

Technical paper 1/2014

Crosswalks between European marine habitat typologies -

A contribution to the MAES marine pilot

- a) EUNIS and the classification under the MSFD,
- b) EUSeaMap and MSFD,
- c) Annex I of the Habitats Directive and MSFD, and
- d) Annex I of the Habitats Directive and EUSeaMap

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1 Background

Both the MAES (Mapping and Assessment of Ecosystems and their Services) analytical framework, which is European guidance on Target 2/Action 5 of the EU 2020 Biodiversity Strategy, and the MAES marine pilot, which scoped and tested this guidance to support Member States implementation efforts, acknowledge the need for cross-walks between existing European marine habitat type classifications in order to support harmonisation of ecosystem definitions and mapping in a MAES context. These classifications are the marine component of EUNIS (European Nature Information System), the predominant habitat types of the EU Marine Strategy Framework Directive (MSFD) and the habitat types used by EUSeaMap, the existing European scheme for consistent seabed broad scale habitat mapping. These cross-walks are necessary in order to link existing European, national or regional marine assessments and maps, based on marine EUNIS and/or mapped using EUSeaMap, to the marine ecosystem typology of the MAES analytical framework (which is an aggregation of the MSFD predominant habitat types¹ to a large extent).

The above-mentioned MAES documents also acknowledge the need to clarify and show the links between the coastal and marine habitat types listed in Annex I of the EU Habitats Directive and the MSFD predominant habitat types as well as the EUSeaMap habitat types. These links are needed to fully benefit from information included in assessments of Annex I marine and coastal habitats under Article 17 of the Habitats Directive, in a MAES context. Thus, Article 17 assessment information could be used, in particular, to assess ‘habitat-based’ marine ecosystem services from some of the marine ecosystems included in the typology of the MAES analytical framework.

2 Introduction

The EUNIS habitats classification is a classification of all habitat types in Europe, covering terrestrial, freshwater and marine habitats, developed by the European Topic Centre on Biological Diversity (ETC/BD) for the European Environment Agency (EEA). It has been used as the basis for habitat type and ecosystem typologies for a variety of European issues, for example the implementation of the MSFD, the production of seabed maps and proposed work on mapping ecosystems and their services (e.g. in the context of MAES).

After a general introduction to crosswalks, this report briefly describes the EUNIS habitats classification, highlighting some known difficulties, then describes Annex I of the Habitats Directive, and the typologies used for the MSFD predominant habitat types and for EUSeaMap, in each case showing how they can be related to the EUNIS classification. Finally EUSeaMap classes and Annex I habitat types are linked to the typology proposed for marine ecosystem mapping and assessments in the context of MAES. The following crosswalks are included as appendices:

- MSFD predominant habitat types & EUNIS (Appendix 1)
- Potential overlap between MSFD and Habitats Directive (Annex I) marine habitat types (Appendix 2)
- Potential overlap between EUSeaMap and Habitats Directive (Annex I) marine habitat types (Appendix 4)
- Crosswalk between EUSeaMap and MSFD predominant habitat types (Appendix 5)
- EUSeaMap and Habitats Directive (Annex I) habitats and MAES European marine ecosystem typology – cross walks for MAES (Appendix 6)

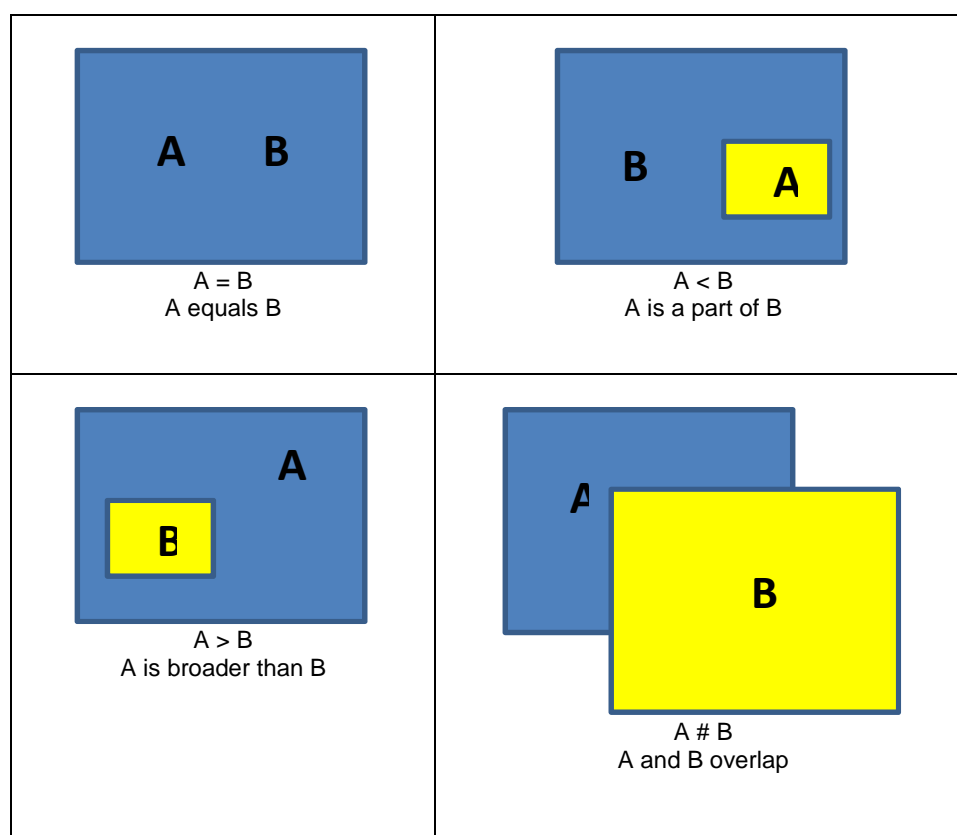
(¹) Cf. Table 5.2 ‘Typology of ecosystems’. Refinement of the EU 2010 Biodiversity Baseline (EEA 2012)’ in the MAES analytical framework

(http://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/MAESWorkingPaper2013.pdf)

3 Crosswalks

Although there are many habitat classifications, it is usually possible to derive links between them, often presented as tables and known as crosswalks. Unfortunately often the links are from ‘many to many’ rather than ‘one to one’. Table 3.1 shows part of a crosswalk from the OSPAR list of threatened and/or declining habitats to the list of habitats of Community Interest given in Annex I of the Habitats Directive (see below). In this case there are no ‘one to one’ relationships; most OSPAR habitats are part of a wider Annex I habitat (e.g. the very widely defined Annex I habitat ‘1170 Reefs’ includes several OSPAR habitats) and in some cases there are overlaps. These relationships can be described and the EUNIS website² uses a series of symbols as described in figure 3.1.

Figure 3.1: Possible relationships between different habitat classifications and the symbols used by EUNIS.



Crosswalks aid the translation between different habitat classifications but often need to be used with care. In many cases it is possible to give more definitive relationships if a crosswalk is for a region or country rather than for Europe. For example the EUNIS habitat ‘G3.4 *Pinus sylvestris* woodland south of the taiga’ includes 6 Annex I habitats (and also forests not covered by Annex I) but in Scotland would only include ‘91C0 Caledonian forest’.

⁽²⁾ <http://eunis.eea.europa.eu/habitats.jsp>

Table 3.1 Extract from a crosswalk between OSPAR habitats and the Habitats Directive Annex I (adapted from Michez, Aish & Dirberg 2012)

OSPAR habitats	Relationship (see Figure 3.1)	Habitat of Community Interest (Annex I Habitats Directive)	
		Code	Name
Coral Gardens	#	1170	Reefs
Deep-sea sponge aggregations	#	1170	Reefs
Intertidal <i>Mytilus edulis</i> beds on mixed and sandy sediments	<	1140	Mudflats and sandflats not covered by seawater at low tide
	<	1170	Reefs
<i>Lophelia pertusa</i> reefs	<	1170	Reefs
Maerl beds	#	1110	Sandbanks which are slightly covered by sea water all the time
	#	1160	Large shallow inlets and bays
<i>Modiolus modiolus</i> beds	<	1170	Reefs

4 The EUNIS habitat classification

In the 1980s, when the CORINE Biotopes project started, there was no suitable classification of habitats or biotopes covering all Europe for sea, freshwater and land; although there were several national or regional classifications such as Pérès & Picard (1964) for the benthic habitats of the Mediterranean. The EUNIS habitat classification was developed for the EEA by the ETC/BD and its predecessors and can be considered to be a development from the earlier CORINE biotopes and Palaearctic habitat classifications (Evans 2012). EUNIS was based on similar principles but aimed to give better coverage of marine habitats and to have agreed criteria to define the habitat classes. Development started in the mid 1990s with the last major revision being published in 2004. EUNIS is a hierarchical classification with 10 level one classes (plus habitat complexes), Class ‘A’ is ‘marine’. The marine part of the classification was largely based on the British marine classification. The divisions at level 2 and 3 for the marine habitats are based on physical parameters, namely depth (related to light penetration and other factors), substrate and energy; with biology (species composition) appearing at level 4.

The EUNIS habitats classification has been produced for levels 1 to 3 (terrestrial) and levels 1-4 (marine). There are currently 56 level 3 and 210 level 4 EUNIS marine habitats. In order to give finer divisions, units from other classifications have been added to give lower levels. For the marine part, these have mostly come from the British marine classification or from the Helsinki and Barcelona Conventions (Connor et al 2004, HELCOM 1998, Barcelona Convention 2002). They may not cover the entire variation within the parent class and there may be overlap between types from different sources.

The current version of the EUNIS habitats classification dates from 2004 (Moss, Davies & Hill 2004), with an extension into the Black Sea (Pontic habitats) in 2007. With increasing knowledge of the marine environment and from experience in using the EUNIS classification for seabed mapping, it has become evident that revision is required. For example Howell (2010) proposes that ‘A6 Deep-sea bed’ should be divided into several zones. A meeting organised by the MESH Atlantic project³ in 2012 brought together researchers who had been using the classification for seabed mapping in various parts of Europe and made recommendations for future revisions (Galparsoro et al 2012). These

⁽³⁾ <http://www.meshatlantic.eu/>

recommendations are the basis for a planned revision of the marine component of EUNIS by the EEA and its ETC/BD in 2014.

The EUNIS habitats classification was conceived as a tool to aid the harmonisation of information on habitats at a European scale and not to replace the many existing national or regional classifications. Several crosswalks have been produced to help EUNIS function as a common language, such as the crosswalks to plant communities (Schaminée et al 2012) and all habitat types listed on Annex I of the EU Habitats Directive can be allocated to one or more EUNIS classes. EUNIS is an approved code list under the EU INSPIRE Directive and is recommended as the typology for the proposed European Red List of habitats (Rodwell et al 2013).

5 Marine Framework Strategy Framework and Predominant Habitat Types

The Marine Strategy Framework Directive (MSFD) adopted in July 2008 aims at achieving or maintaining a ‘good environmental status’ (GES) in the marine environment by 2020 at the latest. GES is defined as **“The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive”**. Eleven qualitative descriptors which describe what the environment will look like when GES has been achieved are given in Annex I of the MSFD. Each Descriptor has several associated criteria and indicators for its further characterisation and operationalization as included in the EC Decision on GES criteria and methodological standards (EC 2010). Descriptor 1: *“Biodiversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climate conditions”* is characterised by 14 indicators at the species, habitat and ecosystem level (EC 2010).

The assessment of habitats (Descriptor 1) includes both ‘predominant seabed and water column types’, often referred to as ‘Predominant Habitat Types’, and ‘Special habitat types’, which refer especially to those recognised or identified under Community legislation (the Habitats Directive) or international conventions (e.g. OSPAR, Barcelona) as being of special scientific or biodiversity interest” (Cochrane et al 2010). There is some overlap between ‘Predominant Habitat Types’ and ‘Special habitat types’, for example the Annex I habitat type ‘1170 Reefs’ includes several ‘Predominant Habitat Types’ (e.g. Littoral rock & biogenic reef). The MSFD clearly treats habitat in the same way as EUNIS (“the term habitat addresses both the abiotic characteristics and the associated biological community, treating both elements together in the sense of the term biotope”) (EC 2010).

Based on Cochrane et al (2010), the [Commission Staff Working Paper on the ‘Relationship between the initial assessment of marine waters and the criteria for good environmental status’](#) lists 24 predominant habitat types (18 benthic, 5 pelagic and 1 ice associated, see Table 5.1). The benthic and ice associated habitats are defined by reference to the EUNIS habitats classification except that sublittoral is divided into shallow & shelf and ‘A6 Deep sea-bed’ is divided into Upper and Lower Bathyal and Abyssal following proposals from Howell (2010), see Appendix 1.

Table 5.1 Marine Strategy Framework Directive predominant habitat types⁴

Ecological zone/realm	Habitat type
Seabed habitats	Littoral rock and biogenic reef Littoral sediment Shallow sublittoral rock and biogenic reef Shallow sublittoral coarse sediment ⁸ Shallow sublittoral sand Shallow sublittoral mud Shallow sublittoral mixed sediment Shelf sublittoral rock and biogenic reef Shelf sublittoral coarse sediment Shelf sublittoral sand Shelf sublittoral mud Shelf sublittoral mixed sediment Upper bathyal rock and biogenic reef Upper bathyal sediment Lower bathyal rock and biogenic reef Lower bathyal sediment Abyssal rock and biogenic reef Abyssal sediment
Water column habitats	Reduced salinity water Variable salinity (estuarine) water Marine water: Coastal, Shelf and Oceanic
Ice habitats	Ice-associated habitats

Table 5.2 shows how depth zones have been used by EUNIS, MSFD and EUSaMap. The section on 'Annex I of the Habitats Directive' (below) discusses how the MSFD predominant habitat types relate to the Habitats Directive Annex I habitats.

Table 5.2 Depth zones as used by the EUNIS habitats classification, the Marine Strategy Framework Directive and EUSaMap. In EUNIS, circalittoral includes upper and deep circalittoral, whilst sublittoral includes infralittoral, upper and deep circalittoral.

EUNIS (level 2 codes)		MSFD	EUSaMap
Littoral (A1 & A2)		Littoral	Not mapped
[Hard substrates]	[Soft substrates] Sublittoral (A5)	Shallow sublittoral (above wavebase)	Infralittoral
Infralittoral (A3)			Upper Circalittoral
Circalittoral (A4)		Shelf sublittoral (below wavebase)	Deep Circalittoral
Deep sea (A6)		Upper Bathyal	Bathyal
		Lower Bathyal	
		Abyssal	Abyssal

(4) From Commission Staff Working Paper on the 'Relationship between the initial assessment of marine waters and the criteria for good environmental status', Brussels, 14.10.2011, SEC (2011) 1255 final
http://ec.europa.eu/environment/marine/pdf/SEC_2011_1255_F_DTS.pdf

Note – The limit between shallow sublittoral and shelf sublittoral for the MSFD corresponds to the limit between (upper) circalittoral and deep circalittoral for EUSeaMap; the lower limit of wave disturbance (wavebase) has been used to define the boundary between these two zones, but other factors such as thermal stability may be important in some regions (see also Appendix 3).

6 Annex I of the Habitats Directive

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora ⁵, more commonly known as the Habitats Directive, aims to protect the EU’s “natural habitats and of wild fauna and flora”. The Directive requires the designation and appropriate management of sites known as Special Areas of Conservation (SACs) for habitat types and species of Community Interest listed on Annexes I & II of the Directive. Annex I currently lists 231 habitat types, the initial list (as included in the 1992 Directive) was a selection of habitat types mostly from the CORINE Biotopes classification (Devillers, Devillers-Terschuren & Ledant 1991). Habitat types added later due to EU enlargements in 1995, 2003 and 2007 were mostly based on the Palaearctic classification (Devillers & Devillers-Terschuren 1996). Descriptions of the habitat types, often with links to other national or regional classifications, are given in a manual (EC 2013) formally adopted by the Habitats Committee (a body established under the Directive to help its implementation).

The number of marine habitats is limited, probably as it was not clear at first if the Directive covered more than inshore waters. The habitat types differ widely in their inherent variability, with some of the marine habitat types (e.g. 1170 Reefs) covering more variation than any of the terrestrial habitat types. It is clear that there is often a difference between Member States in the interpretation of the habitat types (Evans 2006, 2010). This is probably less of a problem for marine habitat types although the interpretation of ‘1110 Sandbanks which are slightly covered by sea water all the time’ has been problematic.

For the EU 2010 Biodiversity Baseline (EEA 2010), 6 Annex I habitat types were considered ‘marine’ while 10 are considered ‘marine’ for reporting under Article 17 of the Directive, see Table 6.1. For Article 17, marine habitats were defined by being part of, or connected to, the open seas (Evans & Arvela 2011). There are further Annex I types which occur at the boundary with terrestrial systems (e.g. certain saltmarsh habitats); where these are regularly covered by seawater they can also be considered as part of the marine environment.

Table 6.1 Habitats Directive Annex I habitats considered as ‘marine’

Natura code	Annex I habitat name	Marine for Article 17 reporting	Marine for 2010 Biodiversity baseline
1110	Sandbanks which are slightly covered by sea water all the time	X	X
1120	<i>Posidonia</i> beds (<i>Posidonia oceanica</i>)	X	X
1130	Estuaries	X	
1140	Mudflats and sandflats not covered by seawater at low tide	X	
1150	Coastal lagoons	X	
1160	Large shallow inlets and bays	X	X
1170	Reefs	X	X
1180	Submarine structures made by leaking gasses	X	X
1650	Boreal Baltic narrow inlets	X	
8330	Submerged or partially submerged sea caves	X	X

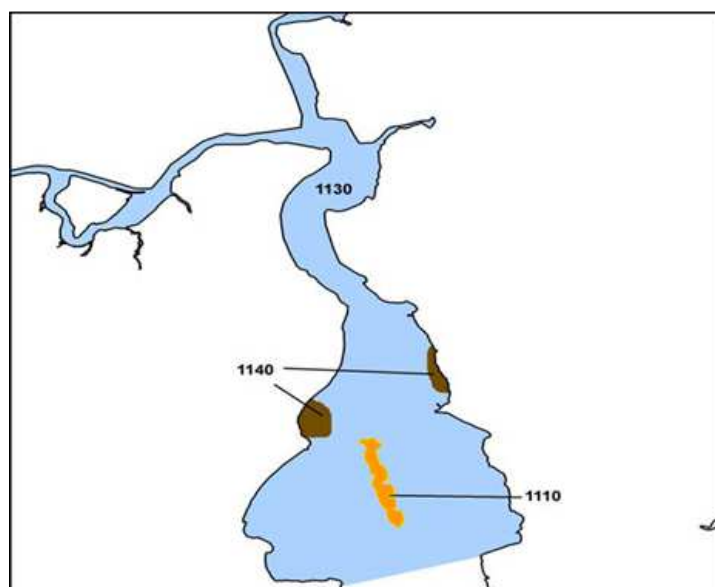
⁽⁵⁾ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0043:EN:NOT>

Crosswalks between Annex I and the EUNIS habitats classification have been produced and can be downloaded from the EEA website⁶. Note that the EUNIS codes given under ‘3) Corresponding categories’ in the 2007 edition of ‘Interpretation manual of European Union habitats’ are incorrect.

Appendix 2 shows how the MSFD predominant habitat types are related to the habitats of Annex I. In most cases, an MSFD type cannot be associated to an Annex I habitat type without additional information. This is partly a result of some Annex I habitat types being ‘landscape’ units which can contain several other habitats, e.g. both ‘1130 Estuaries’ and ‘1160 Large shallow inlets and bays’ can contain ‘1110 Sandbanks which are slightly covered by sea water all the time’ and ‘1140 Mudflats and sandflats not covered by seawater at low tide’ – see Figure 6.1.

Figure 6.1

Overlapping of the Habitats Directive Annex I habitats. ‘1130 Estuaries’ (blue, light grey) may also include areas of ‘1110 Sandbanks which are slightly covered by sea water all the time’ (orange, medium grey) and ‘1140 Mudflats and sandflats not covered by seawater at low tide’ (brown, dark grey) (from Evans & Arvela 2011).



7 EUSeaMap

The need for maps of the seabed has become increasingly urgent in recent years, for a wide range of uses, including reporting on the state of the marine environment in order to implement EU policies such as the Integrated Maritime Policy⁷ and the EU 2020 Biodiversity strategy⁸ as described by Marine Knowledge 2020⁹. Building on earlier regional projects such as BALANCE¹⁰ for the Baltic sea and MESH¹¹ for the seas around north-west Europe, EUSeaMap¹² produced maps for the Baltic, Celtic and North seas and the western Mediterranean (see Figure 7.1). These are broad-scale seabed habitat maps, based on predictive modelling with partial validation using biological data. The maps

⁽⁶⁾ <http://eunis.eea.europa.eu/upload/Link%20between%20EUNIS%202007%20and%20Annex%20I%202008.xls>

⁽⁷⁾ <http://ec.europa.eu/maritimeaffairs/policy>

⁽⁸⁾ <http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm>

⁽⁹⁾ http://ec.europa.eu/maritimeaffairs/policy/marine_knowledge_2020

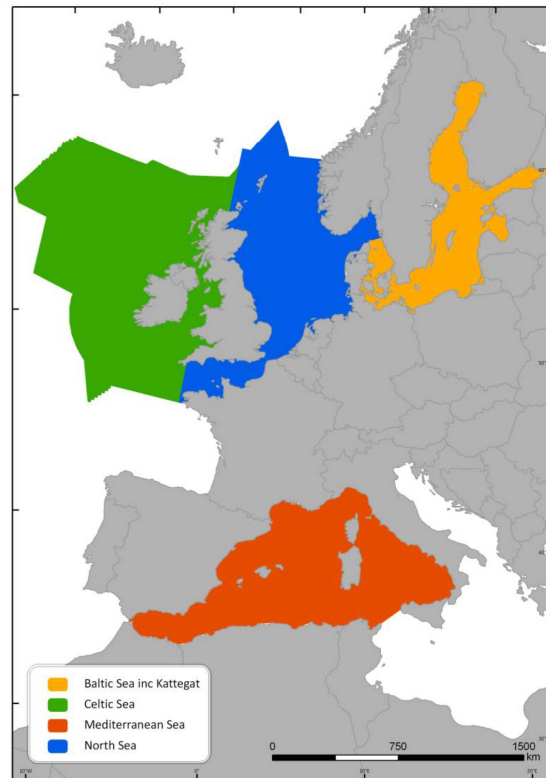
⁽¹⁰⁾ <http://www.balance-eu.org>

⁽¹¹⁾ <http://www.searchmesh.net>

⁽¹²⁾ <http://jncc.defra.gov.uk/page-5020>

assume that biological communities within a given region are largely determined by the combination of physical and chemical factors. E.g. salinity, light (related to depth), current strength, substrate type, etc. Work to extend the coverage to the rest of the EU sector of the north east Atlantic, the eastern Mediterranean and the Black Sea using a similar methodology is underway as part of an EMODnet¹³ project but results are not expected before the end of 2014.

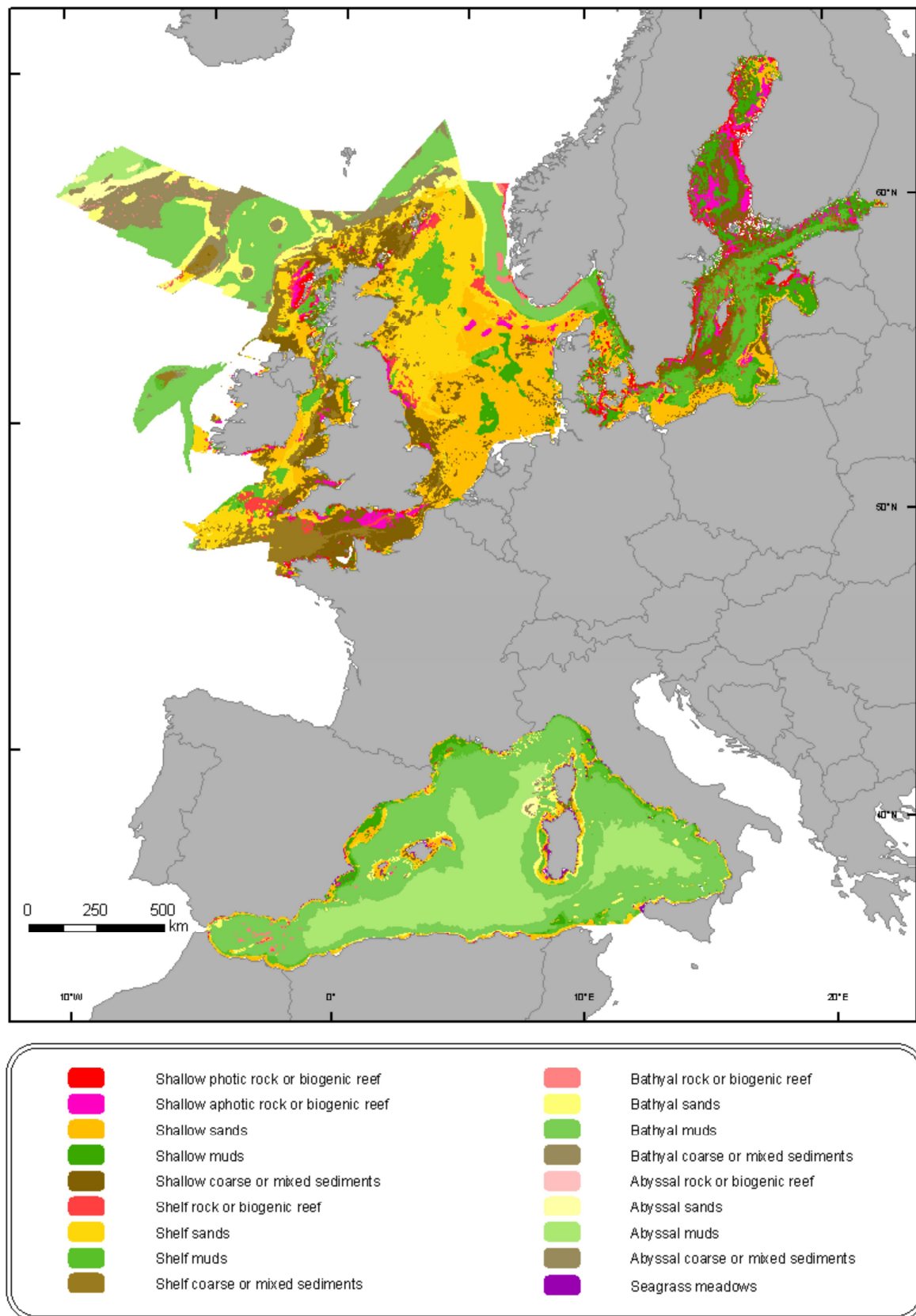
Figure 7.1 Geographic extent of the EUSeaMap project (Cameron & Askew 2011).



EUSeaMap aimed to use the EUNIS habitats classification but defined habitat as the “abiotic environment [...] which contributes to the nature of the seabed” and uses the term biotope for the combination of abiotic environment and associated fauna and flora (i.e. ‘habitat’ in the sense used by EUNIS) (Cameron & Askew 2011).

⁽¹³⁾ European Marine Observation and Data Network <http://emodnet.eu>

Figure 7.2 Benthic habitat map from EUSeaMap showing the area covered by the project. Areas without substrata data have been omitted from this representation (Cameron & Askew 2011)

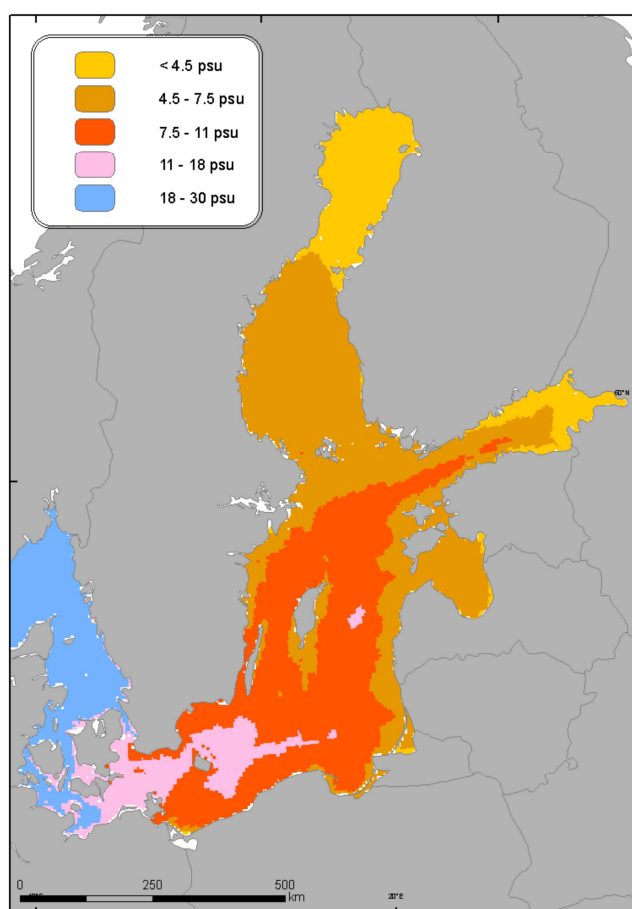


Seabed habitats are modelled using GIS layers representing a range of relevant abiotic parameters (sediment, bathymetry, light, wave and tidal energy at seabed, salinity at seabed, temperature at seabed, dissolved oxygen, ice cover, stratification). EUNIS habitat types are mostly modelled at level 4 for seas other than the Baltic, however *Posidonia oceanica* and *Cymodocea nodosa* (both seagrasses) are species that dominate the seabed so as to effectively become the substrate and the Mediterranean sediment layer maps them allowing the recognition and mapping of the level 5 EUNIS classes ‘A5.535 *Posidonia* beds’ and ‘A5.531 *Cymodocea* beds’ in the Mediterranean.

In the western Mediterranean, it was not possible to incorporate energy into the model and, the range of habitats which could be predicted was restricted to those that can be modelled with only substrate and depth zone. **As with the MSFD, the depth zones used by EUSaMap are modified from those used by EUNIS – see Table 5.1. Depth zones have been defined differently for each basin and the EUSaMap final report includes a table showing regional definitions for each zone (see Appendix 3).**

For some areas of Irish waters, no substrate data was available and it was not possible to model EUNIS habitats, these areas are excluded from the aggregate ‘EUNIS’ map shown as Figure 7.2. In the Baltic sea a modified EUNIS habitats classification from Wikström et al (2010) has been used which also recognises energy classes for sedimentary habitats (EUNIS uses energy for hard but not soft substrates). As salinity varies greatly from the Kattegat to the Bay of Bothnia, EUSaMap gives an alternative classification using 4 salinity classes (see Figure 7.3).

Figure 7.3 EUSaMap Baltic Sea salinity classes using mean salinity from nine years



As noted above, the Habitats Directive Annex I habitat types include several habitats which are physiographic (‘landscape’) features (e.g. estuaries, large shallow bays) and which could be mapped as several EUSaMap classes, or which are particular forms of an EUSaMap class (e.g. not all areas mapped as shallow sand will be the Annex I habitat ‘1110 Sandbanks slightly covered all the time’).

However, two Annex I habitats can be identified – ‘1170 Reefs’ which includes all rocky classes regardless of depth (although littoral reefs which are also part of this habitat are not mapped) and ‘1120 *Posidonia* beds (*Posidonium oceanicae*)’.

Discussions at the Marine Natura 2000 seminar held in Brindisi, Italy in 2011 revealed that in some Mediterranean EU countries, ***Cymodocea* beds have been regarded as equivalent to the Annex I habitat ‘1110 Sandbanks slightly covered all the time’** although they do not conform to the definition given in the EU Interpretation Manual (EC 2013), which is based on sandbanks from northern Europe. This suggests that EUSaMap could possibly also predict Annex I habitat ‘1110 Sandbanks which are slightly covered by sea water all the time’ in the Mediterranean sea.

Appendix 4 shows how EUSaMap classes from the aggregate map (Figure 7.2) correspond to the Habitats Directive Annex I habitat types. Similar relationships could be constructed for the more detailed regional classification. It is clear that the relationships between the different habitat classifications can be complex.

Three Habitats Directive Annex I habitat types are not mapped by EUSaMap (‘1140 Mudflats and sandflats not covered by seawater at low tide’, ‘1150 Coastal lagoons’ & ‘1650 Boreal Baltic narrow inlets’). However, CORINE Land Cover has classes corresponding to the first 2 (4.2.3. Intertidal flats, 5.2.1. Coastal lagoons) so information will be available; while the third is only found in the Baltic and are usually relatively small features.

Appendix 5 gives a crosswalk between the classes used for the aggregate EUSaMap and the MSFD predominant habitat types. This crosswalk is relatively simple because Cochrane et al. (2010) deliberately based the proposed MSFD predominant habitat types on EUNIS classes, with some adaptation to take account of EUSaMap modifications to EUNIS and the needs of MSFD implementation (e.g. separating coastal and shelf habitats); consequently there are unlikely to be problems in relating the habitats mapped by EUSaMap to the MSFD predominant habitat types. There are 5 pelagic MSFD predominant habitat types which are not mapped, some of which could be linked to EUSaMap classes (e.g. shelf water), but the current treatment of pelagic habitats by EUNIS is not considered to be useful. There are 2 littoral MSFD predominant habitat types which are not mapped by EUSaMap (‘Littoral rock & biogenic reef’, ‘Littoral sediment’) due to the typically narrow spatial extent of the littoral zone in relation to the resolution of the EUSaMap modelling (the zone is often narrower than the grid size of the model). CORINE Land Cover may cover these habitats (3.3.2. Bare rock, 3.3.1. Beaches, dunes, and sand plains) although this would need to be tested. It may also be possible to assume that the littoral is the same as the adjacent shallow habitat (e.g. the coastal limit of an area mapped as ‘Shallow sublittoral rock & biogenic reef’ will be ‘Littoral rock & biogenic reef’).

The MSFD predominant habitat types include ‘ice associated habitats’ which are not mapped by EUSaMap and not covered by any Habitats Directive Annex I habitat type. –

8 Mapping and Assessment of Ecosystems and their Services (MAES)

Target 2, Action 5 of the EU 2020 Biodiversity Strategy asks Member States, with the assistance of the European Commission, to “*map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020*”. Working Group MAES (Mapping and Assessment of Ecosystems and their Services) has been established, under the Strategy’s Common Implementation Framework, to coordinate and oversee this work, and has issued an analytical framework for ecosystem assessments (Maes et al, 2013¹⁴). This includes a

⁽¹⁴⁾ http://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/MAESWorkingPaper2013.pdf

European typology of ecosystems (based on broad-scale habitats) to be used both for mapping and for assessments¹⁵. Its marine component has been designed to allow the best use of available marine datasets at the European level, in particular CORINE Land Cover & EUSeaMap, but also information from Member States' reporting under e.g. Habitats Directive, MSFD and the Water Framework Directive. Thus, the core of the typology is an aggregation of the list of MSFD predominant habitat types in order to use Member States reporting on MSFD implementation for the MAES assessments – as that should be the widest ranging reporting in terms of the state of marine ecosystems¹⁶.

Nevertheless, the MAES European marine ecosystem typology is a rather coarse typology with only four classes in view of the exploratory nature of current efforts on the assessment of ecosystems and their services in the European marine environment. Thus, brackish water and marine ecosystems in the land-sea interface are grouped together in a single class and each of the remaining 3 classes include both the relevant water column and seabed broad-scale habitats (cf. MAES analytical framework section 4.2.3 and Table 5.2 for a description of the typology). Testing and application may indicate a need for a more refined marine ecosystem typology.

Indeed, the MAES analytical framework itself acknowledges that it is *'important to stress that the typology of marine ecosystems may undergo further changes during the MAES assessment depending on the increasing availability of marine data as well as on the relations between marine ecosystems and the services they provide. The present typology ignores the important role of the photic zone (under influence of light), which drives the functioning of marine food webs. Using the photic limit as additional criterion can in a later phase be introduced for both pelagic and benthic habitats as derived from EUSeaMap light penetration data. This allows a more accurate zoning per individual marine region, in particular of the shallow Baltic Sea and recognizes the importance of primary productivity as the basis for the marine food chain and so for marine ecosystem services'* (cf. pp 24-25, including footnote 20, of the MAES analytical framework).

At the EU level, the EEA (with its ETC/ICM) is planning to further test this initial MAES proposal for a European marine ecosystem typology.

Appendix 6 shows how the mapping units from EUSeaMap and information on Annex I habitat types from reporting under the Habitats Directive could be linked to the MAES European marine ecosystem typology.

⁽¹⁵⁾ Cf. Table 5.2, 'Typology of ecosystems'. Refinement of the EU 2010 Biodiversity Baseline (EEA 2012)' in the MAES analytical framework (Maes et al, 2013).

⁽¹⁶⁾ Nevertheless, the extraction and analysis of Member States reporting of MSFD Article 8 (Initial assessment) by the EEA (and its ETC/ICM) in the context of the MSFD Article 12 process shows too many divergences for this to happen in 2014 when considering the whole of the EU.

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Annex 1 MSFD predominant habitat types and their relation to EUNIS habitats

(modified from Cochrane et al. 2010 to reflect predominant habitats in the MSFD CSWP (2011)).

Outline depth ranges are given for Atlantic waters for the shallow, shelf, bathyal and abyssal zones. The precise depth ranges vary between subregions and also in the Baltic, Mediterranean and Black Sea Regions where different parameters are used to define depth zones (see Table 5.2)

Realm	Predominant habitat type (MSFD)	Relationship to EUNIS habitat classes
Seabed habitats	Littoral rock and biogenic reef	A1 + A2.7
	Littoral sediment	A2 (except A2.7)
	Shallow sublittoral rock and biogenic reef	A3 + circalittoral habitats in A4 above wavebase, infralittoral & circalittoral biogenic reefs in A5.7 above wavebase
	Shallow sublittoral sediment (coarse, sand, mud, mixed)	Habitats in A5 (except A5.6) above wavebase or other relevant physical factors (from 0m down to about 50-70m depth in Atlantic)
	Shelf sublittoral rock and biogenic reef	Deep circalittoral habitats in A4 & A5.7
	Shelf sublittoral sediment (coarse, sand, mud, mixed)	Deep circalittoral habitats in A5 below wavebase or other relevant physical factors (from about 50-70m depth down to the shelf break in Atlantic)
	Upper bathyal rock and biogenic reef (a)	A6.1 + A6.6 (upper bathyal zone - ~200-1100m in Atlantic)
	Upper bathyal sediment (a)	A6.2+A6.3+A6.4+A6.6 (upper bathyal zone - ~200-1100m in Atlantic)
	Lower bathyal rock and biogenic reef (b)	A6.1 + A6.6 (lower bathyal zone - ~1100-1800m in Atlantic)
	Lower bathyal sediment (b)	A6.2+A6.3+A6.4+A6.6 (lower bathyal zone - ~1100-1800m in Atlantic)
	Abyssal rock and biogenic reef	A6.1 + A6.7 (abyssal zone - ~>1800m in Atlantic)
	Abyssal sediment	A6.2+A6.3+A6.4+A6.6 (abyssal zone -->1800m in Atlantic)
Pelagic habitats	Reduced salinity water	EUNIS pelagic classification not structured in suitable way for purpose here
	Variable salinity water	
	Coastal water	
	Shelf water	
	Oceanic water	
Ice habitats	Ice-associated habitats	A8

(a) Upper bathyal refers to the Slope and Upper Bathyal zones of Howell (2010)

(b) Lower bathyal refers to the Mid and Lower Bathyal zones of Howell (2010)

Annex 2 A crosswalk between MSFD and Habitats Directive Annex I marine habitat types

(Adapted from 'Links between the Marine Strategy Framework Directive (MSFD 2008/56/EC) and the Nature Directives (Birds Directive 2009/147/EEC (BD) and Habitats Directive 92/43/EEC (HD)) - Interactions, overlaps and potential areas for closer coordination', 27 July 2012
<http://ec.europa.eu/environment/nature/natura2000/marine/docs/FAQ%20final%202012-07-27.pdf>

Predominant seabed habitat types for MSFD	HABITAT TYPES LISTED IN ANNEX 1 OF THE HABITATS DIRECTIVE AND CONSIDERED 'MARINE' FOR ARTICLE 17 REPORTING									
	1110 Sandbanks slightly covered all the time	1120 <i>Posidonia</i> beds	1130 Estuaries	1140 Mudflats & sandflats not covered at low tide	1150 Coastal lagoons	1160 Large shallow inlets and bays	1170 Reefs	1180 Submarine structures made by leaking gas	1650 Boreal Baltic narrow inlets	8330 Submerged or partially submerged sea caves
Littoral rock & biogenic reef								These structures may occur in a range of predominant habitat types	To be confirmed by MSs	
Littoral sediment										
Shallow sublittoral rock & biogenic reef										
Shallow sublittoral coarse sediment										
Shallow sublittoral sand										
Shallow sublittoral mud		?								
Shallow sublittoral mixed sediment										
Shelf sublittoral rock & biogenic reef										
Shelf sublittoral coarse sediment										
Shelf sublittoral sand										
Shelf sublittoral mud										
Shelf sublittoral mixed sediment										
Upper bathyal rock & biogenic reef										?
Upper bathyal sediment										
Lower bathyal rock & biogenic reef										?
Lower bathyal sediment										

Predominant seabed habitat types for MSFD	HABITAT TYPES LISTED IN ANNEX 1 OF THE HABITATS DIRECTIVE AND CONSIDERED 'MARINE' FOR ARTICLE 17 REPORTING									
	1110 Sandbanks slightly covered all the time	1120 <i>Posidonia</i> beds	1130 Estuaries	1140 Mudflats & sandflats not covered at low tide	1150 Coastal lagoons	1160 Large shallow inlets and bays	1170 Reefs	1180 Submarine structures made by leaking gas	1650 Boreal Baltic narrow inlets	8330 Submerged or partially submerged sea caves
Abyssal rock & biogenic reef										?
Abyssal sediment										
Ice-associated habitats	No Annex I habitats									

Annex 3 Limits of subtidal zones for the three EUSeaMap regions which have been mapped

(from Cameron& Askew 2011).

Biological zone	North & Celtic Seas (a)		Baltic Sea		W Mediterranean Sea	
	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit
Infralittoral	Lowest Astronomical Tide	Intersection of seabed and 1% surface light depth	Annual maximum low water (b)	2.5 ratio of depth/Secchi depth for mesohaline zones 1.6 ratio of depth/Secchi depth for oligohaline zones	Lowest Astronomical Tide	Intersection of seabed and 1% surface light depth
Upper Circalittoral	Intersection of seabed and 1% surface light depth	Maximum depth at which seabed is affected by waves	2.5 ratio of depth/Secchi depth for mesohaline zones 1.6 ratio of depth/Secchi depth for oligohaline zones	Position of deep halocline	Intersection of seabed and 1% surface light depth	Intersection of seabed and average 0.01% incident light fraction
Deep Circalittoral	Maximum depth at which seabed is affected by waves	Shelf edge delimited by the slope angle change of the continental platform, or proxy (200m)	Position of deep halocline	n/a (seabed)	Intersection of seabed and average 0.01% incident light fraction	Shelf edge delimited by the slope angle change of the continental platform, or proxy
Upper slope	Shelf edge delimited by the slope angle	Top of the permanent thermocline, or proxy	n/a	n/a	n/a	n/a
Bathyal	Top of the permanent thermocline, or proxy (750m)	Shelf slope break delimited by the slope angle change of the continental platform, or proxy (2,700m)			Shelf edge delimited by the slope angle change of the continental platform, or proxy	Shelf slope break delimited by the slope angle change occurring at the base of the continental margin

Biological zone	North & Celtic Seas (a)		Baltic Sea		W Mediterranean Sea	
	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit
Abyssal	Shelf slope break delimited by the slope angle change of the continental platform, or proxy (2,700m for Atlantic but see note (c))	n/a (seabed)	n/a	n/a	Shelf slope break delimited by the slope angle change occurring at the base of the continental margin	n/a (seabed)

(a) Including the Skagerrak and Kattegat

(b) The limit is different compared to the other seas considered due to the lack of regular tides in the Baltic Sea. Since water level fluctuations are typically on a timescale of days rather than hours, the annual maximum low water sets the limit for perennial species without strong draught resistance and is used to delimit the “subtidal”, permanently submerged sea floor. This follows the convention from Baltic Sea scientists (and the HELCOM habitats).

(c) MSFD/Howell (2010) use 1800m – need harmonisation in next phase of EUSeaMap

Annex 4 A crosswalk between EUSeaMap classes and Habitats Directive Annex I marine habitat types

Source: ETC/BD

Mapping units for the aggregated map of all basins (see Figure 7.2)	HABITAT TYPES LISTED IN ANNEX 1 OF THE HABITATS DIRECTIVE AND CONSIDERED 'MARINE' FOR ARTICLE 17 REPORTING										
	1110 Sandbanks slightly covered all the time	1120 <i>Posidonia</i> beds	1130 Estuaries	1140 Mudflats & sandflats not covered at low tide	1150 Coastal lagoons	1160 Large shallow inlets and bays	1170 Reefs	1180 Submarine structures made by leaking gas (a)	1650 Boreal Baltic narrow inlets	8330 Submerged partially caves	or submerged sea
Shallow photic rock or biogenic reef				Not mapped	Not mapped				Not mapped		
Shallow aphotic rock or biogenic reef											
Shallow sands		?									
Shallow muds											
Shallow coarse or mixed sediments		?									
Shelf rock or biogenic reefs											
Shelf sands											
Shelf muds											
Shelf coarse or mixed sediments											
Bathyal rock or biogenic reefs											
Bathyal sands											
Bathyal muds											
Bathyal coarse or mixed sediments											
Abyssal rock or biogenic reefs								?			
Abyssal sands											

Abyssal muds										
Abyssal coarse or mixed sediments										
Seagrass meadows										

(a) Although '1180 Submarine structures made by leaking gas' is a form of reef, they are usually too small in extent to be shown by EUSeaMap

Annex 5 Crosswalk between EUSeaMap and MSFD predominant habitat types

Source: ETC/BD

EUSeaMap (Aggregate Map)	MSFD Predominant Habitat Types
Not mapped	Littoral rock & biogenic reef
	Littoral sediment
	Pelagic habitats (5 types)
	Sea ice habitats
Shallow photic rock or biogenic reef	Shallow sublittoral rock & biogenic reef
Shallow aphotic rock or biogenic reef	
Shallow sands	Shallow sublittoral sand
Shallow muds	Shallow sublittoral mud
Shallow coarse or mixed sediments	Shallow sublittoral coarse sediment and Shallow sublittoral mixed sediment
Shelf rock or biogenic reefs	Shelf sublittoral rock & biogenic reef
Shelf sands	Shelf sublittoral sand
Shelf muds	Shelf sublittoral mud
Shelf coarse or mixed sediments	Shelf sublittoral coarse sediment and Shelf sublittoral mixed sediment
Bathyal rock or biogenic reefs	Upper bathyal rock & biogenic reef
	Lower bathyal rock & biogenic reef
Bathyal sands	Upper bathyal sediment & Lower bathyal sediment
Bathyal muds	
Bathyal coarse or mixed sediments	
Abyssal rock or biogenic reefs	Abyssal rock & biogenic reef
Abyssal sands	Abyssal sediment
Abyssal muds	
Abyssal coarse or mixed sediments	
Seagrass meadows	Shallow sublittoral sand (and coarse/mixed sediment)

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Annex 6 EUSeaMap and Habitats Directive Annex I habitats and MAES European marine ecosystem typology – crosswalks for MAES (MAES European marine ecosystem typology from Table 5.2 of the MAES analytical framework)

Ecosystem type for mapping and assessment (level 2)	Representation of habitats (functional dimension by EUNIS/MSFD for marine ecosystems)	Representation of land cover (spatial dimension)	EUSeaMap aggregate map	Habitats Directive Annex I habitats
Marine inlets and transitional waters	<p><i>Pelagic habitats:</i></p> <ul style="list-style-type: none"> Low/reduced salinity water (of lagoons) Variable salinity water (of coastal wetlands, estuaries and other transitional waters) Marine salinity water (of other inlets) <p><i>Benthic habitats:</i></p> <ul style="list-style-type: none"> Littoral rock and biogenic reef Littoral sediment Shallow sublittoral rock and biogenic reef Shallow sublittoral sediment 	<ul style="list-style-type: none"> Coastal wetlands: Saltmarshes, salines and intertidal flats Lagoons: Highly restricted connection to open sea, reduced, often relatively stable, salinity regime Estuaries and other transitional waters: Link rivers to open sea, variable, highly dynamic salinity regime. All WFD transitional waters included Fjords/sea lochs: Glacially derived, typically elongated and deep; marine salinity regime Embayments Non-glacial origin, typically shallow, marine salinity system <p>Pelagic and benthic habitats in this type include the photic zone, and the upper part of the aphotic zone</p>	<p><i>Pelagic & sea ice habitats :-</i></p> <ul style="list-style-type: none"> not mapped <p><i>Benthic habitats:</i></p> <p>Littoral habitats not mapped</p> <ul style="list-style-type: none"> Shallow photic rock or biogenic reef Shallow aphotic rock or biogenic reef Shallow sands Shallow muds Shallow coarse or mixed sediments Seagrass meadows 	<p>1110 Sandbanks which are slightly covered by sea water all the time</p> <p>1120 <i>Posidonia</i> beds</p> <p>1130 Estuaries</p> <p>1140 Mudflats & sandflats not covered at low tide</p> <p>1150 Coastal lagoons</p> <p>1160 Large shallow inlets and bays</p> <p>1170 Reefs</p> <p>1180 Submarine structures made by leaking gas</p> <p>1310 <i>Salicornia</i> and other annuals colonizing mud and sand</p> <p>1320 <i>Spartina</i> swards (<i>Spartinion maritimae</i>)</p> <p>1330 Atlantic salt meadows (<i>Glauco-Puccinellietalia maritimae</i>)</p> <p>1650 Boreal Baltic narrow inlets</p> <p>8330 Submerged or partially submerged sea caves</p>
Coastal	<p><i>Pelagic habitats:</i> Coastal waters</p> <p><i>Benthic habitats:</i></p> <ul style="list-style-type: none"> Littoral rock and biogenic reef 	Coastal, shallow-depth marine systems that experience significant land-based influences. These systems undergo diurnal	<p><i>Pelagic habitats & sea ice habitats :-</i></p> <ul style="list-style-type: none"> not mapped 	<p>1110 Sandbanks which are slightly covered by sea water all the time</p> <p>1120 <i>Posidonia</i> beds</p>

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Ecosystem type for mapping and assessment (level 2)	Representation of habitats (functional dimension by EUNIS/MSFD for marine ecosystems)	Representation of land cover (spatial dimension)	EUSeaMap aggregate map	Habitats Directive Annex I habitats
	<ul style="list-style-type: none"> Littoral sediment Shallow sublittoral rock and biogenic reef Shallow sublittoral sediment 	fluctuations in temperature, salinity and turbidity, and are subject to wave disturbance. Depth is down to approximately 50-70 meters, depending on local factors determining the zone boundary. Pelagic habitats in this type include the photic zone, benthic habitats can include it or not	<p><i>Benthic habitats:</i></p> <p>Littoral habitats not mapped</p> <ul style="list-style-type: none"> Shallow photic rock or biogenic reef Shallow aphotic rock or biogenic reef Shallow sands Shallow muds Shallow coarse or mixed sediments Seagrass meadows 	<p>1160 Large shallow inlets and bays</p> <p>1170 Reefs</p> <p>1180 Submarine structures made by leaking gas</p> <p>1650 Boreal Baltic narrow inlets</p> <p>8330 Submerged or partially submerged sea caves</p>
Shelf	<p><i>Pelagic habitats:</i> Shelf waters</p> <p><i>Benthic habitats:</i></p> <ul style="list-style-type: none"> Shelf sublittoral rock and biogenic reef Shelf sublittoral sediment 	Marine systems away from coastal influence, down to the shelf break. They experience more stable temperature and salinity regimes than coastal systems, and their seabed is below wave disturbance. Depth is up to 200 meters. Pelagic habitats in this type include the photic zone, benthic habitats are beyond the photic limit for macrophytes (aphotic)	<p><i>Pelagic habitats & sea ice habitats</i> :-</p> <p>- not mapped</p> <p><i>Benthic habitats:</i></p> <ul style="list-style-type: none"> Shelf rock or biogenic reefs Shelf sands Shelf muds Shelf coarse or mixed sediments 	<p>1170 Reefs</p> <p>1180 Submarine structures made by leaking gas</p> <p>8330 Submerged or partially submerged sea caves</p>
Open ocean	<p><i>Pelagic habitats:</i> Oceanic waters</p> <p><i>Benthic habitats:</i></p> <ul style="list-style-type: none"> Bathyal (upper, lower) rock and biogenic reef Bathyal (upper, lower) sediment Abyssal rock and biogenic reef Abyssal sediment 	Marine systems beyond the shelf break with very stable temperature and salinity regimes, in particular in the deep seabed. Depth is beyond 200 meters. Pelagic habitats in this type are, in proportion, mostly aphotic, benthic habitats are aphotic	<p><i>Pelagic habitats & sea ice habitats</i> :-</p> <p>- not mapped</p> <p><i>Benthic habitats:</i></p> <ul style="list-style-type: none"> Bathyal rock or biogenic reefs Bathyal sands Bathyal muds Bathyal coarse or mixed 	<p>1170 Reefs</p> <p>8330 Submerged or partially submerged sea caves</p>

Ecosystem type for mapping and assessment (level 2)	Representation of habitats (functional dimension by EUNIS/MSFD for marine ecosystems)	Representation of land cover (spatial dimension)	EUSeaMap aggregate map	Habitats Directive Annex I habitats
			sediments <ul style="list-style-type: none"> • Abyssal rock or biogenic reefs • Abyssal sands • Abyssal muds • Abyssal coarse or mixed sediments 	

Comments:

Information on habitats not mapped may be available from CORINE Land Cover

‘1610 Baltic esker islands with sandy, rocky and shingle beach vegetation and sublittoral vegetation’ could also be considered as relevant’ for Marine inlets and transitional waters.

‘8330 Submerged or partially submerged sea caves’ is listed as coastal, shelf, and open ocean as they could occur but to date no Natura 2000 sites have been proposed in shelf and open sea categories; the Article 17 distribution reported for the period 2001-2006 was entirely coastal or within marine inlets.

This report was a deliverable in 2013 under ‘1.2.1.B.4 Further development of EUNIS / ii Work on habitats data’ (EEA sub-task manager: Rania Spyropoulou)

“Provide crosswalks between

- a) EUNIS and the classification under the MSFD
- b) EUSea map and MSFD
- c) Annex I of the Habitats Directive and MSFD
- d) Annex I of the Habitats Directive and EUSea map

It is also a contribution to EEA project 1.6.3 (Support to MS and European marine ecosystem assessment) in the 2014 Action Plan