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EMODnet Phase III extension

A combined, harmonized data product showing the best evidence for the distribution of three essential ocean variables in Europe

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1 Introduction

1.1 EMODnet Seabed Habitats as a resource of seabed habitat maps and data in Europe

EMODnet Seabed Habitats hosts the largest European collection of habitat maps from individual surveys and survey-based sample points. As of September 2021 there were over 800 habitat maps from surveys and around 500,000 sample points (Figure 1), freely available to view via the EMODnet Seabed Habitats online interactive map or by web map service (WMS) and download from the EMODnet Seabed Habitats download page or by web feature service (WFS) (https://www.emodnet-seabedhabitats.eu/access-data/).

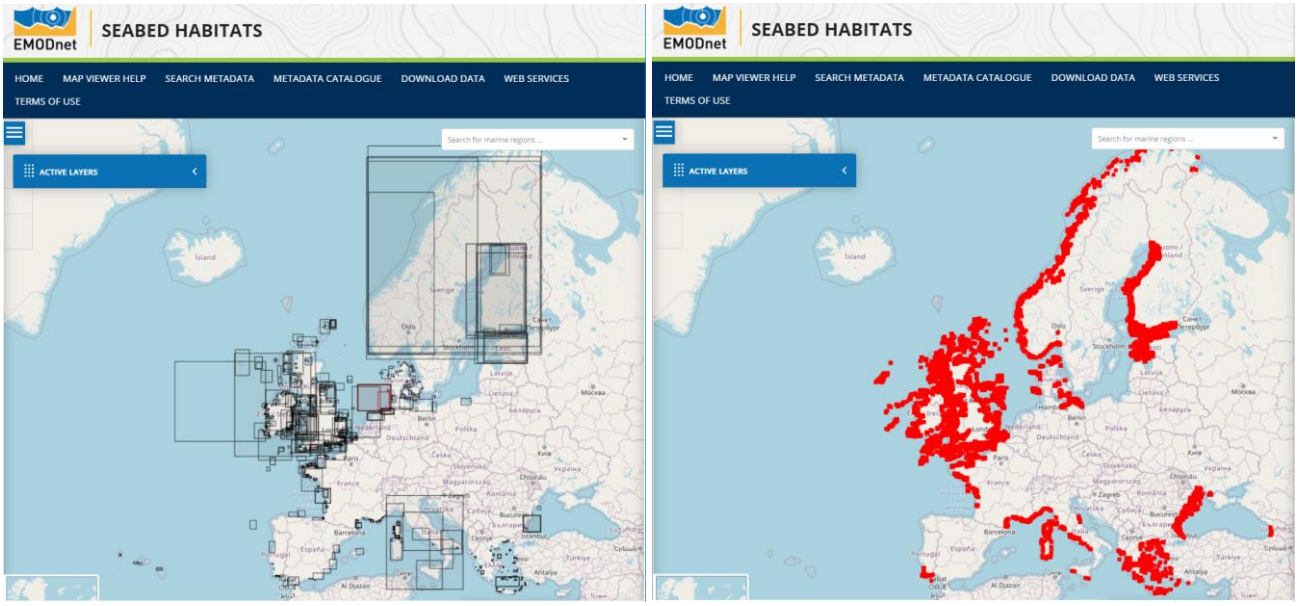

Figure 1: Habitat maps and survey sample points on the EMODnet Seabed Habitats interactive map.

This compilation of polygons and points, with standardised attributes, presents a great opportunity to create new products which aim to answer specific questions, such as 'what is the current known extent of habitat X in region Y?'.

In 2019, the EMODnet Seabed Habitats consortium used this wealth of information to answer the question: '**what is the current best available evidence for the extent of seagrass cover, live hard coral cover and macroalgal canopy cover in Europe?**' (O'Keeffe and Lillis, 2019).

These three habitats are part of a list developed by the Global Ocean Observing System (GOOS) called Essential Ocean Variables (EOVs). The aim of the EOV list is to identify a series of variables that it hopes will lead to consistency and cost-effective marine monitoring, globally. Of the ten EOVs in the 'Biology and Ecosystems' category these are the three that relate to European seabed habitats. Within each EOV there are several sub-variables (specific variables that may be measured), one of which can be directly informed by habitat maps (Table 1).

Table 1: EOV variables and their sub-variables which can be mapped using data from the EMODnet Seabed Habitats portal.

EOV	Relevant sub-variable
Hard coral cover and composition	Live hard coral cover and extent
Seagrass cover and composition	Areal extent of seagrass meadows
Macroalgal canopy cover and composition	Areal extent

1.2 Progress to date

O'Keeffe and Lillis (2019) created the first draft of three maps which aimed to answer the question posed above (Figure 2). They used all available polygon data from the library of individual habitat maps from survey as well as existing composite data products such as the OSPAR threatened and/or declining habitats in the northeast Atlantic and a collection of seagrass polygons in the Mediterranean previously created by EMODnet Seabed Habitats.

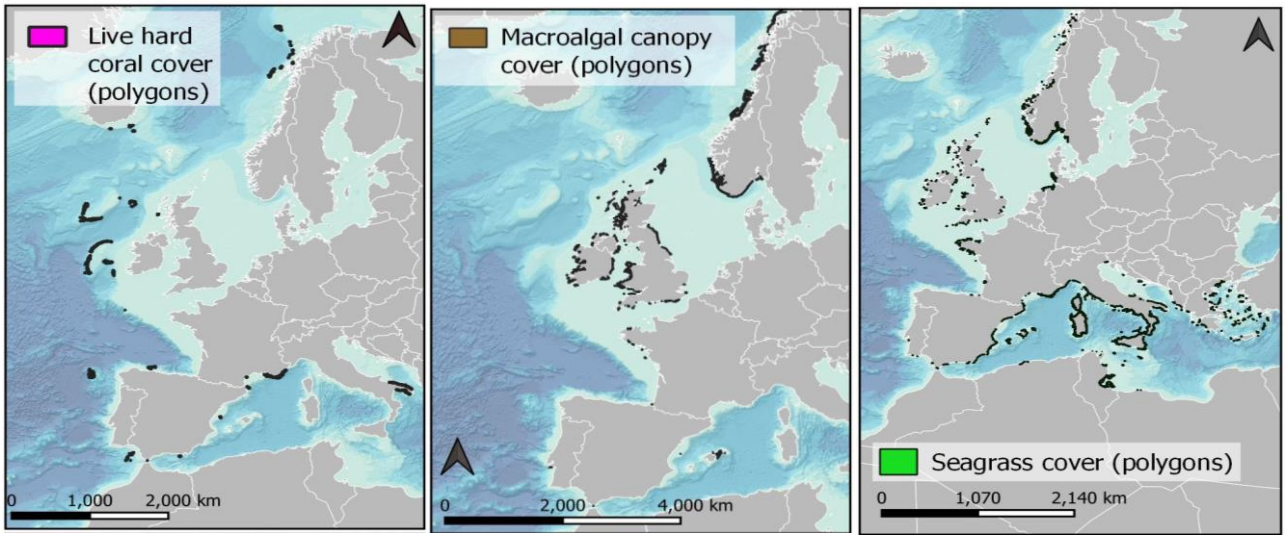

Figure 2: Polygon extent of three essential ocean variables, compiled by O'Keeffe and Lillis (2019). View on the EMODnet Seabed Habitats interactive map here.

Only polygons were used in this first iteration of the product. However, the result showed large gaps where these habitats are known to exist but for which their areal extent has not been mapped. This was

especially notable with respect to live hard coral, which is much less accessible than shallower seagrass beds and macroalgal canopy.

Therefore, the biggest improvement to this data product would be the addition of survey sample points to show where these important habitats have been observed or sampled, but not necessarily mapped. Sampling methods vary and may include photos/video (towed camera, drop-down camera, hand-held camera or remotely operated vehicle), in situ diver, grab or trawl.

1.3 Defining Essential Ocean Variables

At the time of writing, the specification sheets for these three habitats did not contain specific definitions. Therefore, as part of the work described in O'Keeffe and Lillis (2019) the EMODnet Seabed Habitats consortium agreed upon a list of habitat types from other classification systems that should be classed as these EOVs. However, this is only the interpretation of the EMODnet Seabed Habitats consortium and therefore any EOV-related products produced should be treated as unofficial and a work in progress.

1.4 Objectives

The production of this compilation can be divided into several objectives:

1. Identify and access the most complete sources of point data on seagrass cover, live hard coral cover and macroalgal canopy cover.
2. Create a look-up table which lists all habitat types which may qualify as EOVs, in any classification system.
3. Compile all data into a single data product, making sure the provenance of every point is clear in the attribute table.

2 Method

2.1 Identify and access the most complete sources of data

The EMODnet Seabed Habitats survey sample points database contains a wealth of seabed habitat observations in Europe. Its format is based upon that of the Darwin Core Archive event-core data structure, which is flexible data structure allowing habitat types in multiple classification systems. This was our primary source of data.

The secondary source was the official OSPAR threatened and/or declining habitats database. Several of the OSPAR habitats are contained within the definitions of two of the EOVs.

2.2 Create a look-up table

2.2.1 Identify the relevant classification systems

The first step in the data extraction from the survey sample points database was to generate a complete look-up table, which would include rows from every habitat classification system featured in the databases that were relevant to any of the three EOVs.

We started with the look-up tables listed in the Appendices of O'Keeffe and Lillis (2019), which included relevant habitat types from EUNIS v2007-11, Habitats Directive Annex I and OSPAR threatened and/or declining habitats.

Next, we identified which other classification systems were present in the survey sample points database so that new rows could be added to the look-up table as necessary. This information was obtained by summarising the contents of the "seabedclassification" and "seabedclassification_uri" columns.

With this list we found that some of the less common classification systems did not need a separate set of rows because they had also been translated to a more widely used classification system such as EUNIS.

2.2.2 Identify a unique identifier for each habitat type

To create the look-up table that could be joined to the data in order to select and translate classified data into EOVs, we required a unique identifier for each habitat type. Because of the flexibility of the Darwin Core Archive data format, it is possible that the same habitat type may be recorded in the "seabedtype" column in different ways. For example, a EUNIS habitat type may be described by a code and/or its full name, e.g. 'A1.1' or 'High energy littoral rock' or 'A1.1 High energy littoral rock'.

Therefore we used the "seabedtype_uri" column instead, which contains a unique resource identifier (URI) for each habitat type, e.g. for EUNIS A1.1, it is:

http://dd.eionet.europa.eu/vocabularyconcept/biodiversity/eunishabitats/A1.1.

Duncan et al (2021) explain more about URIs for habitat types and habitat classification systems in Europe.

2.3 Compile into a single data product

Once the look-up tables were finalised, they were joined to the table in the database and the matching records extracted.

Different data sources have different columns in their attribute tables, so in order to be able to combine them, we designed a new, standard table structure (Table 2) and translated them all into this standard format. The attribute table is the same as that for the EMODnet Seabed Habitats survey sample points, with the addition of the last three rows.

Table 2: Attribute table format

Field name	Description
measurementid	Unique identifier of the measurement carried out at the sampling point.
eventid	Unique identifier of each sampling point of the dataset.
datasetid	Unique identifier of the dataset
shorttitle	Title of the dataset
expectedcitation	Citation for the dataset

restriction	Usage constraints on the dataset
contactpoints	Contact point for the dataset
eventdate	Sampling date
mindepth	Depth in metres (positive)
maxdepth	Depth in metres (positive)
seabedclassificationsystem	name of habitat classification system
seabedclassificationsystem_uri	URI of habitat classification system
seabedtype	name of habitat type
seabedtype_uri	URI of habitat type
seabedstatus	health status of the habitat according to relevant European Directives (i.e. WFD, Habitat Directive and MSFD) (if available)
samplingmethod	sampling method
samplingmethod_uri	sampling method URI
seabedtypedeterminеddate	when the habitat type was determined
seabedtypedeterminedmethod	how the habitat type was determined
sourcehabitatoccurrenceid	if the seabedtype is based on a translation of an existing record into a new classification system, then this is the measurementid of the original record
relationshiptosourcehabitat	if the seabedtype is based on a translation of an existing record into a new classification system, then this describes the relationship between this and the original seabed type determination
comments	
eventenddate	
EOV	essential ocean variable
EOVsubtype	essential ocean variable subtype
Source	source database, e.g. 'EMODnet Seabed Habitats survey sample points' or 'OSPAR habitats - official 2020 public reference dataset'

3 Results

3.1 Identify and access the most complete sources of data

The EMODnet Seabed Habitats survey sample points database was accessed on 2021-09-17. This may be accessed by Web Feature Service; however, in this case we directly accessed the PostgreSQL database which underpins the EMODnet Seabed Habitats service. The format of the attribute table is that shown in Table 2, minus the last three rows.

The official OSPAR threatened and/or declining habitats database v2020 Was accessed on 2021-09-17.

3.2 Create a look-up table

3.2.1 Identify the relevant classification systems

Once the EMODnet Seabed Habitats survey sample points database was downloaded, we investigated which classification systems needed to be included in the EOV look-up table (Table 3). For those with seabedtype URIs we used the "seabedtype_uri" as the unique identifier. For those without, we used "seabedtype".

Table 3: Summary of habitat classification systems included in the EMODnet Seabed Habitats survey sample points database as of 2021-09-17, and which are relevant for the EOV look-up table (shaded grey).

seabedclassificationsystem	count	do seabedtypes have URIs?	required for EOV look-up table?
Barcelona Convention - Classification of Benthic Marine Habitat Types for the Mediterranean Region	837	no	no - all points are also classified to EUNIS so just join to the EUNIS habitat type
EUNIS (version 2007-2011)	176,861	yes	yes
Folk 16	278	no	no - no EOVs in this classification system
Folk 5	860	no	no - no EOVs in this classification system
Folk 7	1,393	no	no - no EOVs in this classification system
Habitats Directive Annex I Habitats	33,280	yes	yes
HELCOM Underwater biotope and habitat classification system (HELCOM HUB)	103,194	yes	yes

Marine Habitat Classification for Britain and Ireland v15.03	145,421	yes	no - all points are also classified to EUNIS so just join to the EUNIS habitat type
Marine Strategy Framework Directive Benthic Broad Habitat Types	1,587	yes	no - no EOVs in this classification system
National habitat types - Bulgarian Black Sea	971	no	yes
National habitat types - Romanian Black Sea	361	no	no - no EOVs in this classification system
New Portuguese biotopes/habitats based on EUNIS classification (v. 2007-2011)	1,211	no	no - no EOVs in this classification system
NiN (Nature types in Norway) v. 2.0	5,663	no	no - all points are restricted access (view only)
OSPAR List of Threatened and/or Declining Species and Habitats	250	yes	yes
Peres Picard 1964	1,128	no	no - all points are also classified to EUNIS so just join to the EUNIS habitat type
Total	**473,295**		

3.2.2 Select the habitat types from each classification system that are relevant for EOVs

With help from the EMODnet Seabed Habitats consortium, O'Keeffe and Lillis (2019) selected the EUNIS, Habitats Directive and OSPAR habitat types that were thought to represent the EOVs and subtypes shown in Table 4. Note that the subtypes are not included in the GOOS definitions and were selected by the EMODnet Seabed Habitats consortium as a way of adding detail to the broad EOV names. The full list of EUNIS, Habitats Directive Annex I and OSPAR habitats that were selected are summarised in Appendix 1.

It was then necessary to select the habitat types from the HELCOM HUB and Bulgarian national habitat types that may represent EOVs. This was carried out using expert judgement. The lists may be found in Appendix 1.

Table 4: EOVs and subtypes in Europe.

EOV	EOV subtype
Live hard coral cover	Cold water coral reefs
Live hard coral cover	*Lophelia pertusa* reefs
Live hard coral cover	Cold water coral communities
Live hard coral cover	Carbonate mounds
Live hard coral cover	Coral gardens
Macroalgal canopy cover	
Seagrass cover	Seagrass beds
Seagrass cover	*Zostera* beds
Seagrass cover	*Ruppia* beds
Seagrass cover	*Cymodocea* beds
Seagrass cover	*Halophila* beds
Seagrass cover	*Posidonia* beds
Seagrass cover	*Posidonia* dead "mattes"

3.2.3 Identify a unique identifier for each habitat type

In the **OSPAR database**, there are only 15 habitat types and they are recorded in a standard format in the HabType field, so this was used in the look-up table for that data source.

For the extraction from the **EMODnet Seabed Habitats survey sample database**, for those with seabedtype URIs in Table 3 we used the "seabedtype_uri" as the unique identifier. For those without, we used "seabedtype". The aim of using URIs was to ensure a unique value per habitat type. However, it soon became apparent that some of the URIs were included in multiple different ways in the EMODnet Seabed Habitats survey sample database:

- Prefix 'http://' vs 'https://'
- 'vocabularyconcept' vs 'vocabulary' in the middle of the URI
- No suffix vs '/rdf'

For example, for EUNIS habitat A1.1 high energy littoral rock, one might find one of eight variations:

1. http://dd.eionet.europa.eu/vocabularyconcept/biodiversity/eunishabitats/A1.1
2. http://dd.eionet.europa.eu/vocabularyconcept/biodiversity/eunishabitats/A1.1/rdf

3. http://dd.eionet.europa.eu/vocabulary/biodiversity/eunishabitats/A1.1
4. http://dd.eionet.europa.eu/vocabulary/biodiversity/eunishabitats/A1.1/rdf
5. https://dd.eionet.europa.eu/vocabularyconcept/biodiversity/eunishabitats/A1.1
6. https://dd.eionet.europa.eu/vocabularyconcept/biodiversity/eunishabitats/A1.1/rdf
7. https://dd.eionet.europa.eu/vocabulary/biodiversity/eunishabitats/A1.1
8. https://dd.eionet.europa.eu/vocabulary/biodiversity/eunishabitats/A1.1/rdf

(Note that these all redirect to the same place but we consider the first option to be correct.)

In order to account for all of these variations, we generated eight URI variations for each EUNIS and Habitats Directive habitat type, as these vocabularies are both hosted by Eionet.europa.eu. The http vs https issue was also encountered with the HELCOM and OSPAR vocabularies, which are hosted on the NERC Vocabulary Server, so two variations were included for each of these as well.

3.3 Compile into a single data product

3.3.1 Join the look-up tables and export the records relevant to EOVs

A total of 91,311 EOV records were extracted from the two databases, as summarised in Table 5.

Table 5: Number of EOV records extracted from each data source.

Source	Live hard coral cover	Macroalgal canopy cover	Seagrass cover	Total
EMODnet Seabed Habitats survey sample points selected by seabedtype	-	149	5	**154**
EMODnet Seabed Habitats survey sample points selected by seabedtype_uri	28	8,021	13,359	**21,408**
OSPAR habitats - official 2020 public reference dataset	3,836	-	65,913	**69,749**
Total	**3,864**	**8,170**	**79,277**	**91,311**

3.3.2 Standardise the attributes and combine

The OSPAR and EMODnet Seabed Habitats survey sample databases have a different attribute table format; therefore in order to combine the records together, we standardised the attributes to match those described in Table 2.

3.4 Outputs

The final distribution maps are shown in Figure 3. They are freely available from EMODnet (Table 6).

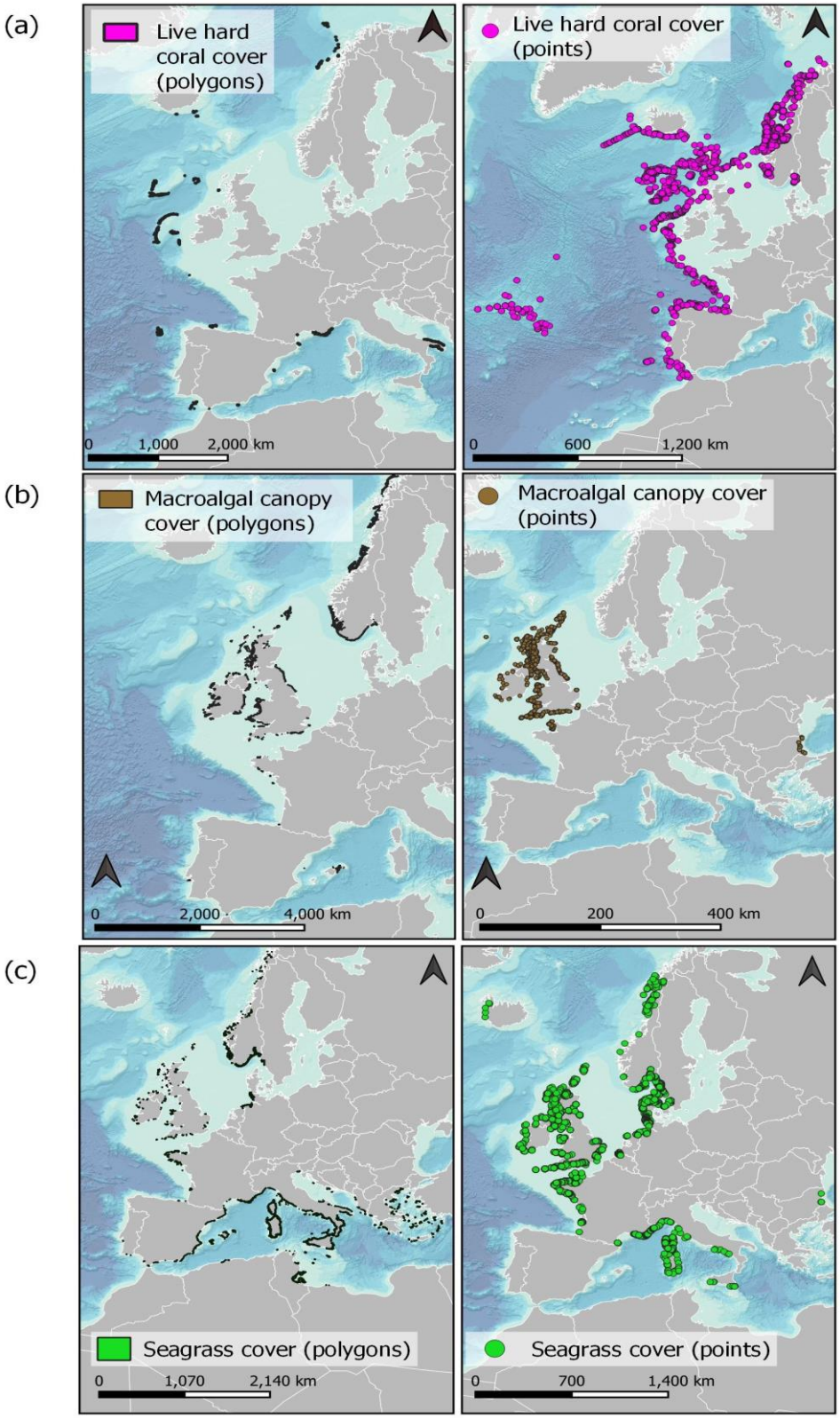

Figure 3: Maps showing the distribution of EOVs from habitat polygons and survey sample points. (a) Live hard coral cover. (b) Macroalgal canopy cover. (c) Seagrass cover. Maps produced in QGIS 3.16 using GEBCO Compilation Group (2021) GEBCO 2021 Grid (doi:10.5285/c6612cbe-50b3-0cff-e053-6c86abc09f8f).

Table 6: Metadata links for the outputs.

Data product	Metadata link Links to view online and download available via metadata
Live hard coral cover	http://gis.ices.dk/geonetwork/srv/eng/catalog.search#/metadata/735ea8c9-5bb7-48a2-a41d-57e521f97ae8
Macroalgal canopy cover	http://gis.ices.dk/geonetwork/srv/eng/catalog.search#/metadata/913a0ee4-45d7-45aa-8de2-3d31af0f7c0e
Seagrass cover	http://gis.ices.dk/geonetwork/srv/eng/catalog.search#/metadata/39746d9c-4220-425c-bc26-7cb3056c36a5

4 Discussion

This report describes a simple way to quickly match the distribution of potential EOVs in Europe. This has added value to the current polygon-based maps of EOVs by showing a wider distribution across Europe. However, there are some issues which could improve this in future:

1. Remove duplicates:
    a. There may be duplicate points in the OSPAR and EMODnet Seabed Habitats survey sample databases. If the unique occurrence identifier has been carried through to both databases ("RecordKey" in the OSPAR database and "measurementID" or "eventID" in the EMODnet Seabed Habitats survey sample database), then it will be possible to remove these duplicates. If not, then it will be less difficult.
    b. There may be duplicates within the EMODnet Seabed Habitats survey sample database itself if a measurement has been translated into multiple classification systems. It will be straightforward to identify these using the "eventID", and using "sourcehabitatoccurrenceid" to select the original classification system as the record to retain.
2. Standardise URIs: having multiple variations of a URI, which by definition is supposed to be unique, reduces the usefulness of this field. Therefore we recommend that part of the quality control check on data going into the EMODnet Seabed Habitats survey sample database should be to ensure URIs are standardised. We recommend:
    a. Use http rather than https
    b. No 'rdf' suffix
    c. 'vocabularyconcept' rather 'vocabulary' within the eionet.europa vocabularies.
3. Future-proof the look-up table: for this exercise we did not include rows in the look-up table for habitat classification systems that are not currently in the EMODnet Seabed Habitats survey sample database, but which may contain classes relevant to EOVs. As more data is added to the database in future these may become relevant. Therefore, these classification systems should be added to the look-up table.
4. Automation using WFS: with a reliable and future-proof look-up table, it would be possible to write a simple script, in R or Python, for example, to automate this process. It could access the

most up-to-date data from EMODnet Seabed Habitats[2] using WFS to produce and up-to-date EOV distribution map.

5. Investigate using other databases: in particular, the ICES Vulnerable Marine Ecosystems database may hold additional data on live hard coral cover that is not yet present in the other databases.

5 Conclusion

The fact that the EMODnet Seabed Habitats survey samples database, exists and compiles data in a standard format using machine-readable URIs means that data may be extracted and reclassified to answer a variety of important questions, such as 'what is the current best available evidence for the distribution of seagrass cover, live hard coral cover and macroalgal canopy cover in Europe'?

This report describes the first attempt at using point data to improve the current polygon-focussed data product. Future improvements would include removing duplicates, standardising URIs, future-proofing the look-up table, automation and including new data sources.

6 References

Duncan, G. Lear, D., Paxman, K., Lillis, H. & Castle, L. 2021. A standard approach to structuring classified habitat data using the Darwin Core Extended Measurement or Fact Extension. EMODnet report. Available online https://www.emodnet-seabedhabitats.eu/resources/documents-and-outreach/#h3298bcd0a15741a8a0ac1c8b4576f7c5

O'Keeffe, E., Lillis, H. 2019. Generating Essential Ocean Variables. EMODnet report. Available online at https://www.emodnet-seabedhabitats.eu/resources/documents-and-outreach/#h3298bcd0a15741a8a0ac1c8b4576f7c5

[2] Guidance on accessing EMODnet Seabed Habitats data via WFS in R is provided here: https://www.emodnet-seabedhabitats.eu/access-data/web-services/

7 Appendix 1: EOV crosswalks

This section contains a series of tables that show the relationship between several habitat classification systems and the EOVs:

1. EUNIS 2007-11
2. Habitats Directive Annex I
3. OSPAR threatened and/or declining habitats in the Atlantic/Arctic
4. HELCOM HUB in the Baltic

Using these crosswalks we were able to extract points from existing survey sample points that have previously been classified according to these classification systems.

7.1 EUNIS 2007-11

Table 7: EOVs that can be determined from EUNIS 2007-11 habitat types.

EUNIS code	EUNIS habitat name	EOV	EOV sub-type
A2.131	Facies of banks of dead leaves of [Posidonia oceanica] and other phanerogams	Seagrass cover	Seagrass beds
A2.61	Seagrass beds on littoral sediments	Seagrass cover	*Zostera* beds
A2.611	Mainland Atlantic [Zostera noltii] or [Zostera angustifolia] meadows	Seagrass cover	*Zostera* beds
A2.6111	[Zostera noltii] beds in littoral muddy sand	Seagrass cover	*Zostera* beds
A2.612	Macaronesian [Zostera noltii] meadows	Seagrass cover	*Zostera* beds
A2.613	Pontic [Zostera marina] and [Zostera noltii] meadows	Seagrass cover	*Zostera* beds

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EUNIS code	EUNIS habitat name	EOV	EOV sub-type
A2.614	[Ruppia maritima] on lower shore sediment	Seagrass cover	*Ruppia* beds
A3.11	Kelp with cushion fauna and/or foliose red seaweeds	Macroalgal canopy cover	
A3.111	[Alaria esculenta] on exposed sublittoral fringe bedrock	Macroalgal canopy cover	
A3.1111	[Alaria esculenta], [Mytilus edulis] and coralline crusts on very exposed sublittoral fringe bedrock	Macroalgal canopy cover	
A3.1112	[Alaria esculenta] and [Laminaria digitata] on exposed sublittoral fringe bedrock	Macroalgal canopy cover	
A3.112	[Alaria esculenta] forest with dense anemones and crustose sponges on extremely exposed infralittoral bedrock	Macroalgal canopy cover	
A3.113	[Laminaria hyperborea] forest with a faunal cushion (sponges and polyclinids) and foliose red seaweeds on very exposed infralittoral rock	Macroalgal canopy cover	
A3.115	[Laminaria hyperborea] with dense foliose red seaweeds on exposed infralittoral rock	Macroalgal canopy cover	
A3.1151	[Laminaria hyperborea] forest with dense foliose red seaweeds on exposed upper infralittoral rock	Macroalgal canopy cover	
A3.1153	Mixed [Laminaria hyperborea] and [Laminaria ochroleuca] forest on exposed infralittoral rock	Macroalgal canopy cover	
A3.117	[Laminaria hyperborea] and red seaweeds on exposed vertical rock	Macroalgal canopy cover	
A3.132	Association with [Cystoseira amentacea] (var. [amentacea], var. [stricta], var. [spicata])	Macroalgal canopy cover	
A3.21	Kelp and red seaweeds (moderate energy infralittoral rock)	Macroalgal canopy cover	

EUNIS code	EUNIS habitat name	EOV	EOV sub-type
A3.211	[Laminaria digitata] on moderately exposed sublittoral fringe rock	Macroalgal canopy cover	
A3.2111	[Laminaria digitata] on moderately exposed sublittoral fringe bedrock	Macroalgal canopy cover	
A3.2112	[Laminaria digitata] and under-boulder fauna on sublittoral fringe boulders	Macroalgal canopy cover	
A3.2113	[Laminaria digitata] and piddocks on sublittoral fringe soft rock	Macroalgal canopy cover	
A3.212	[Laminaria hyperborea] on tide-swept, infralittoral rock	Macroalgal canopy cover	
A3.2121	[Laminaria hyperborea] forest, foliose red seaweeds and a diverse fauna on tide-swept upper infralittoral rock	Macroalgal canopy cover	
A3.213	[Laminaria hyperborea] on tide-swept infralittoral mixed substrata	Macroalgal canopy cover	
A3.2131	[Laminaria hyperborea] forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata	Macroalgal canopy cover	
A3.214	[Laminaria hyperborea] and foliose red seaweeds on moderately exposed infralittoral rock	Macroalgal canopy cover	
A3.2141	[Laminaria hyperborea] forest and foliose red seaweeds on moderately exposed upper infralittoral rock	Macroalgal canopy cover	
A3.2145	[Sabellaria spinulosa] with kelp and red seaweeds on sand-influenced infralittoral rock	Macroalgal canopy cover	
A3.216	[Laminaria hyperborea] on moderately exposed vertical rock	Macroalgal canopy cover	
A3.22	Kelp and seaweed communities in tide-swept sheltered conditions	Macroalgal canopy cover	

EUNIS code	EUNIS habitat name	EOV	EOV sub-type
A3.221	[Laminaria digitata], ascidians and bryozoans on tide-swept sublittoral fringe rock	Macroalgal canopy cover	
A3.222	Mixed kelp with foliose red seaweeds, sponges and ascidians on sheltered tide-swept infralittoral rock	Macroalgal canopy cover	
A3.223	Mixed kelp and red seaweeds on infralittoral boulders, cobbles and gravel in tidal rapids	Macroalgal canopy cover	
A3.234	Association with [Cystoseira tamariscifolia] and [Saccorhiza polyschides]	Macroalgal canopy cover	
A3.239	Association with [Cystoseira brachycarpa]	Macroalgal canopy cover	
A3.23A	Mediterranean and Pontic Association with [Cystoseira crinita]	Macroalgal canopy cover	
A3.23B	Association with [Cystoseira crinitophylla]	Macroalgal canopy cover	
A3.23C	Association with [Cystoseira sauvageauana]	Macroalgal canopy cover	
A3.23D	Association with [Cystoseira spinosa]	Macroalgal canopy cover	
A3.31	Silted kelp on low energy infralittoral rock with full salinity	Macroalgal canopy cover	
A3.311	Mixed [Laminaria hyperborea] and [Laminaria ochroleuca] forest on moderately exposed or sheltered infralittoral rock	Macroalgal canopy cover	
A3.312	Mixed [Laminaria hyperborea] and [Laminaria saccharina] on sheltered infralittoral rock	Macroalgal canopy cover	
A3.3121	Mixed [Laminaria hyperborea] and [Laminaria saccharina] forest on sheltered upper infralittoral rock	Macroalgal canopy cover	

EUNIS code	EUNIS habitat name	EOV	EOV sub-type
A3.313	[Laminaria saccharina] on very sheltered infralittoral rock	Macroalgal canopy cover	
A3.3131	[Laminaria saccharina] and [Laminaria digitata] on sheltered sublittoral fringe rock	Macroalgal canopy cover	
A3.3132	[Laminaria saccharina] forest on very sheltered upper infralittoral rock	Macroalgal canopy cover	
A3.314	Silted cape-form [Laminaria hyperborea] on very sheltered infralittoral rock	Macroalgal canopy cover	
A3.32	Kelp in variable salinity on low energy infralittoral rock	Macroalgal canopy cover	
A3.322	[Laminaria saccharina] and [Psammechinus miliaris] on variable salinity grazed infralittoral rock	Macroalgal canopy cover	
A3.323	[Laminaria saccharina] with [Phyllophora] spp. and filamentous green seaweeds on variable or reduced salinity infralittoral rock	Macroalgal canopy cover	
A3.333	Association with [Cystoseira compressa]	Macroalgal canopy cover	
A4.26	Mediterranean coralligenous communities moderately exposed to hydrodynamic action	Macroalgal canopy cover	
A4.261	Association with [Cystoseira zosteroides]	Macroalgal canopy cover	
A4.262	Association with [Cystoseira usneoides]	Macroalgal canopy cover	
A4.263	Association with [Cystoseira dubia]	Macroalgal canopy cover	
A4.264	Association with [Cystoseira corniculata]	Macroalgal canopy cover	
A5.52	Kelp and seaweed communities on sublittoral sediment	Macroalgal canopy cover	

EUNIS code	EUNIS habitat name	EOV	EOV sub-type
A5.522	[Laminaria saccharina] and [Chorda filum] on sheltered upper infralittoral muddy sediment	Macroalgal canopy cover	
A5.523	[Laminaria saccharina] with [Psammechinus miliaris] and/or [Modiolus modiolus] on variable salinity infralittoral sediment	Macroalgal canopy cover	
A5.524	[Laminaria saccharina], [Gracilaria gracilis] and brown seaweeds on full salinity infralittoral sediment	Macroalgal canopy cover	
A5.52E	Association with [Cystoseira barbata]	Macroalgal canopy cover	
A5.53	Sublittoral seagrass beds	Seagrass cover	Seagrass beds
A5.531	[Cymodocea] beds	Seagrass cover	*Cymodocea* beds
A5.5311	Macaronesian [Cymodocea] beds	Seagrass cover	*Cymodocea* beds
A5.5312	Lusitanian [Cymodocea] beds	Seagrass cover	*Cymodocea* beds
A5.5313	Mediterranean [Cymodocea] beds	Seagrass cover	*Cymodocea* beds
A5.53131	Association with [Cymodocea nodosa] on well sorted fine sands	Seagrass cover	*Cymodocea* beds
A5.53132	Association with [Cymodocea nodosa] on superficial muddy sands in sheltered waters	Seagrass cover	*Cymodocea* beds
A5.532	[Halophila] beds	Seagrass cover	*Halophila* beds
A5.5321	Canary Island [Halophila] beds	Seagrass cover	*Halophila* beds
A5.5322	Mediterranean [Halophila] beds	Seagrass cover	*Halophila* beds

EUNIS code	EUNIS habitat name	EOV	EOV sub-type
A5.533	[Zostera] beds in full salinity infralittoral sediments	Seagrass cover	*Zostera* beds
A5.5331	[Zostera marina]/[angustifolia] beds on lower shore or infralittoral clean or muddy sand	Seagrass cover	*Zostera* beds
A5.5332	Mediterranean and Pontic [Zostera noltii] beds	Seagrass cover	*Zostera* beds
A5.53321	Association with [Zostera noltii] in euryhaline and eurythermal environment	Seagrass cover	*Zostera* beds
A5.53322	Association with [Zostera noltii] on superficial muddy sands in sheltered waters	Seagrass cover	*Zostera* beds
A5.5333	Association with [Zostera marina] in euryhaline and eurythermal environment	Seagrass cover	*Zostera* beds
A5.5334	Mediterranean [Zostera hornemanniana] beds	Seagrass cover	*Zostera* beds
A5.534	[Ruppia] and [Zannichellia] communities	Seagrass cover	*Ruppia* beds
A5.5341	Middle European [Ruppia] and [Zannichellia] communities	Seagrass cover	*Ruppia* beds
A5.5342	Tethyan marine [Ruppia] communities	Seagrass cover	*Ruppia* beds
A5.5343	[Ruppia maritima] in reduced salinity infralittoral muddy sand	Seagrass cover	*Ruppia* beds
A5.535	[Posidonia] beds	Seagrass cover	*Posidonia* beds
A5.5351	Ecomorphosis of striped [Posidonia oceanica] meadows	Seagrass cover	*Posidonia* beds
A5.5352	Ecomorphosis of "barrier-reef" [Posidonia oceanica] meadows	Seagrass cover	*Posidonia* beds
A5.5353	Facies of dead "mattes" of [Posidonia oceanica] without much epiflora	Seagrass cover	*Posidonia* dead "mattes"

EUNIS code	EUNIS habitat name	EOV	EOV sub-type
A5.5354	Association with [Caulerpa prolifera] on [Posidonia] beds	Seagrass cover	*Posidonia* beds
A5.545	[Zostera] beds in reduced salinity infralittoral sediments	Seagrass cover	*Zostera* beds
A5.63	Circalittoral coral reef	Live hard coral cover	Cold water coral reefs
A5.631	Circalittoral Lophelia pertusa reef	Live hard coral cover	*Lophelia pertusa* reefs
A6.61	Communities of deep sea corals	Live hard coral cover	Cold water coral communities
A6.611	Deep-sea Lophelia pertusa reefs	Live hard coral cover	*Lophelia pertusa* reefs
A6.75	Carbonate mounds	Live hard coral cover	Carbonate mounds

7.2 Habitats Directive Annex I

Table 8: EOVs that can be determined from Habitats Directive Annex I habitat types in Europe. Posidonia beds only occur in the Mediterranean.

Habitats Directive Annex I habitat	EOV	EOV subtype
1120 *Posidonia* beds	Seagrass cover	*Posidonia* beds

7.3 OSPAR threatened and/or declining habitats

Table 9: EOVs that can be determined from OSPAR threatened and/or declining habitats – habitats are only classified according to this list in the northeast Atlantic.

OSPAR habitat	EOV	EOV subtype
Carbonate mounds	Live hard coral cover	Carbonate mounds
Coral gardens	Live hard coral cover	Coral gardens
***Lophelia pertusa* reefs**	Live hard coral cover	*Lophelia pertusa* reefs
***Cymodocea* meadows**	Seagrass cover	*Cymodocea* beds
***Zostera* beds**	Seagrass cover	*Zostera* beds

7.4 HELCOM Underwater Biotopes

Table 10: EOVs that can be determined from HELCOM Underwater Biotopes (HUB) habitat types.

HUB code	HUB habitat name	EOV	EOV sub-type
AA-I1B2	Baltic photic coarse sediment dominated by Zannichellia spp. and/or Ruppia spp. and/or Zostera noltii	Seagrass cover	*Zostera* beds or *Ruppia* beds
AA-I1B7	Baltic photic coarse sediment dominated by common eelgrass (Zostera marina)	Seagrass cover	*Zostera* beds
AA-M1B2	Baltic photic mixed substrate dominated by Zannichellia spp. and/or Ruppia spp. and/or Zostera noltii	Seagrass cover	*Zostera* beds or *Ruppia* beds

HUB code	HUB habitat name	EOV	EOV sub-type
AA-M1B7	Baltic photic mixed substrate dominated by common eelgrass (Zostera marina)	Seagrass cover	Zostera beds
AA-H1B2	Baltic photic muddy sediment dominated by Zannichellia spp. and/or Ruppia spp. and/or Zostera noltii	Seagrass cover	*Zostera* beds or *Ruppia* beds
AA-H1B7	Baltic photic muddy sediment dominated by common eelgrass (Zostera marina)	Seagrass cover	*Zostera* beds
AA-J1B2	Baltic photic sand dominated by Zannichellia spp. and/or Ruppia spp. and/or Zostera noltii	Seagrass cover	*Zostera* beds or *Ruppia* beds
AA-J1B7	Baltic photic sand dominated by common eelgrass (Zostera marina)	Seagrass cover	*Zostera* beds
AA-I1C4	Baltic photic coarse sediment dominated by kelp	Macroalgal canopy cover	Kelp forest
AA-M1C4	Baltic photic mixed substrate dominated by kelp	Macroalgal canopy cover	Kelp forest
AA-A1C4	Baltic photic rock and boulders dominated by kelp	Macroalgal canopy cover	Kelp forest
AA-E1C4	Baltic photic shell gravel dominated by kelp	Macroalgal canopy cover	Kelp forest
AB-M1G3	Baltic aphotic mixed substrate dominated by stone corals (Scleractinida)	Live hard coral cover	Cold water coral communities
AB-A1G3	Baltic aphotic rock and boulders dominated by stone corals (Scleractinida)	Live hard coral cover	Cold water coral communities

7.5 Other

Table 11: EOVs that can be determined from National habitat types - Bulgarian Black Sea.

Habitat name	EOV	EOV sub-type
Upper-infralittoral (1-4 m) rock dominated by Cystoseira bosphorica	Macroalgal canopy cover	
Upper-infralittoral (3-10 m) rock dominated by Cystoseira barbata	Macroalgal canopy cover	
Pontic Zostera noltii meadows (1-3 m)	Seagrass cover	*Zostera* beds
Pontic mixed Zostera noltii- Zannichellia palustris-Zostera marina meadows (2-4 m)	Seagrass cover	*Zostera* beds