protection by wetlands, dunes)
		Gaseous / air flows	Storm protection	2231	N	N	N	N	Natural or planted vegetation that serves as shelter belts
			Gas exchange and balance	2232	Y	Y	Y	Y	Natural or planted vegetation that enables air ventilation
	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	Maintaining nursery populations and habitats	2112	Y	Y	Y	N	Habitats for plant and animal nursery and reproduction e.g. seagrasses, microstructures of rivers etc.
		Pest and disease control	Pest control	2321	Y	Y	Y	N	Pest and disease control including invasive alien species
			Disease control	2322	Y	Y	Y	N	In cultivated and natural ecosystems and human populations
		Soil/sediment formation and composition	Weathering processes	2331	N	Y	N	N	Maintenance of bio-geochemical conditions of soils including fertility, nutrient storage, or soil structure; includes biological, chemical, physical weathering and pedogenesis
			Decomposition and fixing processes	2332	Y	Y	Y	Y	Maintenance of bio-geochemical conditions of soils by decomposition/mineralisation of dead organic material, nitrification, denitrification etc.), N-fixing and other bio-geochemical processes;
		Water conditions	Chemical condition of salt waters	2342	Y	Y	Y	Y	Maintenance / buffering of chemical composition of seawater column and sediment to ensure favourable living conditions for biota e.g. by denitrification, re-mobilisation/re-mineralisation of phosphorous, etc.
		Atmospheric composition and climate regulation	Global climate regulation by reduction of greenhouse gas concentrations	2351	Y	Y	Y	Y	Global climate regulation by greenhouse gas/carbon sequestration by terrestrial ecosystems, water columns and sediments and their biota; transport of carbon into oceans (DOCs) etc.
			Micro and regional climate regulation	2352	Y	Y	Y	N	Modifying temperature, humidity, wind fields; maintenance of rural and urban climate and air quality and regional precipitation/temperature patterns

Section	Division	Group	Class	CICES Code	A3. Infralittoral rock and other hard substrate	A4. Circalittoral rock and other hard substrate	A5. Sub-littoral sediment	A6. Deep sea-bed	Examples
Cultural	Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Physical and experiential interactions	Experiential use of plants, animals and land-/seascapes	3111	Y	Y	Y	Y	In-situ whale and bird watching, snorkelling, diving etc.
			Physical use of land-/seascapes in different	3112	Y	Y	Y	N	Walking, hiking, climbing, boating, leisure fishing (angling) and leisure hunting
		Intellectual and representative interactions	Scientific	3121	Y	Y	Y	Y	Subject matter for research both on location and via other media
			Educational	3122	Y	Y	Y	Y	Subject matter of education both on location and via other media
			Heritage, cultural	3123	Y	Y	Y	N	Historic records, cultural heritage e.g. preserved in water bodies and soils
			Entertainment	3124	Y	Y	Y	N	Ex-situ viewing/experience of natural world through different media
			Aesthetic	3125	Y	Y	Y	N	Sense of place, artistic representations of nature
	Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Spiritual and/or emblematic	Symbolic	3211	Y	Y	Y	Y	Emblematic plants and animals e.g. national symbols such as American eagle, British rose, Welsh daffodil
			Sacred and/or religious	3212	N	N	N	N	Spiritual, ritual identity e.g. 'dream paths' of native Australians, holy places; sacred plants and animals and their parts
		Other cultural outputs	Existence	3221	Y	Y	Y	N	Enjoyment provided by wild species, wilderness, ecosystems, land-/seascapes
			Bequest	3222	Y	Y	Y	N	Willingness to preserve plants, animals, ecoystems, land-/seascapes for the experience and use of future generations; moral/ethical perspective or belief
Supporting services	Nutrients Cycling Rate				Y	Y	Y	N	
	Primary production rate				Y	Y	Y	N	
	Solar energy capture and transformation				Y	Y	Y	N	

Accompanying classification of abiotic outputs from natural systems (Provisional)

Section	Division	Group	Examples
Abiotic Provisioning	Nutritional abiotic substances	Mineral	e.g. salt
		Non-mineral	e.g. sunlight
	Abiotic materials	Metallic	e.g. metal ores
		Non-metallic	e.g. minerals, aggregates, pigments, building materials (mud/clay)
	Energy	Renewable abiotic energy sources	e.g. wind, waves, hydropower
		Non-renewable energy sources	e.g. coal, oil, gas
Regulation & Maintenance by natural physical structures and processes	Mediation of waste, toxics and other nuisances	By natural chemical and physical processes	e.g. atmospheric dispersion and dilution; adsorption and sequestration of waters in sediments; screening by natural physical structures
	Mediation of flows by natural abiotic structures	By solid (mass), liquid and gaseous (air)flows	e.g. protection by sand and mud flats; topographic control of wind erosion
	Maintenance of physical, chemical, abiotic conditions	By natural chemical and physical processes	e.g. land and sea breezes; snow
Cultural settings dependent on abiotic structures	Physical and intellectual interactions with land-/seascapes [physical settings]	By physical and experiential interactions or intellectual and representational interactions	e.g. caves
	Spiritual, symbolic and other interactions with land-/seascapes [physical settings]	By type	e.g. sacred rocks or other physical structures or spaces

Annex 8-B9

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Annex 9-B9

Database templates and nomenclature tables

The databases and related tables and vector layers described in the methodological part of the document, as well as the nomenclature tables for ecosystem types and indicators for condition and ecosystem services are provided in a digital format to this Methodology.

The structure and content of the data under Appendix 9 is as follows:

1. Directory: 9.00_EcosystemDatabase_Schema

Contains a template of the database to this methodology in several different formats:

- Ecosystem_DB_v07.diagram: database structure for review in ArcGIS Diagrammer - free software for creating, editing and analyzing geodatabase schemas

- Ecosystem_DB_v07.mdb: database structure in MDB format;

- Ecosystem_DB_v07. XML: database structure in XML format;

- Ecosystem_DB_v07. jpg: preview of the database schema in JPG format.

2. Directory: 9.01_Schema_Report_ES_Database

It contains a descriptive geodatabase document including the specifications of all the tables and vector layers, as well as a description of all the attribute fields in them:

- 9.01_0_Schema_Report_ES_Database.htm: document describing the structure of the database.

3. Directory: 9.02_NOMENCLATURES_XLS

Contains nomenclature tables for ecosystem types and for the indicators for condition and ecosystem services:

- N_EcosystemType.xls: table in MS Excel format containing all ecosystem types at different hierarchical levels;

- N_EcosystemCondition.xls: MS Excel table containing nomenclatures for ecosystem condition indicators up to level 3;

- N_EcosystemConditionIndicator_Parameter.xls: MS Excel table containing information on how to create a table for ecosystem condition parameters for each specific ecosystem type;

- N_EcosystemService.xls: MS Excel table containing ecosystem services nomenclatures up to level 4

- N_EcosystemService_Indicator.xls: an MS Excel table containing information on how to create a table for ecosystem service indicators for each specific ecosystem type;

- Instruction_Nomenclature_Tables_ES_Condition_Services.docx: document in MS Word format containing a description of the sequence and specifics for filling in all the nomenclature tables of the Methodology as well as the tables in the database for each specific ecosystem type.

4. Directory: 9.03_Data_Maps

Contains the EEA (European Environment Agency) reference grid for Bulgaria at 50 km grid.

The data and documents in Annex 9 are available on:

http://www.metecosmap-sofia.org/methodological-framework/