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Meeting of the Ecosystem Approach Correspondence Group on Monitoring (CORMON) Biodiversity and Fisheries

Athens, 7-8 April 2025

Agenda Item 4: IMAP common indicators on marine habitats

Assessment methodologies, assessment criteria and thresholds for biodiversity common indicators CI1 and CI2

SPA/RAC
Tunis, 2025

Note by the Secretariat

At their 19th Ordinary Meeting (COP 19, Athens, Greece, 9-12 February 2016), the Contracting Parties to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention) and its Protocols adopted the Integrated Monitoring and Assessment Programme and related Assessment Criteria (IMAP).

At their 20th Ordinary Meeting (COP 20, Tirana, Albania, 17-20 December 2017), the Contracting Parties endorsed, in Decision IG.23/6, the key findings of the 2017 Mediterranean Quality Status Report (the MED QSR Decision), that recommend a list of directions towards the 2023 MED QSR including the definition of the reference state of habitats and species, threshold values and assessment criteria. To that effect, in line with the Programme of Work 2020-2021 adopted by COP21 (Naples, Italy, December 2019), SPA/RAC has undertaken actions aimed at standardizing the monitoring and assessment methods related to IMAP Biodiversity Cluster, including the elaboration of monitoring and assessment scales, assessment criteria, thresholds and baseline values for the IMAP common indicators (CI).

In this context, and within its Programme of Work for 2022–2023, UNEP/MAP's Specially Protected Areas Regional Activity Centre (SPA/RAC) conducted a study to evaluate the implementation status of Common Indicators CI1 and CI2, which relate to benthic marine habitats (UNEP/MED WG.547/11). Indicator CI1 concerns the 'habitat distributional range,' while indicator CI2 addresses the 'condition of the habitat's typical species and communities.' The study assessed the feasibility of proposing monitoring and assessment elements for CI1 and CI2, with the support of the Biodiversity Online Working Group (OWG) for benthic habitats.

In light of this, SPA/RAC has prepared a proposal for monitoring and assessment elements for the two IMAP Common Indicators for benthic habitats (CI1 and CI2) and their application to three habitat types (Posidonia, Coralligenous, and Maërl), with a view to incorporating them into the next Mediterranean Quality Status Report (MedQSR), due in 2031. This proposal was developed with the support of the Biodiversity Online Working Group (OWG) on benthic habitats.

The Meeting is expected to review the document and agree on its submission to the SPA/RAC Focal Points Meeting (scheduled for May 2025) and the EcAp Coordination Group Meeting (scheduled for September 2025).

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List of abbreviations and acronyms

BC	Barcelona Convention
BHT	Broad Habitat Type(s) (as defined and used in MSFD)
CI	Common Indicator (of IMAP)
CoP	Conference of the Parties (of BC)
CORMON	Correspondence Group on Monitoring (of EcAp process)
CP	Contracting Party (to BC)
D6C1-C5	MSFD Descriptor 6 “Sea-floor integrity” Criteria 1 to 5
EcAp	Ecosystem Approach [process] (of UNEP/MAP)
EcAp CG	Ecosystem Approach Coordination Group (of EcAp process)
EEA	European Environment Agency
EMODnet	European Marine Observation and Data Network (of EC)
EO	Ecological Objective (of IMAP)
EQR	Ecological Quality Ratio
ETC-ICM	European Topic Centre on Inland, Coastal and Marine Waters (of EEA)
ETC-BE	European Topic Centre on Biodiversity and Ecosystems (of EEA)
EU	European Union
EUNIS	European Nature Information System (habitat classification/typology of EEA)
GES	Good Environmental Status (of IMAP, of MSFD)
GES Decision	Commission Decision on criteria and methods for GES (of MSFD, 2010; 2017)
HD	Habitats Directive (92/43/EEC)
ICES	International Council for the Exploration of the Sea
IMAP	Integrated Monitoring and Assessment Programme (of UNEP/MAP)
INFO/RAC	Information and Communication Regional Activity Centre (of UNEP/MAP)
MED QSR	Mediterranean Quality Status Report (of UNEP/MAP)
MPA	Marine Protected Area
MS	Member State (of EU)
MSFD	Marine Strategy Framework Directive (2008/56/EC)
NIS	Non-indigenous species
OWG	Online Working Group (benthic habitats OWG of the CORMON)
QSR	Quality Status Report
RMB	Rhodolith and maërl beds
ROV	Remotely-operated vehicle
SAR	Swept area ratio (bottom-fishing intensity, derived from VMS data)
SPA/BD FPs	Specially Protected Areas and Biological Diversity Focal Points (of UNEP/MAP)
SPA/RAC	Specially Protected Areas Regional Activity Centre (of UNEP/MAP)
TG Seabed	Technical Group on seabed habitats and sea-floor integrity (of MSFD Common Implementation Strategy)
UNEP/MAP	United Nations Environment Programme/Mediterranean Action Plan
VMS	Vessel Monitoring System (of fishing vessels)

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Monitoring and assessment elements for the IMAP Common Indicators on benthic habitats for three habitat types (*Posidonia*, Coralligenous and Maërl)

1 Background

1. In 2008, the Contracting Parties to the Barcelona Convention (BC), through their COP 15 Decision IG.17/6, committed to progressively apply the Ecosystem Approach (EcAp) for managing human activities impacting the Mediterranean marine and coastal environment (UNEP/MAP, 2008). This approach aims to promote sustainable development and achieve Good Environmental Status (GES) for the Mediterranean Sea and its coasts.

2. A key aspect of implementing the Ecosystem Approach involves monitoring and assessing the status of the marine and coastal environment. To establish a coherent regional framework, the Contracting Parties adopted the *Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria* (IMAP), to meet eleven Ecological Objectives (EO), through COP 19 Decision IG.22/7 in 2016 (UNEP/MAP, 2016).

3. In line with further UNEP/MAP Decisions (UNEP/MAP, 2012; 2013; 2017a; 2019b; 2021a; 2021b; 2023b), Contracting Parties have updated or developed their national monitoring programmes based on the IMAP Common Indicators (CI) which are grouped into three clusters: Biodiversity and Non-Indigenous Species (NIS), Pollution and Marine Litter, and Coast and Hydrography. IMAP's 23 Common Indicators primarily focus on state and impact indicators. Contracting Parties implement their monitoring programmes according to a commonly agreed monitoring and assessment framework for each IMAP Common Indicator.

4. A significant element of this process involves defining monitoring and assessment scales and identifying key assessment elements such as criteria, thresholds, and baseline values for each IMAP cluster. Regional expertise has been used to develop these components, particularly for the biodiversity indicators under Ecological Objective EO1, using available data to establish baselines and threshold values.

5. In this context and within its Programme of Work for 2022-2023, UNEP/MAP's Specially Protected Areas Regional Activity Centre (SPA/RAC) conducted a study to evaluate the implementation status of Common Indicators CI1 and CI2 which relate to benthic marine habitats (Garrabou & Kipson, 2023; UNEP/MAP SPA/RAC, 2023b). Indicator CI1 relates to 'habitat distributional range' and indicator CI2 relates to the 'condition of the habitat's typical species and communities'. The analysis was based on extensive research of available documents and a consultation process with the national experts on IMAP and MSFD[1] implementation and specialists on the Reference list of habitats and typical species. The study assessed the possibility of proposing monitoring and assessment elements for CI1 and CI2 with the support of the Biodiversity Online Working Group (OWG[2]) for benthic habitats.

[1] The European Union's Marine Strategy Framework Directive (2008/56/EC).
[2] This document was discussed with the OWG on 21/01/2025 and 19/02/2025 and has been updated, based on their input to these meetings and written comments.

6. This present report builds upon the study by Garrabou & Kipson (2023) by focusing on the development of a proposal for monitoring and assessment elements for the two IMAP Common Indicators for benthic habitats (CI1 and CI2) and their application to three habitat types (*Posidonia*, Coralligenous, and Maërl), with a view to using them in the next Mediterranean Quality Status Report (MedQSR), due in 2031. Across the Mediterranean Sea each of these habitat types encompasses a range of habitat characteristics, with a number of sub-types defined (see Section 3.2); for simplicity the short terms '*Posidonia'*, 'Coralligenous' and 'Maërl' are used throughout this report to encompass the range of characteristics and sub-types of each habitat.

2 Objectives

7. The main objectives of this study and proposal are:

a. To revise the existing scales of monitoring, scales of assessment, assessment methodologies, assessment criteria, and develop baseline and thresholds values for IMAP CIs related to benthic habitats for the three habitat types (*Posidonia*, Coralligenous, and Maërl) based on MedQSR 2023 recommendations;

a. To coordinate, moderate, and compile the results of the work conducted by the dedicated working groups to discuss and agree scales of monitoring, scales of assessment, assessment methodologies, assessment criteria, and develop baseline and thresholds values for IMAP for CI1 and CI2 for the benthic habitats for the three habitat types (*Posidonia*, Coralligenous, and Maërl).

The outputs will be reviewed and discussed by the Meeting of the Ecosystem Approach Correspondence Group on Monitoring (CORMON) for biodiversity and fisheries in April 2025.

3 Current state of monitoring and assessment for EO1 benthic habitats

3.1 Common Indicators CI1 and CI2

8. A set of Common Indicators, each linked to a specific Ecological Objective, was developed for the IMAP, with 'fact sheets' for each indicator approved by the Ecosystem Approach Coordination Group (EcAp CG) in 2017 (UNEP/MAP, 2017b). The fact sheets for CI1 and CI2 are presented in **Annex I**; they are expected to be updated in the light of agreements following the proposals presented in this report.

3.2 About the three habitat types (*Posidonia*, Coralligenous and Maërl)

9. Marine habitat types in the Mediterranean region are listed in a *Reference List of Marine and Coastal Habitat Types in the Mediterranean* which was updated in 2019 (UNEP/MAP, 2019c) and published as the habitat typology for the Barcelona Convention (UNEP/MAP SPA/RAC, 2019b; Montefalcone et al. 2021).

10. The present report focuses on three habitat types which have received particular attention within the process to implement IMAP's Ecological Objective 1 (EO1). The three habitat types, including the codes for the Info/RAC data standards (B1-3) (Section 3.5) and the relevant codes (MB and MC) from the Barcelona Convention habitat typology (UNEP/MAP SPA/RAC, 2019b; Montefalcone et al. 2021), are:

a. B1 Coralligenous
    i. MB1.55 Coralligenous (enclave of circalittoral)
    ii. MC1.51 Coralligenous cliffs (with 17 sub-types)
    iii. MC1.52a Coralligenous outcrops (with 9 sub-types)
    iv. MC1.52b Coralligenous outcrops covered by sediment (see MC1.52a for examples of facies)
    v. MC1.52c Deep banks (with 3 sub-types)
    vi. MC2.51 Coralligenous platforms (with 12 sub-types)
b. B2 Maërl
    i. MB3.511 Association with maërl or rhodoliths[3]
    ii. MB3.521 Association with maërl or rhodoliths
    iii. MC3.52 Coastal detritic bottoms with rhodoliths (with 9 sub-types)
c. B3 *Posidonia*
    i. *Posidonia oceanica* meadow (MB2.54 with 7 sub-types[4])

11. In the monitoring guidelines for these three habitats (UNEP-MAP 2021g), multiple habitats and sub-types are included within the scope of B1 Coralligenous and B2 Maërl. Garrabou & Kipson (2023) based their analysis of the state of monitoring programmes for these habitat types on a narrower scope: they do not include MB1.55, MC1.52a, MC1.52b and MC1.52c within the scope of Coralligenous and do not include MB3.511 or MB3.521 within the scope of Maërl.

12. To provide a clear basis for ongoing monitoring and assessments, the scope of the three habitat types needs to be confirmed. In particular, the broad scope of B1 Coralligenous and B2 Maërl (according to UNEP-MAP, 2021g) needs to be considered, especially in relation to the pressures they face and the link to monitoring and assessment processes. Whilst there is often a desire to maintain broad definitions for habitats which are listed for protection, such broad definitions can hamper subsequent monitoring and assessment processes. This may be particularly relevant when assessing data from sites with markedly different habitat and community characteristics for the same overarching 'habitat'[5].

13. Descriptions of the three habitat types are included in the Habitat Templates prepared by Garrabou & Kipson (2023) and are presented in **Annex II**.

14. The OWG considered the scope of each habitat and recommended their broad scope, as reflected in the typology in paragraph 10, should be retained. However, further consideration is needed on how the varying characteristics of the three habitats across the Mediterranean influence the validity of aggregating data across monitoring sites for region-wide status assessments. In particular, it would be important to limit the variation in data by consistently sampling in the same depth zones. It was also noted that Coralligenous habitat occurs across a wide range of depths, and shallow sites may be subject to differing pressures to the habitat in deeper water.

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[3] MB3.511 and MB3.521 have the same habitat names but are listed under separate higher types (MB3.51 Infralittoral coarse sediment mixed by wave and MB3.52 Infralittoral coarse sediment under the influence of bottom currents).

[4] Sub-types for a) *Posidonia* on artificial substrata and b) *Posidonia* association with *Zostera noltii* are not specifically defined in BC or EUNIS habitat classifications.

[5] For *Posidonia*, three levels are suggested: 1) substratum (e.g. rock, sand etc.), 2) mixed/monospecific meadows (associated species) and 3) dead matte.

Recommendation:

The characteristics (biotic and abiotic) of each habitat at monitoring sites should be reviewed to assess their degree of variance across the region and the validity of aggregating data from different sites within assessment areas and across the region for analysis and status assessment purposes.

Monitoring should focus on a limited number of subtypes and depth zones across the Mediterranean, and preferably a single subtype within each assessment area. For Coralligenous, monitoring of shallow and deep habitat is important as they can be subject to different pressures.

Assessments for IMAP CI1 and CI2 should focus on the higher-level habitat types (i.e. *Posidinia*, Coralligenous and Maërl), unless it becomes clear during further implementation that assessment of subtypes is more appropriate.

15. There is ongoing work by SPA/RAC to consider additional habitat types that could be proposed for EO1 monitoring and assessment (UNEP/MAP SPA/RAC, 2023c). The current state of monitoring across the Mediterranean for a further eight habitat types was assessed by Garrabou & Kipson (2023).

16. It is strongly recommended that if further habitat types are to be included within the scope of EO1 that they are clearly defined (including the relevant EUNIS/BC typology codes) and the primary pressures they face (i.e. causing a threat to their status) are defined to aid subsequent monitoring and assessment processes.

17. The habitat typology adopted under the Barcelona Convention (UNEP/MAP SPA/RAC, 2019b; Montefalcone et al. 2021) has been partially incorporated into the pan-European hierarchical EUNIS habitat classification (European Environment Agency, 2022: EUNIS Marine, 2022), where the habitats are listed at EUNIS levels 4-6 under the relevant EUNIS level 3 marine biogeographic region habitats for the Mediterranean Sea region. Although the overall structure (at levels 2-4) of the two typologies is the same, and there is some correlation of habitats at levels 5-6, there remains significant differences between the two typologies. The differences relating to the three habitat types considered in this report are presented in **Annex III**.

18. Due to the reliance on use of the EUNIS habitat classification by some Mediterranean countries, including for habitat mapping purposes (such as the EUSeaMap product from EMODnet), it is recommended that the alignment of the two typologies be reviewed, in collaboration with the European Environment Agency (EEA), with a view to developing a single typology for use under both EUNIS and the Barcelona Convention. In doing this, it would be important to develop the definitions of each habitat type beyond those currently available, including both the biological community characteristics (main species) and the abiotic habitat characteristics (substrate, depth range, wave and tidal current exposure, salinity and other key parameters).

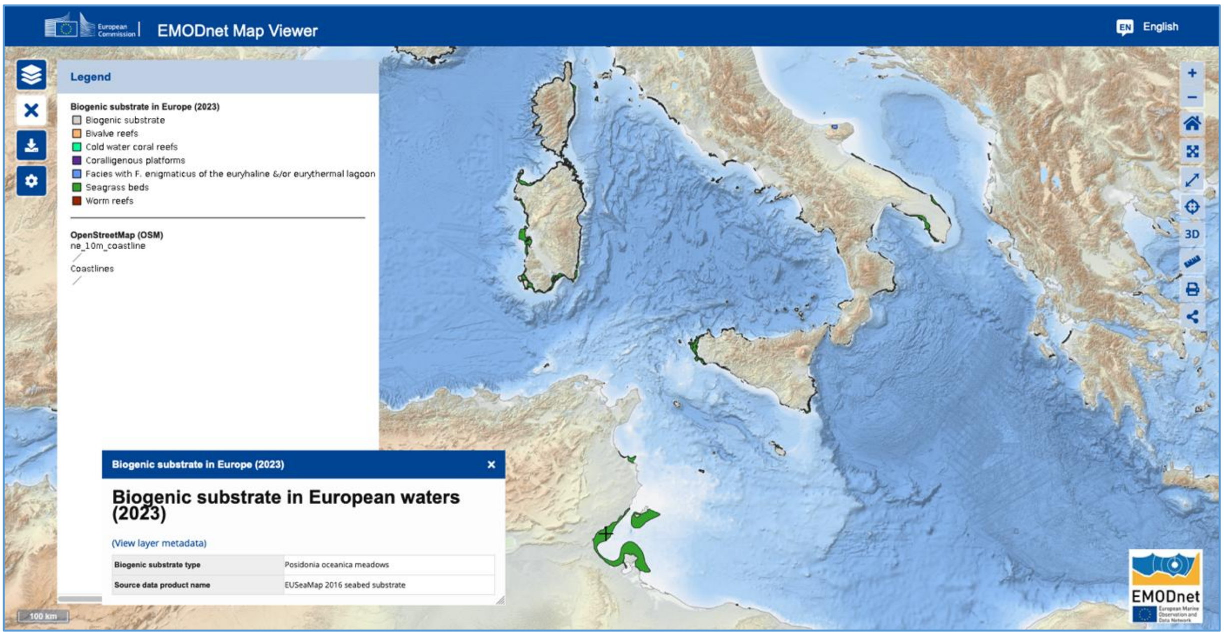
Recommendation:

The relationship between the habitat classifications of the Barcelona Convention (2019) and European Environment Agency (EUNIS 2022) should be reviewed, with a view to developing a single typology for use under both EUNIS and the Barcelona Convention.

The biotic and abiotic definitions of each habitat type in the Mediterranean Sea should be further developed, based as far as possible on field data including high resolution mapping via remote sensing and *in situ* survey, to provide a robust typology for monitoring, assessment, mapping and management purposes.

19. Maps of EUNIS seabed habitats are available in EMODnet (https://emodnet.ec.europa.eu/geoviewer/) (**Figure 1**) as a) maps from surveys (whole area coverage or single habitat types) and b) maps from models (whole area coverage or single habitat types). The maps provide region-wide coverage to indicate the presence and general extent of particular habitat types. However, their use at more local scales, such as for assessing the distribution and extent under CI1, is more limited due in part to incomplete data.

Figure 1*. Example of seabed habitat maps available in EMODnet for the Mediterranean region. Maps shows distribution of seagrass beds, including* Posidonia oceanica *meadows (from https://emodnet.ec.europa.eu/geoviewer/, viewed 04/12/2024).*



3.3 Monitoring methods

20. Methods for mapping and monitoring the three habitat types were developed through IMAP's CORMON Biodiversity and Fisheries working group in 2019 (UNEP/MAP SPA/RAC, 2019a), with the latest version agreed in 2021 (UNEP/MAP, 2021g). This guidance provides detailed information about the overall approach to monitoring each habitat to provide data for CI1 and CI2, together with details about a range of possible monitoring techniques.

21. Guidelines for the assessment of environmental impact on seagrass beds were prepared in 2007 (Pergent-Martini & Le Revallec, 2007), and for coralligenous and maërl assemblages in 2021 (UNEP/MAP, 2021c).

3.4 Current state of monitoring programmes and assessment elements

22. Garrabou & Kipson (2023) provide a recent and thorough analysis of the state of implementation by Contracting Parties of CI1 and CI2 for the three habitat types (and a further 8 other habitat types). For each habitat type they prepared a 'Habitat Template' to summarise the key monitoring and assessment elements. The templates for the three habitat types considered here (*Posidonia*, Coralligenous and Maërl) are presented in **Annex II**.

23. Overall, the analysis revealed that between 11 and 14 (of 21) Contracting Parties (52-67%) are implementing or planning to implement monitoring programmes for one or more of the three habitat types (**Table 3**).

24. The parameters monitored for each habitat vary by country (**Annex IV, Table 8**) and consequently the possible use of the data (e.g. via indices) to assess habitat status also varies.

3.5 Data standards

25. Standards for the monitoring data on the three habitat types to be submitted into the IMAP Info System were agreed in 2019 (UNEP/MAP, 2019a) and are available as Excel spreadsheets for download from http://imapinfosystem.info-rac.org/app/#/standard.

26. The data model for each habitat differs, with each one adapted to different monitoring methods and data collected. Across the three data standards there are 297 fields spread across 17 tables (tabs). **Table 1** provides an overview of the data tables and fields in each standard.

***Table 1**. Overview of the data standards B1, B2 and B3 for benthic habitats, showing the number of fields per data table. Tables are characterised by the main type of information collected, but some contain fields related to other aspects.*

Type	Table	B1 Coralligenous	B2 Maërl	B3 Posidonia
Location	Area	11	11	12
	Site	7	12	11
Sample	Transect_ROV	18	15	19
Seabed characteristics	ReliefSurf_ROV	14		
	Habitat_ROV		14	
	Sample		21	
	Sediment			15
Water characteristics	Physico-chemical		12	15
Community/ species characteristics	Floristic_sample		9	
	Shoots			37
	Measures			19
	Estimations			22

Type	Table	B1 Coralligenous	B2 Maërl	B3 Posidonia
	Megabenthos_ROV	15		
	Megabenthos_CI_ROV	12		
	Plot-diver	35		
	Macrofauna_sample		8	
Pressure (litter)	DebType	8	8	
	Total number of fields	**120**	**110**	**150**

27. The data standards would benefit from a review and update, based upon experiences of their use by Contracting Parties. This should be undertaken in close cooperation between Contracting Party's habitat experts and Info/RAC data specialists, and could include:

a. Harmonising the structure and content across the three habitat types; it would help Contracting Parties and data users if a common data structure was used, thus making the data standard applicable to additional habitat types that may be added to EO1;
b. Simplifying the structure by bringing together similar tables and fields (e.g. tables about the habitat: ReliefSurf_ROV, Habitat_ROV, Sample, Sediment; tables about species composition: Floristic_sample, Megabenthos_ROV, Megabenthos_CI_ROV, Plot_Diver, Macrofauna_sample; fields/tables about anthropogenic influences: Site, DebType);
c. Considering whether summary data could be provided instead of raw data, in cases where this is sufficient for further analysis and assessments; this could, for example, reduce the volume of data reported under the table 'Physico-chemical';
d. Harmonising the terminology used (e.g. for litter categories) with that reported under the Marine Strategy Framework Directive (MSFD);
e. Using a controlled list of taxa instead of reporting 'new species' and 'authors', to ensure consistency in the data reported;
f. Adding fields to report the habitat type (and sub-type) monitored at each site, reporting the EUNIS/BC typology code (and typology version);
g. Reviewing which fields need to remain mandatory, in the light of agreements on the minimum data needed for assessments;
h. Improving the collection of metadata on the monitoring methods (e.g. the area covered by each sample), so that the provenance of the data is fully understandable when interpreted; method (diver or ROV) is only specified in B3 *Posidonia*, whilst it is implied in the other standards (through having separate tabs for diver and ROV).
i. Improving the data collected about human activities and their related pressures, both at each monitoring site and more broadly in each country. This could be combined with a similar data requirement for EO6 on sea-floor integrity;
j. The MESH metadata reporting model, which encompasses multiple survey and monitoring techniques for the seabed and water column, could provide a basis for a harmonised IMAP benthic habitat data standard (MESH Project, 2008).

Recommendation:

Data standards B1, B2 and B3 should be reviewed and updated, in collaboration with Contracting Party's habitat experts, as outlined in paragraph 27 and to reflect agreements on monitoring standards based on the present proposal.

3.6 Data submitted to the IMAP Info System

28. Agreements on the monitoring methods and data standards have enabled Contracting Parties to begin submitting their data on the three habitat types into the IMAP Info System (http://www.info-rac.org/en/infomap-system). **Table 2** summarises the data available in the IMAP Info System, as of November 2024.

Table 2*. Data on the three habitat types reported by Contracting Parties to the IMAP Info System, as of November 2024. The sampling period covered by each uploaded dataset is indicated (as year or years), together with its status (C = Compliant; NC = Non-Compliant; D = Draft). Greece has indicated data are available, as detailed in footnotes, but not yet submitted to the IMAP Info System. Data from other Contracting Parties are not yet available in the IMAP Info System.*

Contracting Party	B1 Coralligenous	B2 Maërl	B3 Posidonia
Egypt			2023 (D)
Israel	2019 (NC), 2021 (NC)		
Italy			2018-2019 (NC), 2018-2020 (C)
Malta		2018 (NC)	2017-2019 (NC), 2020 (D x4; NC x2), 2020-2021 (NC)
Montenegro	2019 (D)		2018 (D), 2019 (D), 2020 (C)
Morocco	2015-2019 (NC)		
Slovenia			2016-2018 (D)
Spain		2021 (NC)	2012-2023 (NC)
Tunisia			2023 (D)
Total no. of datasets	**4**	**2**	**17**

29. In total, the IMAP Info System held 23 datasets from 9 Contracting Parties for B1, B2 and B3 data standards in November 2024. The uploaded datasets are indicated as having the following status:

a. Compliant (2 data sets) – data are fully compliant with the Data Standard;
b. Non-compliant (11 datasets) - data failed the conformity check for the Data Standard;
c. Draft (10 datasets) – data are under preparation by the Contracting Party and not yet released.

30. From **Table 2** it can be observed that there is more reporting of data for B3 Posidonia (7 countries, 17 datasets), compared with B1 coralligenous (3 countries, 4 datasets) and B2 maërl (2 countries, 2 datasets). The remaining 12 contracting parties[6] have yet to submit data for these three habitat types.

31. An overview of the data submitted for each field within each data standard is provided in **Annex V**. The frequency of use of the different fields should be considered if the data standards are to be updated.

[6] Excludes the European Union (EU) as a Contracting Party, as it has no marine waters.

3.7 Overview of monitoring programmes and data submission per country

32. **Table 3** provides an overview of the state of implementation of monitoring programmes and submission of monitoring data for each habitat type. The presence or absence of the habitat type in each Contracting Party is based on information in Garrabou & Kipson (2023) and the 2023 MedQSR report on benthic habitats (Connor et al., 2023, UNEP/MAP, 2023a). The state of monitoring programmes in each Contracting Party is based on information in Garrabou & Kipson (2023), whilst the situation on data submissions is taken from the IMAP Info System, as of November 2024 and summarised in **Table 2**. The table has been updated following input by the OWG in early 2025.

Table 3. *Overview of habitat presence, monitoring and data submission in each Contracting Party. For habitat presence: Y=yes, N=no, QSR=habitat present, tbc=presence to be confirmed. For monitoring, Yo=ongoing, Yp=planning, Yu=unknown, NR=not relevant (as habitat is absent). See paragraph 32 for details.*

Contracting Party	B1 Coralligenous			B2 Maërl			B3 Posidonia		
	Present	Monitoring	IMAP data	Present	Monitoring	IMAP data	Present	Monitoring	IMAP data
Albania	Y	Yp	N	Tbc	N	N	Y	Yo	N
Algeria	Y	Yp	N	Y	Yu	N	Y	Yo	N
Bosnia & Herzegovina	Tbc	N	N	Tbc	N	N	Y[7]	N	N
Croatia	Y	Yp	N	Y	Yp	N	Y	Yo	N
Cyprus	QSR	N	N	Y	N	N	Y	Yo	N
Egypt	Y	Yu	N	Tbc	N	N	Y	Yu	Y
France	Y	Yo	N	Y	Yo	N	Y	Yo	N
Greece	Y	Yo[8]	N	Y	Yo	N[9]	Y	Yo	N[10]
Israel	Y	Yo[11]	Y	QSR	N	N	N	NR	NR
Italy	Y	Yo	N	Y	Yo	N	Y	Yo	Y
Lebanon	Y	Yo	N	Y	N	N	N	NR	NR
Libya	QSR	N	N	Tbc	N	N	QSR	N	N
Malta	QSR[12]	N	N	Y	Yo	Y	Y	Yo	Y

[7] BiH: *Posidonia* has been lost from all three sites where it was previously known. Loss of *Posidonia* in Bosnia may be connected with warmer sea last year [2024]. There were some serious heatwaves with sea temperatures even above 30ºC, It is a shallow sea (up to 25 m deep). There is no detected pollution, fishery or ship activity to blame. Funds are needed to monitor (2025 or next) other parameters which can negatively influence *Posidonia* meadows. Bosnia also lost the *Pinna nobilis* population and so far it did not recover.
[8] EL: Currently being monitored in the 2024-2029 MSFD implementation.
[9] EL: Available data from WFD and MSFD monitoring networks could be provided to IMAP. Existing info is collected and collated to create distribution maps and identify monitoring gaps at national level.
[10] EL: There are available data from the implementation of HD, WFD and MSFD across the country that could be provided to IMAP.
[11] UNEP/MED WG.547/11 (Annex V, p23-27) does not indicate monitoring of this habitat type by Israel, but Israel has submitted data to the IMAP Info System.
[12] MT: Presence of Coralligenous habitat in Malta's waters is to be confirmed. Martin et al. (2014) indicates the habitat is present, based on a literature review.

Contracting Party	B1 Coralligenous			B2 Maërl			B3 Posidonia		
	Present	Monitoring	IMAP data	Present	Monitoring	IMAP data	Present	Monitoring	IMAP data
Monaco	Tbc	N	N	Y	Yu[13]	N	Tbc	N	N
Montenegro	Y	Yp	Y	Tbc	N	N	Y	Yu	Y
Morocco	Y	Yo	Y	Y	Yu	N	QSR	N	N
Slovenia	Tbc	N	N	Tbc	N	N	Y	Yo	Y
Spain	Y	Yo[14]	N[15]	Y	Yp[16]	Y[17]	Y	Yo	Y
Syria	Tbc	N	N	Tbc	N	N	N	NR	NR
Tunisia	Y	Yu	N	Y	Yu	N	Y	Yu	Y
Türkiye	Y	Yp	N	Y	Yo	N	Y	Yo	N
Total: Yes	14 (67%)	14 (67%)	3 (14%)	13 (62%)	11 (52%)	2 (10%)	15 (71%)	14 (67%)	7 (33%)
Total: QSR/tbc	7 (33%)			8 (38%)			3 (14%)		
Total: No	0 (0%)	8 (38%)	18 (86%)	0 (0%)	10 (48%)	19 (90%)	3 (14%)	4 (19%)	11 (52%)
Total: Not relevant								3 (14%)	3 (14%)

33. The heterogeneity in monitoring approaches, coupled with the implementation of monitoring by only a proportion of the countries, provides a significant limitation to the provision of data into the IMAP Info System (Section 3.6) and hence the possibility for region-wide assessments of habitat status in future MedQSRs.

3.8 The MedQSR assessments and recommendations

34. Assessments of the three habitat types were reported on in both the 2017[18] and 2023[19] Mediterranean Quality Status Reports (UNEP/MAP, 2017a; UNEP/MAP, 2023b; 2023d).

35. For the 2023 MedQSR, a chapter on benthic habitats was prepared (Connor et al., 2023). This chapter addressed the three specific habitat types being considered in this report (under

[13] UNEP/MED WG.547/11 (Annex V, p28-30) does not indicate monitoring of this habitat type by Monaco, but the underlying database spreadsheet indicates monitoring of 3 sites for shallow kurkar ridges.
[14] ES: We have gathered the first extensive data sets for Coralligenous habitats, but we were not able to carry out an evaluation-assessment for the MSFD due to lack of previous data, data from very pristine areas, pressure maps, habitat maps, etc. We are at an initial stage in Spain where we are getting the first data in different sites of each assessment area and also getting a better idea on the spatial distribution of the Coralligenous habitats by exploring new sites that were never explored.
[15] ES: Some info on Infralittoral Coralligenous is obtained as part of monitoring programme of Infralittoral bottoms using scuba diving and transects of 50 metres and quadrats of 50 cm x 50 cm. This monitoring is not targeting Coralligenous habitats and is including other infralittoral habitats. In Circalittoral and Bathyal bottoms, Coralligenous habitats are monitored using ROV transects of at least 100 metres.
[16] ES: Within the BIODIV_A5.3 project, the mapping of RMBs (rhodolith and maërl beds) around Mallorca-Menorca (Balearic Islands) and at a few areas in southern Iberian Peninsula (Murcia Region) will be carried out. Data are being collected for the MSFD. However, at the moment, the MSFD research surveys do not have an established periodicity.
[17] ES: In early 2022, data were provided from a research survey undertaken in 2021 within the MSFD along the sedimentary bottoms of the Levantine–Balearic demarcation. This information corresponds to 23 sampling stations in which the presence of RMBs was detected and it was collected from beam trawl. Data provided was hour, data, area, depth, lat./long, flora and macrofauna. The same information exists from other stations sampled during a similar MSFD research survey undertaken in autumn 2022.
[18] https://www.unep.org/unepmap/resources/quality-status-report-mediterranean-med-qsr-2017.
[19] https://medqsr2023.info-rac.org/.

EO1) and the wider seabed of the Mediterranean under EO6 on sea-floor integrity, dealing with both in relation to the Common Indicators CI1 and CI2.

a. For CI1, the distribution and extent of each habitat was reported, based on the data submitted by Contracting Parties up to December 2022, and supplemented by information available in the scientific literature;
b. For CI2, an assessment of the condition of each habitat could not be undertaken, as there were insufficient data and a lack of agreed assessment methods and threshold values.

36. On benthic habitats, the 2023 MedQSR (UNEP/MAP, 2023d) made the following recommendations regarding improvements needed in monitoring and assessment processes:

a. Despite many decades of scientific study on particular habitats in specific locations, systematic assessment of seabed habitats, both broad-scale and fine-scale, for the Mediterranean Sea as a whole is generally at an early stage of development. However, the knowledge base and assessment methodologies are under rapid development and offer good prospects for future QSRs.
b. Improvement in the availability of data is needed for:
    i. Habitat maps – these provide the fundamental basis for habitat assessments and need to be further improved in quality and accuracy. The EUSeaMap full coverage map of broad habitat types relies on the quality of the underlying input data, especially on seabed substrates, and needs to be improved across much of the region. Countries should be encouraged to contribute mapping data to help improve the region-wide seabed mapping;
    ii. Activities and pressures – the mapping of pressures, using activities as a basis, provides a good means to assess the wider seabed of the region. These data are generally more easily (and cheaply) collected than direct observational data of the seabed, offering a more cost-effective means to undertake assessments[20]. Further, such data are important for management of pressures (i.e., reducing pressures in areas to help achieved GES) and for marine spatial planning; further data collection is needed, particularly in the south and east, to provide an even coverage across the Mediterranean. The current region-wide datasets of activities and pressures (from the EEA/ETC-ICM[21]) are at a 10km-by-10km grid resolution – for use in relation to seabed assessments, the data need to be prepared at a finer resolution;
    iii. Monitoring data on the state of the seabed – the traditional collection of direct observations of the seabed (e.g., through video and sampling) remains an important aspect of data collection programmes, providing a means to validate pressure data to assess seabed habitat condition. Monitoring programmes are costly and need to be focused on the needs of assessment and measures to ensure good value. To facilitate pan-regional assessments, the monitoring data need to be compatible between countries, following specified data standards; further data collection is needed, particularly in the south and east, to provide an even coverage across the Mediterranean;
    iv. Pressure-state interactions – there is continued need for study of pressure-state interactions, both at research level and through state assessments, to improve confidence in use of pressure data (such as a proxy for broad-scale state assessments);

[20] FR: But more often with a poor accuracy. At least it can provide a trend and a broad context in terms of impacting activities (already useful for management).
[21] Now ETC-BE (European Topic Centre on Biodiversity and Ecosystems).

v. Climate change – the effects of climate change on the seabed and its communities need to be better understood; of particular importance is assessment of the carbon storage capacity of marine habitats and the contribution this makes to mitigation of climate change effects; the importance of shallow vegetated habitats, such as *Posidonia oceanica* meadows, for blue carbon is often highlighted, but the carbon sequestration capacity of the much more extensive soft sediment habitats of the shelf zone and its disruption by physical disturbance pressures is ultimately a more important knowledge gap;
vi. Assessment methods – further work is needed to develop specific indicators (or test existing indicators available in other regions) for use with the monitoring data, and to bring the assessment methods to a fully operational level. Based on these methods, Contracting Parties need to agree threshold values to provide a clear means to assess the extent to which GES has been achieved;
vii. Assessment results – the availability of seabed assessment results, including visualisation of the extent of GES in each part of the region, provides an important output that demonstrates the work of the IMAP and Contracting Parties, stimulates improvements and helps direct actions towards achieving GES.

37. The present proposal aims to address some of these shortcomings, with a view to enabling a data-driven assessment of the three habitat types in the next MedQSR, scheduled for 2031.

4 Revision of the existing monitoring scale and further development of adequate assessment scales, assessment methodologies, and assessment criteria

4.1 Introduction

38. The development of monitoring and assessment methods for the three habitat types presented here forms part of the ongoing development of IMAP implementation for EO1, including monitoring and assessment methods for:
a. birds (UNEP/MAP, 2022b);
b. mammals (UNEP/MAP, 2021d; UNEP/MAP SPA/RAC, 2022);
c. turtles (UNEP/MAP, 2021e); and
d. non-indigenous species (UNEP/MAP, 2021f; UNEP/MAP, 2022a).

39. The Fact Sheets for CI1 and CI2 (**Annex I**), agreed in 2017, set out the overall approach to assessing each indicator, and are generally applicable to all habitat types under EO1. Conceptually the fact sheets appear to largely be sound, although they would benefit from some updating, particularly regarding:
a. The current specifications for indicator objectives, GES and targets;
b. The setting of baselines/reference states, reflecting natural variations in habitat characteristics across the region;
c. The definition of the extent of each habitat that should be in a good state (or the maximum extent that can be adversely affected) for the habitat to be in good environmental status (GES);
d. The definition of the geographical areas for assessment, to reflect biogeographic variation in each habitat (species composition);

e. The need to clarify the relationship to pressures and how pressure data could be used in an assessment process;
f. Specific application of the indicators to the three habitats being considered here;
g. A need to review the range of monitoring methods (guidelines) and resulting data with a view to use of the data in future MedQSR assessments undertaken in a region-wide process;
h. Assessment of the current state of implementation of monitoring by Contracting Parties, and the submission of data to the IMAP info system, to identify improvements needed over the next 6-year cycle of monitoring (ahead of the next QSR assessment process).

Recommendation:

The Fact Sheets for CI1 and CI2 should be updated, taking into account points raised in paragraph 39 and further development of CI1 and CI2 based on the present proposal.

40. Garrabou & Kipson (2023) analysed the status of monitoring and assessment elements for CI1 and CI2 across the Contracting Parties. Whilst there is considerable room for improvement in the implementation processes for CI1 and CI2, with some countries yet to start their monitoring for one or more of the habitat types, it is possible to identify key elements for each habitat type, based on the practices already in place in some Contracting Parties. **Annex II** summarises what is already being done for each habitat type.

4.2 Towards a harmonised region-wide approach

41. The following sections set out key elements of the monitoring and assessment processes that are needed to undertake a region-wide assessment of the status of each habitat type, based upon CI1 and CI2, in future MedQSRs. There is a focus on the data needed for undertaking a status assessment, the need for harmonised approaches based on compatible data and methods, and the need for data collection programmes in the coming years.

42. The characteristics of the three habitat types differ, necessitating some differences in how they are monitored and assessed. However, their overall assessment is within the general framework already agreed for CI1 and CI2 and there should remain as much commonality as possible to the monitoring and assessment elements used (as well as for any further habitat types included under EO1).

43. The range of possible monitoring methods currently described for each habitat type (UNEP/MAP, 2021g) leads to wide variation in the data being collected by Contracting Parties (**Annex IV** and **Table 8Erreur ! Source du renvoi introuvable.** shows the variety of parameters currently being monitored per habitat type) and ultimately makes it difficult or impossible to aggregate the data across the region or even within a subregion or assessment area, such that region-wide assessments are not possible. It is therefore recommended that Contracting Parties move towards providing more harmonised data that can be readily aggregated and analysed.

Recommendation:

Contracting Parties should undertake monitoring of the three habitats according to commonly agreed methods which yield data that can be readily aggregated for region-wide assessments of CI1 and CI2.

44. CI1 and CI2 are state indicators which, when used together, aim to assess key aspects of benthic habitat status, i.e. the distribution and extent of the habitat (how much has been lost) and its condition (how much is in a good state). The current monitoring methods and data standards also focus on the state of the habitats. Monitoring habitat state alone, particularly aspects related to habitat condition, will reveal that the habitat (at each monitoring site) changes over time, because the species composition varies over time and the abundance and distribution of its key species will also vary with time. This variation in state over time may be related to:

a. natural variation in the ecosystem (e.g. normal processes of recruitment, growth and mortality of species within communities), and/or
b. changes in state due to the effects of anthropogenic pressures (deterioration) or management actions which reduce or remove those pressures (recovery).

45. Consequently, in the absence of contextual information, particularly about the nature and extent of pressures, it will be intrinsically difficult to interpret any changes apparent in the state-based monitoring data. It will be possible to document change and variation, but not to attribute it to natural variation or to anthropogenic pressures or management actions. This limitation in the power of the monitoring data may be further exacerbated by possible uncertainties in the quality and consistency of monitoring over time and between countries, particularly if the monitoring is undertaken infrequently and with changes in personnel between monitoring events.

46. Careful design of monitoring programmes is needed to help overcome such limitations as far as possible, including by:

a. Providing clear definitions of the monitoring data needed and how it will be used in assessments;
b. Reducing the complexity of monitoring (e.g. the variety of techniques used), as far as possible, so that it can be undertaken consistently across all countries;
c. Maintaining a technical capacity in each country which provides continuity of expertise throughout the assessment period, even though all sites and habitat types are unlikely to be monitored every year;
d. Where possible, automating the collection and/or analysis of the data to reduce inter-personal variation in the data;
e. Collecting contextual data on the distribution and intensity/frequency/duration of relevant anthropogenic activities and their pressures, both at monitoring sites and more broadly across each country, according to standardised methods;
f. Collecting information on management actions introduced to reduce or eliminate particular pressures on the habitat/area being monitored.

47. The data collected need to be used to assess changes in the state of the habitats, including whether they are degraded due to anthropogenic pressures, and whether they are recovering following management actions which reduce or remove pressures; from this follows the importance of monitoring aspects of each habitat that are affected by relevant pressures, thereby focusing monitoring efforts on the most relevant parameters (**Table 4**).

***Table 4**. Links between parameters for monitoring Common Indicators CI1 and CI2 and associated pressures. Light blue cells indicate key pressure-state interactions for focused monitoring.*

Common Indicator	Parameter	Links to pressures
CI1 Habitat distribution/ extent	Habitat distribution - the three habitat types are widely distributed across the region and significant changes are only likely due to major oceanographic changes.	Climate change, particularly changes in sea temperature for habitat-forming species / anomalies of the summer thermocline; possibly increased ocean acidification.
	Habitat extent/loss – loss of the spatial extent of the habitat is a far more likely aspect of CI1.	Physical loss caused by installation of infrastructures, fish farms, dredging of the seabed, bottom fishing, anchoring.
	Upper and lower depth distribution – changes may occur due to water quality issues that lead to increased turbidity and/or reduced transparency – this can affect the upper and/or lower limit of growth of vegetation (***Posidonia***, less likely for maërl as it occurs more offshore).	Increased coastal run-off (sediment from rivers); land-based pollution or nutrient enrichment. Physical disturbance by bottom trawling (Maerl, possibly *Posidonia*)
	Distribution pattern – coastal run-off, pollution or nutrient enrichment (eutrophication) could lead, in severe cases, to significant loss of habitat in affected areas, providing gaps in the natural distribution pattern of the habitat.	Severe cases of coastal run-off, land-based pollution or nutrient enrichment (e.g. sewage disposal, fish farms).
CI2 Habitat condition	Habitat structure – both ***Posidonia*** and **maërl** species are key structuring species within their habitats, as are bioconstructors and erect species within Coralligenous (e.g. gorgonians, scleractinians, large sponges, Fucales). Their density and distribution within the habitat are essential aspects contributing to the overall health of the habitat.	Physical disturbance caused by bottom fishing, the construction phase of new infrastructures, dredging of the seabed, anchoring and mooring chains, and sediment plumes from such activities. 'Pollution' caused by increased coastal run-off (sediment from rivers), land-based pollution or nutrient enrichment. Effects of desalination plants (brine, hot water)
	Condition of megafauna in **coralligenous** habitats – individuals may be damaged by physical abrasion or litter entanglement (e.g. from ghost fishing nets).	Litter, bottom-contacting fishing gear (including static gear), anchoring and mooring chains, divers.
	Species composition, abundance and diversity – these parameters reflect the overall character and quality of each habitat type. Changes to these parameters may be due to natural dynamics and to various or multiple pressures, often making it difficult to interpret possible causes of change.	Multiple pressures can affect overall species diversity: physical disturbance and the 'pollution' pressures, non-indigenous species.
	Habitat functioning – amount of carbon sequestrated and sequestration rates. Sequestration into marine vegetation (*Posidonia*) and sediments (maërl) plays an important role in overall ecosystem functioning and climate control[22].	Physical disturbance caused by bottom fishing, the construction phase for new infrastructures, dredging of the seabed, anchoring and mooring chains.

[22] Maërl and rhodolith beds may be a source rather than a carbon sink. Dead rhodoliths in the sediment act as a very long-term carbon stock (that should not be disturbed).

Common Indicator	Parameter	Links to pressures
	Habitat structure and function - many other aspects of habitat condition are possible to monitor[23], with varying effects from one or more pressures. Improvements in scientific understanding and emerging monitoring techniques may show merit in selecting other parameters to monitor.	

4.3 State/impact monitoring in the context of pressures

48. Knowledge of pressures at the monitoring sites and across each country provides a basis for understanding possible change in the state of the monitored habitats, and ultimately links to management actions that would relieve pressures on the habitats and allow for their recovery towards good status.

49. Measuring pressures in the field over large areas (nationally) is challenging, particularly when considering the wide range of possible pressures (physical, biological, chemical). Monitoring the activities which generate the main pressures affecting *Posidonia*, Coralligenous and Maërl provides a more achievable approach, particularly if focused on the monitored sites.

50. In the data standards B1, B2 and B3 there is very limited allowance for reporting of pressures at the monitoring sites:

a. B1 Coralligenous (Tab: DebType) includes fields to report debris (litter) type and abundance;
b. B2 Maërl (Tab: DebType) includes fields to report debris (litter) type and abundance[24], [25];
c. B3 *Posidonia* (Tab: Site) includes text fields (non-quantitative) for reporting Artificialisation, Anthropogenic Action and Pollution;
d. All these fields are non-mandatory.

51. The reporting of human activities and related pressures needs to be significantly improved, including some degree of quantification, even if simply as the presence of activities/pressures in a grid cell-based report. The most appropriate way to report on activities and pressures needs further discussion, including how it links to similar data collection for other EOs. The proposal for EO6 on sea-floor integrity is of particular relevance here, because of its strong links to using pressure-based data (UNEP/MAP SPA/RAC, 2025). Note also that the pilot assessment of EO6 for the Adriatic Sea subregion (Connor et al., 2023) used the available region-wide pressure data from the EEA's European Topic Centre on Inland, Coastal and

[23] For example, recent evidence shows *Posidonia* can be impaired by artificial light (Dalla Carbonare et al., 2023) and human-generated underwater noise (Sole et al., 2021).
[24] ES: Under the MSFD monitoring programme, Spain is obtaining abundance (and density) of different types of litter and human activities indicators (fishing nets, etc.) from scuba-diving techniques in 50 metres transects in the infralittoral and 100 metres ROV transects in the circalittoral and bathyal. VMS data are analysed at a 5x5 km grid (1x1 km grid in some MPAs) in order to map fishing activities such as bottom trawling, long line, among others. % cover and biomass of some invasive species have been obtained in infralittoral and circalittoral bottoms, including some areas with coralligenous bottoms...see Rueda et al (2023).
[25] ES: Marine litter is being reported during the monitoring surveys, both the annual MEDITS surveys (bottom trawl) and the two European Marine Strategy Framework Directive surveys developed until now (beam trawl samples and submarine images from photogrammetric sledge). In any case, there are other important pressures, such as demersal fishing and aquaculture activities, for which data should also be also collected.

Marine Waters (ETC/ICM) (Korpinen et al., 2019). Key findings of this pilot study were that the pressure data need to be at a finer scale than the 10 km by 10 km grid data available from the ETC/ICM and that further data should be added, particularly for southern and eastern parts of the Mediterranean. In practice, the most relevant pressure data for EO1 monitoring data will be on physical loss and physical disturbances and much of this can readily be collected at fine scales (e.g. infrastructures mapped with 10 m or less accuracy). Data on disturbance of the seabed by bottom-contacting fishing gear is routinely collated as SAR (Swept Area Ratio) gridded data based on VMS (Vessel Monitoring System) signals: for use in assessing seabed habitats SAR data need to have a minimum resolution of 1 km by 1 km[26].

Recommendation:

Data on the distribution and intensity/frequency/extent of human activities and related pressures relevant to benthic habitats should be collected, using a standardised grid and methods, and at an appropriate resolution to support assessments under both EO1 and EO6. This should link to relevant data collection processes for other IMAP EOs and be done in association with similar processes by the ETC-BE and for EMODnet (human activities).

4.4 Assessment scales and areas

52. Assessments of whether GES and targets have been achieved, as needed for the periodic MedQSRs, for national purposes and to inform management actions, need to be made for specified areas within the Mediterranean Sea region. The scale used for assessment has a direct and marked influence on assessment outcomes (i.e., whether a habitat has achieved GES or not), due to the distribution and extent of impacts, which vary according to the situation in different parts of the Mediterranean. For example, a habitat may be deemed to be below GES in one (part of a) country, as it is subject to extensive pressures and impacts in this area but is considered to be in GES in another country where the impacts are less extensive. Also, if the habitat is assessed at the whole Mediterranean Sea scale its GES status could differ to that at national scale because of the overall extent of pressures and impacts across the region.

53. To date, assessment scales and areas for the Mediterranean region have not been formally agreed for either EO1 or EO6.

54. Assessments could be undertaken at a variety of scales, such as at the whole region scale or one of its four subregions. However, these are too large to be meaningful for management purposes, as actions needed to achieve GES and targets typically need to be taken at finer scales, such as at national or subnational level.

55. The assessment of habitats under the MSFD (Descriptor 6) is guided by the scale of assessment given in the GES Decision (EC, 2017) which is the 'subdivision of region or subregion, reflecting biogeographic differences in species composition of the broad habitat type (BHT)'. TG Seabed, the MSFD expert group on seabed habitats, provides guidance on defining assessment scales and areas in its MSFD Article 8 assessment guidance (EC, 2023a[27]). Further consideration of the issue of assessment scales and their effects on the outcomes of assessments

[26] See also Quemmerais-Amice et al (2020).
27 MSFD GD19, version 12-12-2023: further elaborated in TG Seabed's extended guidance (latest draft TG Seabed, 2024: SEABED_19-2024-04).

and for management[28] indicates the importance, within this biogeographic approach, of national (or sub-national)-level assessments (reporting) because responsibilities for taking management actions (if GES has not been achieved) would lie at national level[29].

56. Taking the above considerations into account, and with a view to undertaking region-wide assessments in the next MedQSR, a harmonised set of scales/areas was proposed for implementation of EO6 on sea-floor integrity (UNEP/MAP SPA/RAC, 2025; **Erreur ! Source du renvoi introuvable.**). This proposal has been considered by the CORMON Biodiversity working group, the SPA Focal Points and the EcAp Coordination Group during 2022-2024 (UNEP/MAP, 2023c; UNEP/MAP SPA/RAC, 2023a; 2023b; 2024). The rationale and data used to define the assessment areas are presented in UNEP/MAP SPA/RAC (2024).

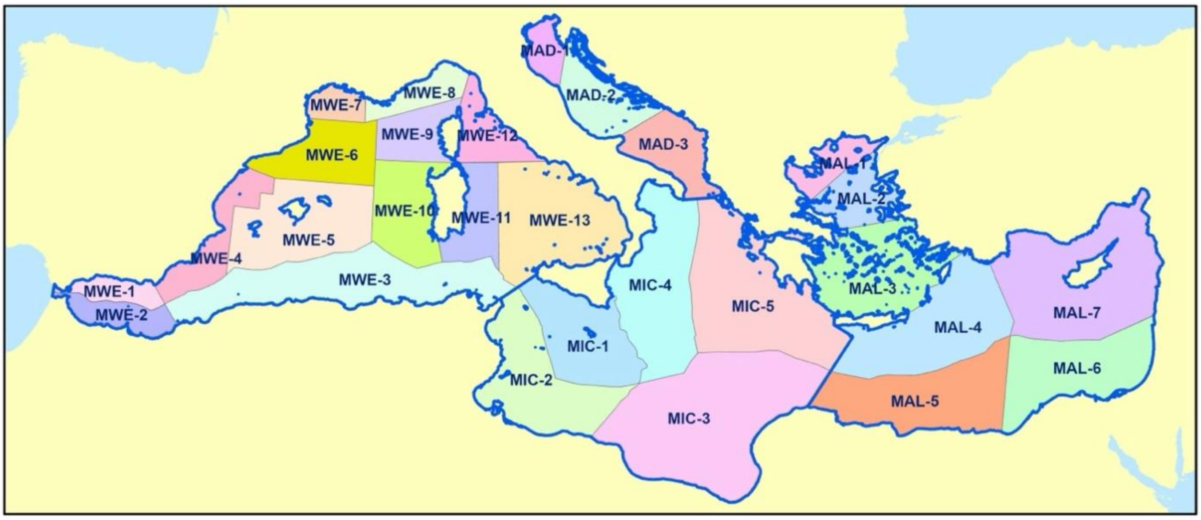


Figure 2. *Subdivisions proposed for EO6 application. Subdivisions are numbered within each subregion (blue lines) with codes: MWE-Western Mediterranean Sea; MAD-Adriatic Sea; MIC-Ionian Sea and the Central Mediterranean Sea; MAL-Aegean-Levantine Sea (UNEP/MAP SPA/RAC, 2025). This map is for assessment purposes only and shall not be considered as an official map representing marine borders. This map shall be used without prejudice to the agreements made between countries under international law in respect of their marine borders[30].*

57. The rationale for defining assessment areas at this scale (i.e. subdivisions of each subregion) is equally applicable to the specific habitat types addressed under EO1. Furthermore, use of these assessment areas under both EO1 and EO6 offers coherence and consistency of approach between the two EOs that address the seabed, harmonisation of assessment methods, easier reuse of common data (such as on pressures) and facilitates a common presentation of assessment results, understandable for policy and management purposes.

Recommendation:

EO1 assessments should use the same set of assessment areas as EO6, as shown in **Erreur ! Source du renvoi introuvable.**.

28 SEABED_12-2022-02
29 This should not preclude countries taking collective action, through regional or subregional cooperation, on activities which are transnational in character (e.g., some types of bottom fishing).
30 In cases where the boundaries of certain subdivisions are based on national marine borders and these borders are modified, such as through new agreements with neighbouring countries, the subdivision boundaries should be updated.

4.5 CI1 habitat distribution and extent

58. Baselines for distribution and extent are needed for all three habitat types, both to provide a basis for assessing CI1 and as a means to select appropriate sites for monitoring CI2.

59. Maps of the distribution of each habitat in the region are available, but these are likely to be incomplete and give only limited information on the extent of each habitat:

a. *Posidonia oceanica* meadows (Giakoumi et al. 2013; Telesca et al., 2015);
b. Maërl/Rhodolith beds (Martin et al. 2014; Basso et al, 2017);
c. Coralligenous (Martin et al. 2014).

60. The habitat monitoring guidelines (UNEP/MAP, 2021g) describe a range of possible mapping techniques and strategies for mapping which can be used to improve knowledge on the distribution and extent of each habitat type. Due to the potentially high costs of seabed mapping programmes at national level, it seems unlikely that such programmes would be undertaken for these three habitat types alone; however, full coverage seabed mapping (i.e. mapping of all habitats in an area or nationally) is a valuable pursuit, with long-term benefits for implementation of EO1 and EO6, marine spatial planning and general management of the marine environment.

61. As an intermediate approach between full-scale seabed mapping (for all habitat types or the three specified types here) and the current situation, it is recommended to build upon the existing published distribution maps by:

a. Adding data already available in each country, e.g. national maps of *Posidonia* in Mediterranean countries (Ruiz et al. 2015; Basso et al. 2017);
b. Collating published records of the habitats. The collation of available data could be modelled on the approach used to map the historic distribution and extent of European oyster beds (Thurston et al. 2024) which includes ways to account for uncertainties in both location and extent of the habitat;
c. Further developing the available habitat suitability models, using key physical and hydrographic parameters for each habitat type (e.g. Agnesi et al., 2020 for maërl) to compliment the availability of known occurrences of each habitat.

Recommendation:

Available data on the national distribution and extent of each habitat, and from published literature, using the approaches of Thurston et al. (2024) to accommodate uncertainties in the location and extent of the habitat, should be collated to prepare up-to-date maps of each habitat distribution and extent for the Mediterranean (compiling data in a common format to enable its aggregation across the region).

Supplement the data on known distribution of each habitat with further development of habitat suitability models, based on key physical and hydrographic parameters.

Use the habitat distribution maps and suitability models to inform implementation of CI1 and CI2 (e.g. selection of monitoring sites, linked to distribution of pressures, interpretation of monitoring data, management actions linked to specific pressures).

62. Habitat extent, or rather loss in habitat extent, is likely to be the most important parameter to assess under CI1. Given that it will be very difficult to assess the historic extent

of each habitat (due to lack of suitably accurate data on historic extent), it is recommended to follow a more practical approach:

a. If determining a baseline for habitat extent at a national level is unfeasible, establish a baseline through mapping the extent of the habitat at a selected range of sites through fine-scale mapping (see Section 4.6), taking into account documented losses in extent (e.g. from known activities) at these sites;
b. Monitor the extent of the habitat against the established baseline at these sites over time, to provide an evaluation of changes in extent since the baseline period;
c. Monitoring at selected sites (reference sites and sites subject to anthropogenic pressures) offers to more achievable approach to assessing CI1 than for all countries to cover their entire marine waters.
d. Monitoring changes in habitat extent at specified (monitoring) sites should be supplemented by knowledge of changes in extent across the country, assessment area and region, using information from the wider mapping (paragraph 61) and from ongoing monitoring of pressures (particularly habitat losses due to new infrastructure development).

Recommendation:

Where determining the extent of habitat, including loss of habitat extent, at national level for CI1 is not feasible, determine the baseline extent of each habitat (through fine-scale mapping) at the monitored sites and document known losses.

Monitor changes in habitat extent over time at monitoring sites to provide a proxy assessment of habitat loss at national level and per assessment area for CI1 assessment purposes. Supplement this assessment with known losses elsewhere in the country/assessment area (e.g. from infrastructure developments, published information).

63. This more practical approach to monitoring habitat extent would have an influence on the definition of GES and target values for CI1, because the approach uses a known (recent) baseline for assessing changes in habitat extent at selected sites, rather than the historical reference state across the whole country and thus does not account for historical losses or fully account for losses across the country/assessment area.

64. Assessment of the vertical distribution of the habitat (upper and lower depth limits) is closely linked to habitat extent but is likely to be influenced by pressures mostly relating to water quality. This parameter is most relevant for *Posidonia* meadows. It is relatively easy to monitor and is already monitored by several Contracting Parties.

4.6 Monitoring scale

65. Section 4.2 emphasises the importance of linking the state of each habitat to known pressures. The selection of monitoring sites (stations) for each habitat should therefore include:

a. sites which are known to be subject to one or more specific pressures and, for contrast,
b. sites which are, as far as possible, free from pressures. This latter consideration needs to exclude widespread pressures that can effectively be considered to occur everywhere (e.g. climate-induced hydrographic changes in temperature, salinity and acidity, diffuse pollution). Sites which are designated as marine protected areas (MPAs) may be used, provided they are actually free from relevant pressures.

c. a gradient in the intensity of the pressures should be selected, such that the sites overall range from no pressure through to high pressure.
d. data on activities and related pressures at monitored sites should be collected in order to better quantify the nature and scale of pressures.
e. awareness of the possible influences of particular pressures at each site will help in interpretation of the state-based monitoring data.

66. A minimum number of sites per habitat type should be selected. Sites should be distributed evenly across the habitat's geographic distribution in the region, taking account the specificities across the region (oligotrophy, turbidity and perhaps geomorphology). With a view to using the monitoring data in future region-wide QSRs, site selection should also take into account the proposed assessment areas (**Section 4.4, Erreur ! Source du renvoi introuvable.**), distributing sites across each assessment area to reflect the gradients in pressures. It is proposed that there should be at least five sites[31] for each habitat type in each assessment area, giving a minimum of 140 sites[32] per habitat type across the 28 assessment areas of the Mediterranean region. Countries may (continue to) monitor additional sites, as this will strengthen the data available for both national and regional purposes.

67. The periodicity and timing of monitoring needs to be specified within IMAP's 6-year timeframe (2024-2029) for collecting data for the MedQSR (with 2030-2031 scheduled for data analysis and preparation of the QSR).

68. It is likely that initial work is needed in some countries to collate activity and pressure data with a view to selecting suitable monitoring sites (section 4.6) and establishing locations for monitoring as well as setting a baseline for habitat extent at each site (paragraph 62). These aspects may already have been well considered in those countries where IMAP monitoring for EO1 is already underway (**Table 3**).

69. A minimum of two sampling events within the 6-year period would yield two datasets for comparison (and also allow comparison with previously collected monitoring data in countries where monitoring is already underway). These two events should ideally be 3 years apart (such as years 2 and 5, or years 3 and 6, taking account of the time needed to process the samples and submit data into the IMAP Info System ahead of its use for QSR analysis). Sampling only once within the 6-year period would give no data on habitat changes over the assessment period. Some countries may wish to sample more frequently, every two years or annually, to give greater understanding of the variation in character and condition of the habitats. For CI1, once a good baseline has been established at each site, it is probably adequate to assess changes in extent only once during the 6-year period, although assessment every 3 years is desirable[33].

70. To account for seasonal variation in habitat characteristics, monitoring events should be undertaken during the same specified time period across the region. Seasonal variation is likely to affect vegetated habitats (e.g. *Posidonia and* macroalgae in Coralligenous and

[31] ES: sometimes impacted and unimpacted sites are located far away and changes of the habitat may also be related to different environmental conditions.- impacted inshore habitats to pristine offshore-far away located habitats at similar depths. Important to know what each CP is able to do regarding number of sites and methods.
[32] The overall number of sites would be less if a habitat type does not occur in particular assessment areas (e.g. *Posidonia* is not present in Israel, Lebanon and Syria).
[33] FR: 3 years is ok and enough to monitor changes of the habitats according to management except for extreme events like mass mortality event of storms for example.

Maërl/rhodolith habitats) more, such that monitoring is best undertaken during the late spring to early autumn growing periods.

Recommendations:

A minimum of five sites should be monitored per habitat type in each of the 28 assessment areas. The sites selected within each assessment area should reflect a gradient in pressures from sites most affected by one or more pressures through to sites considered largely free of human activities causing pressures on the habitats. Contracting Parties sharing an assessment area should agree on the distribution of these sites across the assessment area.

Within the 6-year data collection period for an IMAP QSR, there should be a minimum of one monitoring event for CI1 (change in extent of habitat from baseline) and two monitoring events for CI2 (habitat condition) at each site.

Monitoring should be undertaken within the same season across all sites:
Coralligenous: May to August
Maërl: May to August
Posidonia: May to September

4.7 Assessment methods and criteria

71. The habitat monitoring guidelines (UNEP/MAP, 2021g) describe methods for collecting data on many aspects of habitat quality. This report advocates focusing monitoring effort on a fewer number of parameters, and especially those that can directly reflect the possible effects of anthropogenic pressures (**Table 4**). Some Contracting Parties may wish to (continue to) collect a wider range of data; such additional data are of scientific value and will inform ongoing assessments of habitat status. Assessment of CI1 and CI2 should involve use of several parameters and metrics/indices per Common Indicator as this offers a more robust way to assess habitat status (ICES, 2022).

72. Agreement on the format of the data submitted to the IMAP Info System and the methods for processing these data are needed, making a clear link back to the data collection (monitoring) processes and which data are most important to collect. It is envisaged that the data will be aggregated across countries to enable a region-wide assessment for the next QSR. Some types of data (e.g. species composition and abundance) can be processed via a number of metrics and indices, while other metrics/indices use data in more specific ways.

73. **Table 5** sets out a proposed minimum set of parameters to be collected for each habitat type and the metrics and indices that are to be used. This minimum specification should be followed by all Contracting Parties. Additional parameters that would provide an enhanced and more optimal assessment are also indicated in **Table 5**. Contracting Parties who are already collecting these (and other) additional parameters are encouraged to continue this level of monitoring, as this greater detail will enable a more ecosystem-based assessment and possible use of several metrics, as recommended by ICES (2022).

***Table 5**. Proposed parameters, metrics and indices for assessing CI1 and CI2 for the three habitat types at monitoring sites.*

Habitat/CI	Minimum protocol	Optimal protocol
B1 Coralligenous **CI1**	Habitat extent (km^2) Habitat loss (m^2) Extent (km^2) and proportion (%) of habitat loss across all monitored sites	Extent of habitat loss at assessment area/national level
B1 Coralligenous **CI2**	For MACS (Enrichetti et al., 2019): Extent of hard bottom (% rock and biogenic) Species richness of conspicuous megabenthic sessile and sedentary species Structuring species: count, height (cm) and density (no. of colonies/individuals m^{-2}) % sediment cover % of colonies with epibiosis, necrosis and entangled in lost fishing gears for all structuring anthozoans Marine litter (density m^{-2})	For EBQI[34] and other indices (Di Camillo et al., 2023): Typical species composition Condition of key species/groups: • Filter- and suspension feeders (cover and diversity) • Detritivores abundance • Related fish assemblage biomass (distinguishing piscivores, carnivores of invertebrates, planktivores) Sensitivity level
B2 Maërl **CI1**	Analysis of existing knowledge (scientific and grey literature) on the presence of maërl/rhodolith beds Habitat extent (km^2)[35] Habitat loss (m^2) Extent (km2) and proportion (%) of habitat loss across all monitored sites	Extent of habitat loss at assessment area/national level
B2 Maërl **CI2**	Index to be defined. Rhodolith/maërl (% cover live and dead) Rhodolith/maërl density	Index to be defined. Species composition: abundance and diversity (filter-feeders, carnivores, detritivores, etc.) including echinoderms Particulate organic matter cover Detritic litter cover Rhodolith size and shape
B3 *Posidonia* **CI1**	Habitat extent (km^2) Habitat loss (m^2) Upper and lower depth limit of meadow (to nearest 0.1m) at monitored sites Extent (km2) and proportion (%) of habitat loss across all monitored sites Change in vertical distribution of habitat (+ or – m) at monitored sites	Extent of habitat loss at assessment area/national level
B3 *Posidonia* **CI2**	For PREI (Gobert et al., 2009): Leaf surface Leaf biomass	For EBQI (Personnic et al., 2014): Growth rate of vertical rhizomes Meadow cover

[34] FR: From Ruitton et al. 2014 updated by Astruch et al. (under review). See also: https://www.researchgate.net/publication/325607434_Guide_methodologique_pour_l%27evaluation_ecosystemique_des_habitats_marins.

[35] ES: To estimate this parameter for RMBs, firstly it will be necessary to have the maps of the benthic biocenoses throughout the entire continental shelf. Currently, these maps are only available for certain (few) areas.

Habitat/CI	Minimum protocol	Optimal protocol
	Shoot density Lower limit depth and type Leaf epiphytes biomass For BiPO (Lopez y Royo et al., 2010) (same parameters as PREI but without sampling living material): Leaf surface Shoot density Lower limit depth and type For functional assessment: Sea urchin density	Biomass density and species diversity in all compartments: • Filter- and suspension feeder density • Sea urchin *Paracentrotus lividus* density • Related fish assemblage biomass (distinguishing piscivores, carnivores of invertebrates, planktivores) • *Pinna* spp. density (not only *Pinna nobilis* now that *P. rudis* occurrence is increasing)
All sites	Parameters related to water quality (sea temperature, salinity, turbidity, transparency)	

74. An adequate number of replicate samples need to be taken per site to account for fine-scale variability in the habitat. Coralligenous and Maërl habitats are highly variable, with significant spatial heterogeneity, so larger sample areas and more replicates are needed to account for this complexity. *Posidonia* meadows are typically more uniform in structure compared to Coralligenous or Maërl habitats, allowing for fewer replicates and smaller sample areas while still capturing the variability at each site. For Coralligenous and Maërl habitats, it is important to account for depth-related variability even when using horizontal transects, as some degree of depth influence may still exist.

75. It is important to standardise the methods and protocols as much as possible between SCUBA-diving and remotely-operated vehicle (ROV) methods of survey to ensure data comparability if both methods are used within the same monitoring programme. Use of ROVs is likely to be necessary in some parts of the Mediterranean, especially to monitor Coralligenous and Maerl habitat that is deeper than safe SCUBA-diving depths. ROVs are becoming more affordable (e.g. https://bluerobotics.com/store/rov/bluerov2/) and offer a practical technology for image sampling of Coralligenous and Maërl habitats in both shallow and deeper situations. Use of ROV may also allow a greater sampling area to be taken per site, thereby increasing the robustness of the data collected. Analysis of photographic imagery to identify species requires trained scientific expertise, which may not be readily available in all countries. Consideration could be given to provision of centralised services to undertake elements of the monitoring (e.g. field sampling, image analysis). Use of automated image analysis software is also likely to become more feasible.

76. The following are recommended minimum numbers of replicates per site:

a. Coralligenous[36] – For monitoring using SCUBA divers (infralittoral/upper-circalittoral zone), three areas of 4 m^2 located tens of metres apart should be sampled at each site. A

[36] ES: This methodology seems to come from traditional scuba diving monitoring. Small sampling areas (ca 1-2 m2) could be good for monitoring small species from the Coralligenous but maybe is not good for getting information on the large megafauna species, threatened species and pressures from the habitat. Large sampling areas (50 m² and larger areas) may be good for monitoring both the megafauna, some threatened rare species and the pressures. The use of the same method for infralittoral and circalittoral coralligenous habitats would be ideal, or at least to define one methodology for the infralittoral coralligenous habitats and another one for the circalittoral that are as similar as possible.

minimum of 10 replicate photographic samples of 0.25 m^2 each should be collected in each area, giving a total sampling surface area of 7.5 m^2 per site[37]. The photographic samples should be taken along a horizontal transect, so that variation due to depth or other physiographic parameters is avoided and it provides a better representativity of the site. For monitoring with ROVs (circalittoral zone), it is very important to have an appropriate site and area allocation strategy so that a significant number of replicates are taken (e.g. Di Stefano et al., 2024; Radicioli et al., 2022).

a. Maërl – At each site, a minimum of 10 replicate photographic samples (using 1 m^2 quadrats) should be collected in each of three distinct areas which are tens of meters apart, giving a total sampling surface area of 30 m^2 per site. The photographic samples should be taken along a horizontal transect, so that variation due to depth or other physiographic parameters is avoided.

b. *Posidonia* –At each site, a minimum of 10 independent replicate counts (using 20 cm × 20 cm quadrats) should be done in each of three distinct areas which are tens of meters apart. This total of 30 replicates per site is considered enough to catch the natural within-patch variability[38]. The samples should be taken at the same depth. For consistency across the region, sampling should be undertaken at 15 m depth, which corresponds to the intermediate depth of the meadow throughout much of the Mediterranean. If the meadow is shallower than 15 m (e.g. in the Gulf of Lyon and Alboran Sea), the sampling can occur at a shallower depth. Correspondence grids exist, for example, to interpretate the shoot density (Pergent-Martini and Pergent, 2010).

Recommendations:

The minimum set of parameters set out in **Table 5** should be monitored at each site, so that the data can be analysed according to the indices noted in the table. Contracting Parties may collect data on the additional parameters noted in the table to enable a more optimal ecosystem-based assessment with the indices indicated in the table.

A minimum number of replicates per monitoring site should be taken:

Coralligenous by scuba diving: 10 replicates (50 cm x 50 cm quadrats) in three areas per site (total of 30 replicates covering 7.5 m^2 per site).

Coralligenous by ROV: 10 replicates (100 cm x 100 cm quadrats) in three areas per site (total of 30 replicates covering 30 m^2 per site).

Maërl by ROV: 10 replicates (100 cm x 100 cm quadrats) in three areas per site (total of 30 replicates covering 30 m^2 per site).

Posidonia by scuba diving: for PREI and BiPo methods, 10 replicates (20 cm x 20 cm quadrats) in three areas per site (total of 30 replicates covering 1.2 m^2 per site). For enhanced assessments using the EBQI method, use quadrats of 40 cm x 40 cm to give a total sample area of 4.8 m^2. Sample at 15 m depth (or mid depth of the meadow if the meadow depth limit is shallower than 15 m).

[37] FR: The sampling should not be limited to quadrat frames (and photographs). A representative overview of a Coralligenous site needs several hundred m² and more. Along the transect, it's fine so it allows the sampling at a more suitable scale.

[38] FR: Using 20 x 20 quadrats involves more variability in shoot density and a potential overestimation compared to larger quadrats (40 x 40).

5 Development of baseline and threshold values

5.1 Baselines

5.1.1 CI1 Habitat distribution and extent

77. The definition of a baseline from which to assess changes in habitat distribution and extent can be centred around an historical baseline or a more recent baseline.

78. Using a historical baseline allows for the possibility to determine the 'natural' distribution and extent of a habitat and assess changes in these parameters over time. This approach can be severely limited by the availability of historic data, particularly data which are sufficiently accurate for making judgements on the degree of change over time.

79. A further consideration is the feasibility of recovering a habitat towards an historic baseline, because of the natural dynamics of marine ecosystems and how they may react to reduction or removal of anthropogenic pressures. It is therefore better to consider how a habitat might recover within the context of the 'prevailing physiographic, geographic and climatic conditions' (terminology of MSFD Descriptor 1) rather than to recover to a historic ecosystem state that is unlikely to be realised (TG Seabed, 2021).

80. The second approach is to set a baseline with a more recent time frame. This approach is intrinsically easier due to the greater availability of more recent data, although such data may not be evenly available across the region.

81. It has been common practice for EU countries to use the situation in 1992, when the EU Habitats Directive (HD) was adopted, to define the baseline state. This baseline year may be appropriate for EU Member States as the three habitat types considered here have been included within the scope of the Habitats Directive (*Posidonia* is a priority habitat; coralligenous can be included under 'reefs' and maërl can be included under 'sandbanks'). However, it is likely that the distribution and extent of the three habitats was not fully known in 1992, particularly for southern and eastern countries in the region (who are, anyway, not implementing the Habitats Directive).

82. For some countries it may only be feasible to establish a baseline for a more recent time period, such as the start of their IMAP monitoring programme for benthic habitats.

83. Whilst it is desirable to establish a common baseline across the whole region, limitations in the availability of data may make this unrealistic. It may help to supplement known and accurate data on a habitat's distribution and extent with less accurate historic evidence or modelled information on possible habitat occurrence (Section 4.4).

84. To help overcome these data deficiencies, and in the light of the proposed monitoring strategy (Section 4.6), the extent of the habitat at each monitoring site should be established (using suitable mapping techniques described in UNEP/MAP, 2021g) together with an assessment of the loss in extent due to definable activities (i.e. the footprint of infrastructure on the seabed and evidence of seabed damage from activities causing physical disturbance, e.g. bottom fishing, dredging, anchoring and mooring chains). The same survey methods would then be used to assess change in extent over time.

85. This more focused approach to assessing CI1 (i.e. at specific monitoring sites) would lead to an assessment of the extent of habitat loss in relation to a specified baseline year and

against an agreed threshold value (see Section 5.2), allowing an assessment of GES for CI1 at each site. The results should be put in the context of wider knowledge about the extent of each habitat and the activities and pressures that are leading to habitat loss.

Recommendation:

For assessment of CI1 a baseline for habitat extent should be established at each monitoring site, based on a detailed mapping of the sites (using a combination of suitable remote sensing and in situ techniques[39]). The baseline should account for known losses in habitat extent (such as from published literature) from before this initial mapping survey.

Overall assessment of CI1 should take into account known losses in habitat extent (such as from published literature) across the wider assessment area/country/region.

5.1.2 CI2 Condition of a habitat's typical species and communities

86. The baseline to be defined is commonly referred to as 'reference state', which can be considered as the state of the habitat when largely free of the influence of anthropogenic pressures. Deterioration in habitat quality from this reference state provides a mean to assess CI2, with a quality threshold value set which distinguishes a habitat (at a particular location) in a good state from one in a poor state (i.e. the habitat is 'impacted' or 'adversely affected'[40]) (section 5.2).

87. Defining a baseline for the condition of each habitat faces similar issues about the lack of historical data to the assessment of habitat distribution and loss. In addition, natural ecosystem dynamics are a major influence on habitat condition, with species composition and abundance constantly changing due to variations in reproductive success of species, predator-prey dynamics, evolving environmental conditions (sea temperature, currents, etc.)[41] and the influences of anthropogenic pressures.

88. Similarly to setting a baseline for habitat distribution and extent, it is best to assess reference state in relation to 'prevailing physiographic, geographic and climatic conditions' rather than to establish an historic reference state. The ongoing influences of the ecosystem will not allow recovery to such historic conditions, even though historic knowledge can be important in determining a suitable current baseline (e.g. knowledge of the historic presence of species in a habitat that have since been lost due to anthropogenic activities). The definition of prevailing conditions needs to focus on areas within the region which are largely free of anthropogenic pressures and account for variation in their characteristics across the region.

89. Defining reference state should therefore focus on the state of the habitat at sites which are largely free of pressures (see section 4.6 on site selection). The influences of widely dispersed pressures, such as pollution from contaminants and the presence of non-indigenous species, should be minimal at such sites. Ongoing monitoring and assessments will provide data

[39] DZ: Establish baseline data for seagrass distribution, extent and biomass, taking into account historical data to assess losses. Using remote sensing is essential. It is necessary to combine *in situ* observations and remote-sensing methods (acoustic and optics).

[40] MSFD uses the term 'adversely affected' for a habitat which is not in a good condition (at a particular location), while others may refer to this as 'environmental impact'. Under MSFD the boundary between a habitat in good condition and one in poor condition (i.e. it is adversely affected) is defined by a quality threshold value.

[41] FR: Ok but most important functional compartments of an ecosystem (engineer species, high level predators, primary producers, etc.) can be represented by characteristic species or group of species with a relatively more stable diversity over time.

on changes in habitat condition at these ‘reference’ sites, including the effects of natural ecosystem dynamics. To account for natural variation in both physical and biological characteristics of the habitat across the region, reference state needs to be defined specifically for each assessment area. The definition also needs to reflect the parameters and metrics being used to assess habitat condition (see section 4.7).

5.2 Threshold values[42]

90. The setting of a quality threshold value enables an assessment of the extent (proportion) of the habitat which is in a good state (above the threshold) and in a poor state (below the threshold) in each assessment area.

91. Quality threshold values may differ between assessment areas across the Mediterranean Sea region, due to local specificities in environmental conditions which naturally influence habitat features.

92. Quality threshold values should preferably be defined on the basis of large and representative datasets for the Mediterranean region.

93. This section should be further developed once there is further agreement on the parameters and metrics to be used for each habitat type, and after testing monitoring data from across the region in the chosen indices for each habitat, noting that some quality threshold values are already defined in the IMAP monitoring guidance (UNEP/MAP, 2021g).

5.3 Integration of CI1 and CI2 to assess GES

94. Under the MSFD, specific integration rules are used to assess whether a habitat is considered to be in GES in an assessment area (TG Seabed, 2022). A similar approach is proposed for EO6 on sea-floor integrity (UNEP/MAP SPA/RAC, 2024) and, for compatibility, should also be followed for habitats under EO1.

95. For CI1, a maximum extent of habitat loss in an assessment area can be set. The value adopted under the MSFD is a maximum 2% loss per MSFD broad habitat type (BHT) (European Commission, 2024)[43]. If the metrics used for CI1 do not enable assessment of total extent (and total loss) of the habitat, then an alternative method should be developed (such as using the extent of loss at the monitoring sites as a proxy for the entire habitat in the area).

96. For CI2, several metrics are proposed for assessing habitat quality and these vary by habitat type. An integration of the metrics will determine the extent of habitat at each monitored site that is considered to be in a good state, based on the quality threshold values set for each metric.

97. For MSFD implementation of criterion D6C5 (equivalent to CI2) the maximum extent (proportion) of a habitat that can be adversely affected (impacted) has been agreed as the ‘adverse effect extent threshold’ (European Commission, 2017, 2024). Under the MSFD, a

[42] ES: It is premature to discuss thresholds, when we don’t have the habitat mapping and much less values of CI1 and CI2 indicators. In any case, with regard to CI2, estimates of the percentage of habitat adversely affected could be proposed, as is done in the MSFD. It will be more difficult in the case of CI2 quality threshold, when we do not even know the GES.

[43] The Habitats Directive also defines % loss values, both within a 6-year assessment period and overall, as part of its criteria to assess Favourable Conservation Status (https://cdr.eionet.europa.eu/help/habitats_art17).

maximum of 25% of each habitat is allowed to be adversely affected; this value includes any habitat loss (as determined under criterion D6C4, equivalent to CI1).

98. Having this ‘adverse effect extent threshold’ means the habitat does not need to be in a good state across its entire distribution. Whilst a significant proportion of the habitat should be in a good state, this approach provides a balance between protection of the seabed and its continued use by human activities that may be degrading the seabed. By setting these extent threshold values (extent of loss and extent of adverse effects), a proportion of the habitat may be degraded or lost but the habitat overall can still be considered to be in GES, providing the extent of degradation remains within a specified limit (TG Seabed, 2022).

Recommendation:

Contracting Parties should set values for the maximum extent of habitat loss (for CI1) and habitat which is adversely affected per assessment area, as well as a quality threshold value (relevant for indices/indicators used) which distinguishes a habitat in good state from one in a poor state (for CI2).

Contracting Parties should consider whether the 2% loss and 25% adverse effect values adopted under the MSFD are appropriate for use under EO1 (and EO6).

Further work is needed on region-wide application of monitoring data into the indices to be used for assessment of CI2 in order to establish suitable quality threshold values (reflecting where appropriate the variation in environmental specificities across the region).

6 Summary of proposed monitoring and assessment elements

99. This report reviews a variety of key elements of the monitoring and assessment process associated with the three habitat types under EO1. The proposals are to be discussed and further developed with CORMON’s OWG on benthic habitats, with a view to refining the proposals presented here. On the basis of these discussions, it may be necessary to further refine some aspects of the monitoring and assessment elements in order to provide a clear specification for Contracting Parties to use going forward. This specification will help guide monitoring and data collection in the coming 6-year period leading up to use of the data in the next MedQSR, to be prepared by 2031.

100. A summary of proposals is set out in **Table 6**.

Table 6. *Overview of the main aspects of monitoring and assessment elements for CI1 and CI2 for the three habitat types Posidonia, coralligenous and maërl.*

Element	CI1 & CI2
Habitat types	Define more clearly each of the habitat types, including specification of which EUNIS/BC subtypes are to be considered, and the most important pressures they face
Monitoring scale: number of sites	A minimum of five sites per habitat type per assessment area (28 subdivisions of Mediterranean region) Sites to be distributed across countries within each assessment area, and represent a gradient of conditions from impacted to non-impacted locations

Element	CI1 & CI2
	Assess state of habitats (extent and condition) at monitoring sites as a proxy for their state across the wider assessment areas and region (to make monitoring and assessment process feasible for all Contracting Parties)
Monitoring methods: parameters	Refer to **Table 5** for minimum and optimal set of parameters per habitat type.
State/impact monitoring in context of pressures	Sites selected for detailed monitoring should include a range of pressures or intensities of pressures, as well as sites which are 'unimpacted'. Pressures (and related activities) should be reported at monitoring sites and across each country (linked to EO6), assigning data to a standardised grid system.
Assessment scale	Use same set of assessment areas (28 subdivisions of the 4 Mediterranean subregions) as proposed for EO6.
Assessment methods	Use several indicators to represent differing aspects of habitat distribution and extent (CI1) and structure and function (CI2), as given in **Table 5**. The indicators need testing with data from multiple CPs to help define suitable thresholds and ensure comparability of results across the region.
Data standards	Simplify data standards to facilitate data submission and aggregation for analyses.
Baselines	Use unimpacted sites to establish the current extent and state of each habitat type in reference state (under prevailing physiographic, geographic, climatic and environmental conditions).
Quality threshold	Re-evaluate threshold once sufficient data are available to set fully meaningful threshold for the assessment area/subregion and habitat type. Ensure equivalent level of quality across assessment areas, habitats, indicators and pressures.
Extent thresholds	Set thresholds for the maximum extent of habitat loss (for CI1) and habitat which is adversely affected (for CI2) that is permitted per habitat in each assessment area.
Progress with monitoring and assessment processes	Contracting Parties should update their monitoring programmes, if necessary, based on general agreements for monitoring and assessment elements. SPA/RAC should evaluate progress in implementation of the monitoring programmes, say at a mid-point in the 6-year data collection phase. This evaluation should include the state of data submissions to the IMAP Info System and undertaking a trial region-wide assessment. Outcomes should guide further implementation of the programmes in the lead up to the next MedQSR assessment.

7 Recommendations

101. A preliminary set of recommendations is given below:

a. Further harmonisation of the methods used by Contracting Parties is needed to ensure resulting data are comparable and support region-wide assessments of habitat status.

b. A minimum set of parameters should be monitored in all countries, although some countries may wish to monitor additional parameters. The parameters need, as far as possible, to relate to changes caused by pressures.

c. Use of data in indicators needs to distinguish change in habitat quality compared with natural variability. Monitoring at least two parameters/indicators offers the ability to assess different aspects of habitat health. The nature of the parameter is less important than its reproducibility, reliability and the precision of the method used for its acquisition.

d. Support may be necessary in some countries to develop or modify their monitoring programmes. This support may be needed to establish a monitoring strategy, to identify suitable sites and for the initial set up of each monitoring site (e.g. transect and site marking). Such support could involve experts in the overall habitat monitoring and assessment process, as well as those with specific knowledge of each habitat type[44]. There should be emphasis in establishing the monitoring in a consistent manner across countries, so as to ensure the data collected are harmonised and usable in subsequent region-wide assessments.
e. Relate state to pressures – monitoring state alone, in the absence of any understanding of pressures upon each habitat, will likely reveal changes in habitat extent and condition, perhaps deterioration in one or both, but without giving indication of possible causes;
f. There is a continued need for scientific research into the relationship between pressures and their effects on the marine ecosystem, including benthic habitats, described where possible in quantitative ways which are applicable to habitat status assessments in the Mediterranean Sea region.
g. A mapping of pressures should be initiated. For physical damage and loss, this should build upon the datasets already available from the ETC/ICM (Korpinen et al. 2019) and link to the implementation of EO6. The resolution of the data should increase from 10 km by 10 km grid to at least 5 km by 5 km and preferably to 1 km by 1 km (noting that some source data e.g. for aggregates, oil and gas installations and anchoring, can be provided at even higher resolution and summarised to a 1 km grid). Mapping of biological and chemical pressures should use the same gridded approach (to allow cumulative pressure assessments) and draw upon data collected in implementing the other IMAP Ecological Objectives.
h. CI1 – need to adopt a minimum resolution for mapping distribution, which accommodates historic data (with imprecise location data) and acknowledges some countries may not have resources to undertaken detailed surveys. Suggest 1 km or 5 km grid[45].
i. CPs to collate historic data on distribution and extent, from available scientific literature, grey literature and other sources (e.g. anecdotal public information). This should build upon the latest available maps and could be organised centrally (e.g. a literature search, questionnaires to CPs) as a starting point.
j. CI1 – for extent of habitat, it seems unrealistic to expect full survey mapping to high resolution (1-5 m^2) at many sites. CPs to identify selected sites for monitoring extent, choosing carefully sites which are in low-pressure and high-pressure areas, so that possible effects of human activities (high pressure) and climate change (low pressure) can be monitored over time.
k. It is important to agree on a consistent format for submitting data to the IMAP information system, while defining clear methods for processing and analysing these data. A direct connection between the data collection and monitoring processes must be

[44] FR: For your information, in the frame of a LIFE project, Marha (Marine Habitat), we've conducted training of MPA managers to implement ecosystem-based indices. Some of them were able to implement by themselves a monitoring network on Posidonia meadow, Shallow rocky reefs and coralligenous. I've presented this work at the previous SPA/RAC Symposium in Genova back in 2022 (Astruch et al. 2022: ASTRUCH P., SCHOHN T., BELLONI B., CASSETTI O., CABRAL M., RUITTON S., MICHEZ N., MASINSKI I., HARTMANN V., BOUDOURESQUE C.F., 2022. Involving managers in the ecosystem-based assessment of marine habitats: a case study in French Catalonia. *Mediterranean Symposia on Marine Vegetation, Coralligenous, Dark Habitats, Non-Indigenous Species 19/23 September 2022, Genoa, Italy.*

[45] FR: The minimum resolution should be different according to the habitat. For example: 1 km or less could be OK for *Posidonia* and Coralligenous and 5 km for Maerl/Rhodoliths.

established to guarantee the efficiency and consistency of evaluations. In addition, it is imperative to determine the most significant types of data to be collected to ensure an accurate assessment of habitat status.

l. Mapping and monitoring strategies need to acknowledge the wide variation in resources and technical capabilities across the Mediterranean countries. Whilst the best practices can be highlighted and technological advances promoted, the realities of current capabilities suggest that a more modest level of ambition, that all countries could potentially achieve, should be aimed for to provide adequate data for the next MedQSR. This requires defining minimum standards to be achieved, commitment from CPs and the development of practical guides where necessary.

m. Additional support may be needed for some countries, such as help to establish suitable monitoring strategies and to identify monitoring sites within the context of varying pressures along the coast, initial mapping of monitoring sites (e.g, use of remote sensing to prepare fine-scale habitat maps), establishing monitoring sites (e.g. marking sites for repeat monitoring), and training in the agreed monitoring techniques. Wherever possible, the long-term sustainability of the habitat monitoring and assessment processes, and related management efforts, should be considered.

n. The development of monitoring and assessment elements described in this report is likely to need further work before it becomes fully operation (both at national level and for aggregating and analysing data for QSRs). This should be achieved through the continued involvement of the CORMON Biodiversity working group, particularly its Online Working Group on benthic habitats, helping to improve regional coordination and to strengthen synergies with other initiatives (e.g., MedPAN project for MPAs, EMODnet for seabed mapping).

102. Recommendations for data submission and management:

a. To facilitate use of the submitted data, file names for uploaded data should be standardised and include the following information: habitat code, Contracting Party 2-letter code, year covered by the data set, date of submission YYYYMMDD (e.g. B3_ES_2018_20220912.xlsx). Datasets should cover a single year of monitoring data.

b. The reasons for data being non-compliant need further investigation, to identify possible causes and improve the degree of compliance with the Data Standard, or potentially to modify the Data Standard; there should be a mechanism for data providers to verify and control the data and correct any potential errors before submission.

c. The data portal should only show datasets that have been submitted by Contracting Parties (Compliant and Non-Compliant data sets). Draft datasets should not be visible in the data portal or downloadable by third parties; they should only become visible/accessible once submitted by the Contracting Party.

d. It is possible that the current status of data submissions needs updating, with some data awaiting submission. Contracting Parties who have not yet submitted data[46], or who have submitted data only for particular years, should be encouraged to submit their monitoring data.

e. The periodicity and timeframe for data submission should be agreed (such as an annual data submission[47] with data covering a single year per file); periodic reminders to Contracting Parties to submit their data by a specified date may be helpful.

[46] ES: Submission data spreadsheet is very complex. It should be improved with the minimum fields required and if CPs want to submit more data then could be filled in an extended version of the spreadsheet. From our experience, the file structure to compile the data is too complicated. It should be simplified as much as possible.

[47] The periodicity of monitoring may differ to such an annual data submission process.

f. There needs to be a mechanism for Contracting Parties to report the absence of a particular habitat type in their marine waters.
g. There is a need to report historical data which may come from scientific and other sources. Such data are unlikely to fully comply with the Data Standard but are valuable in the context of assessing CI1 to help assess the distribution and extent of each habitat.
h. Once the assessment methods are agreed, it may be appropriate to develop modules for integrating the collected data to directly perform calculations and estimations, based on the raw data. This could facilitate countries in evaluating their own data each year, as well as contributing to the region-wide assessment process in the next QSR.
i. To enable aggregation for regional analysis of the data from multiple CPs, the separate datasets should be downloadable as a compiled dataset (e.g. in a relational database format).

Recommendations:

The recommendations for monitoring and assessment of benthic habitats outlined in paragraph 101 and elsewhere in this report should be taken forward within the scope of the IMAP, through SPA/RAC and the Contracting Parties. SPA/RAC should be requested to develop a clear plan with timelines on how to overcome the shortcomings identified in this report so that consistent and sufficient data will become available for the next Med QSR.

Recommendations on the IMAP Info System and data submission process, outlined in paragraph 102, should be followed up via Info/RAC.

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Annex I. Fact Sheets for Common Indicators CI1 and CI2

103. The Fact Sheets for Common Indicators CI1 and CI2, relevant for benthic habitats, were agreed in 2017 and are presented below (from UNEP(DEPI)/MED WG.444/6/Rev.1).

104. These Fact Sheets should be updated, where necessary, to reflect any agreements on monitoring and assessment elements from the present report. Preliminary amendments, marked in RED text, have been made following proposals by the OWG.

Common Indicator 1: Habitat distributional range (EO 1)

Indicator Title	***Common Indicator 1: Habitat distributional range***		
Relevant GES definition	**Related Operational Objective**	**Proposed Target(s)**	
The habitat is present in all its natural distributional range	Coastal and marine habitats are not being lost	**State**	**Pressure**
		The ratio Natural / Observed distributional range tends to 1	Decrease in the main human causes of the habitat decline
Rationale			
Justification for indicator selection The loss of habitat extent i.e. from infrastructure developments and by damage from physical activities such as trawling and possibly damage from pollution is an important factor to monitor and assess. The indicator is in principle applicable to all habitat types across the Mediterranean region and it is considered to be highly sensitive to physical pressures.			
Scientific References *List (author(s), year, Ref: journal, series, etc.) and url's* Andersen et al., 2013 ▪ Coggan, R., Populis, J., White, J., Sheehan, K., Fitzpatrick, F., Peil, S. (eds) (2007) Review of standards and protocols for seabed habitat mapping, 192pp. ▪ Coll, M., Piroddi, C., Albouy, C., Lasram, F.B.R., Cheung, W.W.L., et al. 2012. The Mediterranean Sea under siege: spatial overlap between marine biodiversity, cumulative threats and marine reserves. Glob. Ecol. Biogeogr. 21, 465–480. ▪ Giakoumi, S., Sini, M., Gerovasileiou, V., Mazor, T., Beher, J., et al. 2013. Ecoregion-based conservation planning in the Mediterranean: dealing with large-scale heterogeneity. PLoS ONE 8(10): e76449. doi:10.1371/journal.pone.0076449. ▪ Halpern, B.S., Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., et al., 2008. A global map of human impact on marine and coastal ecosystems. Science 319, 948–952. ▪ Halpern, B.S., Kappel, C.V., Selkoe, K.A., Micheli, F., Ebert, C.M., et al. 2009. Mapping cumulative human impacts to California current marine and coastal ecosystems. Conserv. Lett. 2, 138–148. • Halpern, B. S., Frazier, M., Afflerbach, J., Lowndes, J. S., Micheli, F., O'Hara, C., ... & Selkoe, K. A. (2019). Recent pace of change in human impact on the world's ocean. Scientific reports, 9(1), 11609. • Kappel, C.V., Halpern, B.S., Napoli, N., 2012. Mapping Cumulative Impacts of Human Activities on Marine and coastal ecosystems. Coastal and Marine Spatial Planning Research Report 03.NCEAS.12). Sea Plan, Boston. 109pp.			

Indicator Title	*Common Indicator 1: Habitat distributional range*

- Korpinen S., Meidinger M., Laamanen, M., 2013. Cumulative impacts on seabed habitats: An indicator.for assessments of Good Environmental Status. Mar. Poll. Bull., 74: 311–319.
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Policy Context and targets (other than IMAP)

Policy context description

The CORMON Biodiversity and Fisheries Meeting (Ankara, 26-27 July 2014) recommended that loss of habitat extent is typically more important/at higher risk, with loss of distributional range only secondarily at risk.

Indicator/Targets

This indicator is an area-related indicator, i.e. proportion of the area of habitats that are permanently or for a long-lasting period lost or subject to change in habitat-type due to anthropogenic pressures. As a target, the damaged or lost area per habitat type, especially for physically defined and not biogenic habitats could be set as to not exceed an acceptable percentage of the baseline value. As an example, this target was derived from OSPAR to not exceed 15% of the baseline value and was similarly proposed by HELCOM.

For habitats under protective regulations (such as those listed under the SPA/Biodiversity Protocol, EU Nature directives) the target could be set as habitat loss stable or decreasing and not greater than the baseline value. As an example, as regards the EU guidance for the assessment of conservation status under the Habitats Directive, Member States have generally adopted a 5% tolerance above the baseline to represent "stable". However, in some cases a more stringent <1% tolerance has been attached to the maintenance of habitat extent.

A list of the basic marine habitat types – at higher level – to be considered within this indicator is given below (supralittoral habitats are excluded). This list is based on the RAC/SPA Reference List of Marine and Coastal Habitat Types in the Mediterranean (see the RAC/SPA Reference List for a more detailed classification).

II.1 Mediolittoral muds, sandy muds and sands
II.2. Mediolittoral sands
II.3. Mediolittoral stones and pebbles
II.4. Mediolittoral hard beds and rocks
III.1. Infralittoral sandy muds, sands, gravels and rocks in euryhaline and eurythermal environment
III.2. Infralittoral fine sands with more or less mud
III.3. Infralittoral coarse sands with more or less mud
III.4. Infralittoral stones and pebbles
III.5. Infralittoral *Posidonia oceanica* meadows
III.6. Infralittoral biogenic and hard beds and rocks
IV.1. Circalittoral muds
IV.2. Circalittoral sands
IV.3. Circalittoral biogenic and hard beds and rocks
V.1. Bathyal muds
V.2. Bathyal sands
V.3. Bathyal biogenic and hard beds and rocks
VI.1 Abyssal muds

Indicator Title	***Common Indicator 1: Habitat distributional range***
Specific attention should be given to the types of marine habitats (defined at different levels) covered by the Updated Reference List of Marine Habitat Types for the Selection of Sites to be included in the National Inventories of Natural Sites of Conservation Interest in the Mediterranean (UNEP/MAP-RAC/SPA 2017) and EU Nature directives. Marine habitat types in *Annex* I of the EU Habitats Directive (92/43/EEC), based on MSFD Common Implementation Strategy (2012), with the exclusion of estuarine habitats, is given below: 1110 – Sandbanks which are slightly covered by sea water all the time 1120* – Posidonia beds (*Posidonion oceanicae*) 1140 – Mudflats and sandflats not covered by seawater at low tide 1160 – Large shallow inlets and bays 1170 – Reefs 1180 – Submarine structures made by leaking gasses 8330 – Submerged or partially submerged sea caves * *Priority habitats*	
Policy documents *List and url's* • SPA/Biodiversity Protocol (http://www.rac-spa.org/protocol) • EU Nature directives (http://ec.europa.eu/environment/nature/info/pubs/directivesen.htm) ▪ OSPAR (http://www.ospar.org/)	
Indicator analysis methods	
Indicator Definition This area-related indicator could be described as the proportion of the area of habitats that are permanently or for a long-lasting period lost or subject to change in habitat-type due to anthropogenic pressures, and is closely linked to condition elements (i.e., if a habitat condition is sufficiently poor and irrecoverable, it is lost).	
Methodology for indicator calculation Three options have been identified for the assessment of this indicator: 1. The use of condition indices and a representative sampling and assessment in a restricted number of areas with subsequent extrapolation into the larger area 2. Modelling habitats and mapping against impacts and spatial pressure intensity data. It may also be possible to combine options 1 and 2. 3. Direct monitoring of habitats	
Indicator units The parameter/metric for the assessment of this indicator is the surface area of lost habitat for each habitat type. It is suggested to largely use cumulative impact data derived from knowledge of anthropogenic pressures.	
List of Guidance documents and protocols available • RAC/SPA Protocol for the Posidonia meadows monitoring networks[48] - update • RAC/SPA Protocol for the monitoring of coralligenous community[49] - update	
Data Confidence and uncertainties	

[48] Pergent G., 2007. Protocol for the setting up of Posidonia meadows monitoring systems. «MedPosidonia» Programme / RAC/SPA - TOTAL Corporate Foundation for Biodiversity and the Sea; Memorandum of Understanding N°21/2007/RAC/SPA_MedPosidonia Nautilus-Okianos: 24p + Annexes.
[49] RAC/SPA - UNEP/MAP, 2014. Monitoring Protocol for Reefs - Coralligenous Community. By Garrabou J, Kipson S, Kaleb S, Kruzic P, Jaklin A, Zuljevic A, Rajkovic Z, Rodic P, Jelic K, and Zupan D. Ed. RAC/SPA - MedMPAnet Project, Tunis. 35 pages + annexes.

Indicator Title	***Common Indicator 1: Habitat distributional range***
The identification of habitat sites in marine areas away from the coast has to be based on more general geological, hydrological, geomorphological and biological data than is the case for coastal or terrestrial areas. Where the location of sub-littoral habitat types is not already known, they can be located in two steps using available data: (1) broad scale geophysical or oceanographic information is often available for large sea areas, and can be used as the first step in the selection of sites by helping to identify the location of potential habitats; (2) step two then involves focused information gathering or new surveys, directed to those specific areas where existing information indicates that a habitat type is present or is likely to be present. This approach is particularly useful for Contracting Parties with large sea areas and deep waters, where detailed biological information is likely to be sparsely distributed. Collation of data should involve examination of scientific archives and data from relevant academic, government, NGO, and industry stakeholders. This information can include historical charts of relevant seabed features and fishing grounds. Data regarding human activities causing habitat loss have been usually produced by projects requiring licensing procedures and Environmental Impact Assessments (e.g. wind farm constructions, sediment extraction, fish farms). Therefore, relevant data should be available to Contracting Parties. A range of activity data regarding habitat damage caused by other activities (e.g. fishing) is also available from various sources (e.g. VMS or log-book data for larger fishing vessels that undertake bottom trawling). On the basis of these data, it should then be decided on a case-by-case basis, applying a risk-based approach, where to focus monitoring/sampling efforts to validate, extrapolate or measure habitat area.	
Methodology for monitoring, temporal and spatial scope	
Available data sources *Sources and url's* UKSeaMap 2010 - predictive mapping of seabed habitats: http://jncc.defra.gov.uk/ukseamap EMODnet Seabed Habitats (EUSeaMap) project: http://jncc.defra.gov.uk/euseamap EMODnet Human Activities: http://www.emodnet.eu/human-activities Recent European projects have produced updated habitat lists and catalogues with habitat map resources (e.g. CoCoNet, NETMED, MAREA-Mediseh, MERCES).	
Spatial scope guidance and selection of monitoring stations Considering that the monitoring under IMAP should follow a risk-based approach, the reference sites to be monitored should be located in zones with infrastructure developments or significant physical activities having the potential to generate damages to the marine habitats (dredging, trawling activities, etc.). Possible damage from pollution should be also considered. For the marine areas located away from the coast, the identification of monitoring sites has to be based on general geological, hydrological, geomorphological and biological data. The monitoring programmes of each Contracting Party should cover the reference habitat in at least two monitoring areas: - low pressure area (e.g. marine protected area/Specially Protected Area of Mediterranean Importance) - high pressure area from human activity The monitoring sites should be selected among those which can showcase the relationship between environmental pressures and their main impacts on the marine environment.	
Temporal Scope guidance	

Indicator Title	***Common Indicator 1: Habitat distributional range***
Consistent scales and methods will be necessary for mapping a given habitat in a sub-region. The time of sampling should be synchronised for a sub-region so as to standardize the influence of seasonal, inter-annual or climate-related changes on results depending on the habitat type (yes for *Posidonia*, but not relevant for Coralligenous and Maërl). Intervals of 3-6 years are probably appropriate when non-invasive surveys (e.g. side scan sonar, video) or models (to be validated by optimized sampling) are used for mapping.	
Data analysis and assessment outputs	
Statistical analysis and basis for aggregation No statistical analyses are needed for this assessment.	
Expected assessments outputs *I.e. trend analysis, distribution maps etc, and methods used* In general terms, the following steps should be part of the indicator's assessment: • Generate maps of the marine habitats in each Contracting Party's marine areas; • Attribute a specific sensitivity to physical pressures to different habitat types; • Collate spatial and temporal pressure intensity data (e.g. VMS or log book data for fisheries, activity data from approved plans and projects); • If vulnerability is addressed in the first three points, deduce impacts from either (i) known pressure/impact relationships, using reference sites and risk-based monitoring of selected stations (link to condition indices), or (ii) mapping cumulative impact models (with ground-truthing); • If vulnerabilities are not addressed in first three points, derive measures of habitat extent; • Determine whether the target is reached (i.e. proportion of lost or damaged area, related to total area the habitat type, above which GES is not achieved).	
Known gaps and uncertainties in the Mediterranean Information sources on the distribution of habitats are substantially greater for the northern than the southern coasts of the Mediterranean Sea.	
Contacts and version Date	
Key contacts within UNEP for further information	

Version No	**Date**	**Author**
V.1	20/07/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

Common Indicator 2: Condition of the habitat's typical species and communities (EO 1)

Indicator Title	***Common indicator 2: Condition of the habitat's typical species and communities***	
Relevant GES definition	**Related Operational Objective**	**Proposed Target(s)**
The population size and density of the habitat-defining species, and species composition of the community, are within reference conditions ensuring the long-term maintenance of the habitat	Coastal and marine habitats are not being lost	**State:** - No human induced significant deviation of population abundance and density from reference conditions -The species composition shows a positive trend

Indicator Title	***Common indicator 2: Condition of the habitat's typical species and communities***	
		towards reference condition over an increasing proportion of the habitat (for recovering habitats)

Rationale
Justification for indicator selection The concept of "typical species" emerges from the conservation status of natural habitats to their long-term natural distribution, structure and functions, as well as to the long-term persistence of their typical species within the territory. Therefore, typical species composition should be near/close to natural conditions for their habitat to be considered in natural condition.
Scientific References *List (author(s), year, Ref: journal, series, etc.) and url's* • Pérès JM, Picard J (1964) Nouveau manuel de Bionomie benthique de la Mer Méditerranée. Recueil des Travaux de la Stations Marine d'Endoume, 47: 3-137. • Templado, J., Ballesteros, E., Galparsoro, I., Borja, A., Serrano, A., Marín, L., Brito, A., 2012. Inventario español de Hábitats y Especies Marinos. Guía Interpretativa: Inventario Español de Hábitats Marinos. Ministerio de Agricultura, Alimentación y Medio Ambiente. 229 pp. • UNEP/MAP-RAC/SPA, 2015. Handbook for interpreting types of marine habitat for the selection of sites to be included in the national inventories of natural sites of conservation interest. Bellan-Santini, D., Bellan, G., Bitar, G., Harmelin J-G., Pergent, G. Ed. RAC/SPA, Tunis. 168 pp. + Annexes (Orig. pub. 2002). • UNEP-MAP-RAC/SPA, 2019. Updated Reference List of Marine Habitat Types for the Selection of Sites to be included in the National Inventories of Natural Sites of Conservation Interest in the Mediterranean. Ed. RAC/SPA, Tunis.
Policy Context and targets (other than IMAP)
Policy context description Typical species have already been identified by several Contracting Parties for listed habitat types to fulfil the assessment requirements under the Habitats Directive. Additionally, the coastal area out to 1 nautical mile offshore has already been covered by these Contracting Parties under the Water Framework Directive[50]. Therefore, the indicator is available for considerable benthic habitats within these areas and is already covered by monitoring efforts and has been assessed using appropriate metrics. Soft-bottom benthic invertebrates and seagrasses[51] are traditionally used in the Mediterranean Sea for environmental quality assessment and several indices have already been widely applied by Mediterranean Contracting Parties, Member States of the EU and compared in the framework of the Mediterranean Geographical Intercalibration Group of the EU Water Framework Directive (MED GIG), while two indices have also been based on macroalgae[52] and compared in the framework of MED GIG. Already in 2009, the Meeting of UNEP/MAP MED POL experts on Biological Quality Elements (UNEP/DEPI/MED WG. 342/3) recommended the application of benthic indices developed and tested under the Water Framework Directive for use by all Contracting Parties, despite not assessing the habitats at ecosystem scale (but only a proxy of the water quality). Recent European projects have focused on MSFD indicators and monitoring aspects for various habitats (e.g. DEVOTES, PERSEUS,

[50] FR: I don't see the link between WFD and listing typical species.
[51] FR: Precise which index? I guess M-AMBI and PREI/BiPO? Then add the corresponding citations? Borja et al. ; Gobert et al., 2009; Lopez y Royo et al., 2010).
[52] FR: Which ones? Probably CARLIT? Ballesteros et al., 2007.

Indicator Title	***Common indicator 2: Condition of the habitat's typical species and communities***
IRIS-SES). To this end, the 2015 PERSEUS Project specific training course targeting Southern Mediterranean countries could be utilized.	
Indicator/Targets In order to assess the state/condition of a habitat (i.e. its typical species composition and their relative abundance, absence or particularly sensitive or fragile species or species providing a key function, size structure of species), the Contracting Parties need to define lists of typical and/or characteristic species (or groups of species) and to set targets to determine their presence. It is also important to compile typical species lists consistently per biogeographical region, to allow for the consistent assessment of state/condition. Typical species composition includes both macrozoobenthos and macrophytes, depending on the type of habitat (i.e. macrophytes do not occur in aphotic habitats). Long-lived species and species with high structuring or functional value for the community should preferably be included; however, the typical species list might also contain small, short-lived species if they characteristically occur in the habitat under natural conditions. The general target of this indicator is to reach a ratio of typical and/or characteristic species similar to baseline conditions as defined above, for all considered habitats. With regard to plankton communities, a recommended target might be: "Plankton community not significantly influenced by anthropogenic drivers". This target allows unmanageable climate change but triggers management action if linked to an anthropogenic pressure and could be used with all datasets across all Contracting Parties. Monitoring of important pelagic habitats should be considered in the future.	
Policy documents *List and url's* UNEP/DEPI/MED WG. 342/3 http://www.unepmap.org/index.php http://195.97.36.231/dbases/MEETING_DOCUMENTS/09WG342_3_eng.pdf EU Water Framework Directive (MED GIG) http://ec.europa.eu/environment/water/water-framework/index_en.html http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/10473/1/3010_08-volumecoast.pdf	
Indicator analysis methods	
Indicator Definition This indicator should be implemented as a state condition indicator, with respect to baseline conditions, by using a list of typical and/or characteristic species in the communities of different habitats per sub-region.	
Methodology for indicator calculation[53] The calculation of this indicator involves simple comparison of typical and/or characteristic species (or groups of species) per habitat and sub-region with respect to baseline conditions, for all considered communities. Within this process, an acceptable deviation from baseline conditions would need to be defined. This deviation might be implemented by setting a certain percentage value to define GES. However, for baseline setting, the use of current state might be inappropriate if the considered habitats actually underlie high human pressure and no reference sites are available. The definition of a reference state of Mediterranean Sea habitats may be	

[53] FR: I find it challenging to consider a similar approach for all habitats, particularly by considering typical species. Here, the functional aspects should be evoked: Characteristic species of the main functional compartments of the ecosystem (e.g., filter-feeders, detritivores, herbivores, primary producers…). This is more a common denominator to all habitats and fitting with the EcAp.

Indicator Title	***Common indicator 2: Condition of the habitat's typical species and communities***

problematic and the use of past state may be more appropriate[54]. This cut-off value has to be habitat-specific and regionally adapted in view of the natural variability of species composition by habitat type and bioregion.

The required methods and effort strongly depend on the habitat type (and selected species) to be addressed.

Detailed overviews presenting the basic guidelines and methodologies for the inventorying and monitoring of various Mediterranean key habitats (seagrass meadows, coralligenous and rhodolith beds and "dark habitats", i.e. marine caves and deep-sea assemblages) have been recently produced by UNEP/MAP-RAC/SPA in the framework of MedKeyHabitats project. Large attached epibenthic species on hard substrates are preferably monitored using optical, non-destructive methods, such as underwater-video while endobenthic communities are sampled using standardized grabs or corers, which are commonly used in marine monitoring programmes. Several specific benthic biotic indices have been developed and have become operational, in particular to fulfil MED GIG requirements. They are all well methodologically defined but the way to combine these parameters in sensitivity/tolerance classification or depending on structural, functional and physiological attributes is heterogeneous, depending on the issue (pressure type), habitat types or sub-region. Qualified personnel, in particular experienced taxonomists, are required for both field and laboratory work to guarantee quality in sampling accuracy, consistency of data over time, meaningful data analyses and interpretation of the results.

The following resources are usually required for the calculation of this indicator:

- Research vessels, suited to work from sublittoral to bathyal zones, depending on the sub-region;
- Scuba diving sampling to infralittoral and upper circalittoral (0-50 m depth)
- Adequate equipment (box core samplers, grabs, dredges, underwater camera systems, etc.) for sample collection from intertidal to bathyal zones;
- Laboratory infrastructure to analyse samples (e.g. microscopes, weighing scales).
- Qualified personnel for data processing, analysis and interpretation.
- Good taxonomy skills are essential for the adequate assessment of this indicator.

Indicator units

This indicator could be calculated as a ratio of typical and/or characteristic species for every habitat type with respect to baseline conditions for this sub-region. Within this process, an acceptable deviation from baseline conditions should be defined. This cut-off value has to be habitat-specific and regionally adapted in view of the natural variability of species composition by habitat type and bioregion. Furthermore, several specific well-defined benthic biotic indices have been developed and have become operational. The selection of the relevant parameters and the development of metrics strongly depend on the selected habitat.

List of Guidance documents and protocols available

[54] FR: Considering a past state as reference can be tricky knowing that the current climate change will impede habitats to turn back to past states. Reference to reach should be the appropriate state in terms of Ecosystem services expected (fish resources, primary production, carbon sink, etc.) which must be defined through management goals (different between each Mediterranean subregion).

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- Lepidochronology and phenology protocols for *Posidonia oceanica*[55]
- ISO 16665: 2014 Guidelines for quantitative sampling and sample processing of marine soft-bottom macrofauna (http://www.iso.org/iso/catalogue_detail.htm?csnumber=54846) These guidelines provide standard methodology for collection and processing of subtidal soft-bottom macrofaunal samples in marine waters, in particular:
  - the development of the sampling programme;
  - the requirements for sampling equipment;
  - sampling and sample treatment in the field;
  - sorting and species identification;
  - storage of collected and processed material.
- ISO 19493: 2007 Guidance for marine biological surveys of supralittoral, eulittoral and sublittoral hard substrate for environmental impact assessment and monitoring in coastal areas (http://www.iso.org/iso/cataloguedetail.htm?csnumber=39107): It covers:
  - the development of the sampling programme,
  - survey methods,
  - species identification,
  - storage of data and collected material

Data Confidence and uncertainties

For baseline setting of GES per habitat type, the use of current state might be inappropriate if the habitats actually underlie high human pressure and no reference sites are available. The use of past state may be more appropriate, as the definition of a reference state of Mediterranean Sea habitats may be problematic. In order to verify comparability and reproducibility, (a) descriptions of the followed methodology should be provided, and (b) biogeographic regions with common species compositions per habitat must be identified in advance.

Methodology for monitoring, temporal and spatial scope

Scientific literature

Sources and url's

The monitoring techniques depend on the species to monitor and the related habitat. Non-destructive optical methods are recommended for the monitoring of large benthic species such as epibenthic species on hard substrates, while endobenthic species can be monitored using standardized grabs, drill sampling or corers. As far as possible, monitoring activities should be non-invasive/non-destructive.

- UNEP/MAP-RAC/SPA, 2015. Guidelines for Standardization of Mapping and Monitoring Methods of Marine Magnoliophyta in the Mediterranean. Pergent-Martini, C., Ed., RAC/SPA publ., Tunis: 48 p. + Annexes.
- UNEP-MAP-RAC/SPA, 2015. Standard methods for inventorying and monitoring coralligenous and rhodoliths assemblages. Pergent, G., Agnesi, S., Antonioli, P.A., Babbini, L., Belbacha, S., Ben Mustapha, K., Bianchi, C.N, Bitar, G., Cocito, S., Deter, J., Garrabou, J., Harmelin, J-G., Hollon, F., Mo, G., Montefalcone, M., Morri, C., Parravicini, V., Peirano, A., Ramos-Espla, A., Relini, G., Sartoretto, S., Semroud, R., Tunesi, L., Verlaque, M. Ed. RAC/SPA, Tunis. 20 pp. + Annex.

[55] Pergent G., 2007. Protocol for the setting up of Posidonia meadows monitoring systems. «MedPosidonia» Programme / RAC/SPA - TOTAL Corporate Foundation for Biodiversity and the Sea; Memorandum of Understanding N°21/2007/RAC/SPAMedPosidonia Nautilus-Okianos: 24p + Annexes.

Indicator Title	***Common indicator 2: Condition of the habitat's typical species and communities***

- UNEP-MAP-RAC/SPA, 2017. Draft Guidelines for Inventorying and Monitoring Dark Habitats. Aguilar, R., Pilar, M., Gerovasileiou, V. and contributors. Ed. RAC/SPA, Tunis. in press.
- Zamboukas, N., Palialexis, A. (eds.), Duffek, A., Graveland, J., Giorgi, G., Hagebro, C., Hanke, G., Korpinen, S., Tasker, M., Tornero, V., Abaza, V., Battaglia, P., Caparis, M., Dekeling, R., Vegas, M. F., Haarich, M., Katsanevakis, S., Klein, H., Krzyminski, W., Laamanen, M., Jean, LG., Leppänen, J.-M., Urmas, L. 2014. Technical guidance on monitoring for the marine strategy framework directive. Luxembourg, European Union. 166 p. JRC Scientific and Policy Reports; 2014, 26499 EN.

Spatial scope guidance and selection of monitoring stations

This indicator is applicable in all regions provided that typical and/or characteristic species lists, including both macrozoobenthos and macrophytes, will be developed for every type of habitat, at a sub-regional scale (or bioregion within each sub-region). Benthic biotic indices are also conceptually applicable in all sub-regions but appropriate adjustments might be still needed to cover biogeographic heterogeneity.

Temporal Scope guidance

Natural variability in species composition in space and time must be considered for this indicator and the list of typical and/or characteristic species must be defined and updated every 6 years per habitat type in particular geographic areas. The ideal temporal scale for this indicator is once per year while the minimum required sampling frequency is at least twice per period of 6 years.

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

Data analysis for this indicator involved simple comparison of typical and/or characteristic species with respect to baseline conditions for the considered habitat in a given region. A number of tools and software have been developed for the calculation of benthic biotic indices.

Expected assessments outputs

Assessments outputs for this indicator include (1) a list of typical and/or characteristic species per habitat of a given region, recorded following a well-described methodology and/or values of the appropriate benthic biotic indices for the considered habitats and (2) comparison with baseline/past data to indicate trends in the habitat conditions/state.

Known gaps and uncertainties in the Mediterranean

Information about the typical and/or characteristic species of some habitats and their past state/conditions is often unavailable for southern and eastern sub-regions of the Mediterranean. The limited data availability may restrict the number of habitats that can be assessed with sufficient statistical confidence at present. Although benthic biotic indices are conceptually applicable in all sub-regions, adjustments might be required in order to cover biogeographic heterogeneity.

Contacts and version Date

Key contacts within UNEP for further information

Version No	**Date**	**Author**
V.1	20/07/2016	SPA/RAC
V.2	14/04/2017	SPA/RAC

Annex II. Summary of currently used monitoring and assessment elements for CI1 and CI2

105. Garrabou & Kipson (2023) provide an overview of the current state of implementation of CI1 and CI2. The situation for each of the three habitat types considered in this report is presented below as 'Habitat Templates', reproduced from Annex V in UNEP/MED WG.547/11. Some amendments to these templates by the OWG in early 2025 are shown in dark red text.

Posidonia oceanica meadow (MB2.54)

Short description of the habitat

106. This biogenic habitat is created by the ecosystem engineer species, the endemic seagrass *Posidonia oceanica*. It is the only Mediterranean seagrass able to build a ''matte'', a monumental construction resulting from horizontal and vertical growth of rhizomes with entangled roots and entrapped sediment (Boudouresque *et al*. 2006). Posidonia meadows occur between the sea surface and 40 m depth, depending on the water transparency, and can be commonly found on different types of substrate, from sandy bottoms to rocks. *P. oceanica* beds are considered the Mediterranean biodiversity hotspots providing crucial ecosystem services such as primary production, oxygen release, sediment retention and hydrodynamics attenuation as well as carbon fixation and sequestration. Moreover, they serve as nurseries for numerous marine species, including the ones of commercial interest (Vassallo *et al.* 2013 and references therein). Rare sexual reproduction and slow horizontal growth of rhizome edges prevent rapid recolonization of degraded or new forming beds. Pressures to this habitat include the impacts of boat anchoring, trawling, coastal development, turbidity, invasive species, eutrophication and pollution. Moreover, climate change poses an additional threat to this habitat through the impact of marine heatwaves, sea level rise and increased frequency of the extreme weather events (Gubbay *et al*. 2016).

Contracting parties (CPs) indicating IMAP monitoring activities in the habitat

107. Fourteen contracting parties namely Albania, Algeria, Croatia, Cyprus, Egypt, France, Greece, Italy, Malta, Montenegro, Slovenia, Spain, Tunisia and Türkiye.

General comment on the CI1 and CI2 IMAP implementation on the habitat

108. Related to CI1, 8 CPs have a clearly ongoing monitoring programme, 2 CPs are planning it and the current status of implementation is unknown for 5 CPs. Related to CI2, 11 CPs have a clearly ongoing monitoring programme whereas the status of implementation is unknown for 3 CPs. Considering that *Posidonia oceanica* cannot be assessed in 3 CPs (Israel, Lebanon and Syria) because it is not present there (Telesca *et al*. 2015), this habitat is among the most often monitored ones at the Mediterranean level.

Implementation features CI1

▪ Scales of Monitoring:

Scale	Range	Comments
Spatial	Not indicated	
Temporal	Mainly every 3 years[56]	

▪ Metrics:

109. Habitat area/extent

▪ Assessment criteria and thresholds:

110. The assessment criteria may be identified as the extent of loss of the habitat type, resulting from anthropogenic pressures /physical disturbance.

111. To date, no Contracting Party has established the maximum allowable extent of habitat lost or disturbed as a proportion of the total natural extent of this biogenic habitat type in the assessment area (which should take into account regional or sub-regional specificities).

▪ Baselines:

112. Operational habitat mapping baselines are available in almost all CPs monitoring Posidonia meadows (no evidence for Egypt). However, they are rarely completed at the national level but are available for certain locations/areas; sometimes also historical baseline is available (e.g. France, Italy, some areas in Tunisia). The EU Member states have the obligation to report on Posidonia habitat range and extent in the scope of the Habitat Directive, however the quality of data varies from extrapolations to detailed habitat mapping at the national level (e.g. in Slovenia).

Implementation features CI2

▪ Scales of Monitoring:

Scale	Range	Comments
Spatial	1-10 sites (7 CPs), 11-50 sites (3 CPs), 51-100 sites (1 CP - France)	Not defined for 3 CPs with ongoing or planned monitoring
Temporal	Every 2-3 years (7 CPs), every 1 year (2CPs), every 3-6 years (1 CP)	Not defined for 4 CPs with ongoing or planned monitoring

▪ Metrics:

Country	Metrics
Albania	modified POMI index; Population level descriptors (meadow characteristics): Depth of upper and lower limits, Shoot density, Meadow cover % living patches, Dead-matte cover %, Plagiotropic rhizomes; Individual level descriptors: Leaf morphometry (number and type of leaves, leaf width and length), Shoot foliar surface (length and width of leaves), Necrosis on leaves, State of the apex or Coefficient A % of broken leaves (without apex) per shoot, Foliar production, Rhizome production, Biomass of epiphytes
Algeria	distributional limits, density, percent cover, mean size, associated flora and fauna
Croatia	POMI — Posidonia oceanica Multivariate Index (POMI9: Shoot density, Leaves surface, percentage foliar necrosis, meadow cover, N content in epiphytes, sucrose content in rhizomes, δ 15N and δ 34S isotopic ratio in rhizomes, Pb content in rhizomes)

[56] EL: 3 years are usually too soon except for cases of abrupt loss. In Greece, we aim to assess the loss during the current cycle of the MSFD i.e., 5 years.

Country	Metrics
Cyprus	PREI — Posidonia oceanica Rapid Easy Index; Angiosperms Population abundance - coverage and shoot density, biomass, leaf surface area per shoot, epiphyte biomass,
Egypt	species composition, population abundance of selected species: population size (number of individuals), population density (number of individuals / unit area), breeding season, migration patterns, body size, age structure, sex ratio, fecundity and mortality of selected species
France	PREI — *Posidonia oceanica* Rapid Easy Index (Gobert *et al*. 2009; used in the frame of the Water Framework Directive): leaf surface, shoot density, mapping of the depth limit (typology of depth limit and condition of shoot), epiphyte biomass. EBQI - Ecosystem-based quality index (used in the frame of MPA management); Mapping of depth limit of the *P. oceanica* meadows (Typology of depth limit and condition of shoots). Shoot density, leaf biomass number of leaves per shoot Leaf surface Epiphytic cover on leaves Morphometry (length) of leaves Quantification of 13 *P. oceanica* components (EBQI; Personnic et al., 2014); certain parameters remain to be determined BIPO - Biotic index using *Posidonia oceanica* (Lopez y Royo *et al*., 2010) used in the frame of the MSFD): leaf surface, shoot density, mapping of the depth limit (typology of depth limit and condition of shoot).
Greece	Biotic index (Weighted *Posidonia oceanica* Index - WePOSI), Ecosystem-based indexes (e.g., EBQI), Synthetic indexes (e.g., CI, PSI, SI[57]). Metrics in different levels of biological organization (biogeochemical to community): Depth and Type of lower limit. %, Dead matte cover %, Plagiotropic Shoots %, Shoot characteristics (e.g., number of leaves per shoot, leaf length), Shoot biomass, Associated fauna and flora (e.g. Epiphytic biomass) incl. other seagrasses or invasive algae; Habitat extent/loss, Extent of adverse effects on the condition of a habitat. Abundance of habitat type, Habitat quality - ecological quality status.
Italy	PREI — *Posidonia oceanica* Rapid Easy Index; meadow composition, continuity, shoot density; % coverage alive Posidonia, matte mort, other seagrasses or invasive algae; flowering events, lepidochronological measures, shoot morphometry, biomass, sources of disturbances; at lower limit: depth and type of limit, % of plagiotropic shoots
Malta	PREI — *Posidonia oceanica* Rapid Easy Index
Montenegro	modified POMI; lower limit type, shoot density, coverage of live plants and dead matte, lower and upper limit depth
Slovenia	Shoot density, coverage
Spain	POMI — *Posidonia oceanica* Multivariate Index and Valencian CS; Shoot density (ABU) Meadow cover (ABU-REL) % Invasive species, opportunistic species (ABU-REL) Number of individuals of *Pinna nobilis* and other habitat-typical species such as echinoderms) (ABU) % N, % P, metals and isotopic nitrogen in biota (CONC-B-OT) Maximum depth of the upper and deep habitat boundaries (DIST-DEPTH) Position of upper and deep habitat boundaries; accurate and reliable mapping information available (EXT) Position of geographical distribution boundaries (DIST-R)
Tunisia	not indicated
Türkiye	Ecologic Evaluation Index (EEI), species richness, coverage, shoot density

[57] FR: Also the PREI is applied for WFD purpose (to check with Vasilis Gerakaris or Eugenia Apostolaki)

113. Synthesis of the metrics/descriptors used by different ecological indices to evaluate the status of the “seagrass” (*P. oceanica*) biological quality element may be found in an overview provided by UNEP-MAP (2020).

▪ Assessment criteria and thresholds

Assessment criteria	Thresholds					Comments
	HIGH	**GOOD**	**MODERATE**	**POOR**	**BAD**	
EQR derived from POMI	0.775–1	0.550–0.774	0.325–0.549	0.1-0.324	0-0.1	Romero *et al*. 2007, Benett *et al*. 2011
EQR derived from PREI	0.775-1	0.55-0.774	0.325-0.549	0.100-0.324	0-0.1	Gobert *et al*. 2009
EQR derived from EBQI[58]	≧7.5	≧6 - 7.5	≧ 4.5 - 6	≧ 3.5 - 4.5	<3.5	Personnic *et al*. 2014
EQR derived from Valencian CS	0.775-1	0.55-0.774	0.325-0.549	0.100-0.324	0-0.1	Fernandez-Torquemada *et al*. 2008
Posidonia shoot density (N shoots/m2)	> 750	749-500	499-250	249-50	< 50	Lipej *et al*. 2018
EQR derived from WePOSI	0.775-1	0.550-0.774	0.325-0.549	0.100-0.324	0-0.100	Gerakaris *et al*. 2021

▪ Baselines:

114. Except Egypt for which no information on availability of baselines could be retrieved, the operational baselines are available for all CPs with ongoing or planned monitoring of this habitat type. Occasionally, historical baselines are also available, e.g. for Italy, France and certain parts of Tunisia (e.g. Gulf of Gabes, De Gaillande 1970 cited in El Zrelli *et al*. 2020).

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[58] EL: EBQI values are not considered as EQR values.

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Coralligenous cliffs (MC1.51) & Coralligenous platforms (MC2.51)

Short description of the habitat

115. Coralligenous habitats are hard bottoms of biogenic origin dwelling in dim light conditions, mainly in the circalittoral zone between 20-200 m depth. The coralligenous is produced by the accumulation of calcareous encrusting algae and other macroinvertebrates that

consolidate the biogenic structures while the physical and biological erosion causes the partial destruction of the "coralligenous buildings". The result of these two opposite processes is always a very complex structure providing contrasted environmental conditions in terms of light, water movement, sedimentation rate and other. This complex habitat allows the development of several kinds of communities including those dominated by living algae (on the upper part of the concretions), suspension feeders (upper and lower part of the concretions, wall cavities, and overhangs of the build-up), borers (inside the concretions), and even soft-bottom fauna (in the sediment deposited in cavities and holes), finally a rich fish community and mobile invertebrates (Ballesteros 2006). In fact, the coralligenous habitats, with more than 1600 species, are considered one of the Mediterranean biodiversity hot spots. These habitats provide commercial fishing grounds for fish and Decapoda species, sources of bioactive compounds for the medical and industrial uses and areas for the development of recreational diving activities. Commercial trawling fisheries, climate change, invasive species, chemical pollution by organic matter and excess nutrients are the major threats identified for these habitats (Gubbay *et al*. 2016).

Contracting parties (CPs) indicating IMAP monitoring activities in the habitat

116. Twelve contracting parties namely Albania, Algeria, Croatia, Egypt, France, Italy, Lebanon, Montenegro, Morocco, Spain, Tunisia and Türkiye.

General comment on the CI1 and CI2 IMAP implementation on the habitat

117. Related to CI1, 3 CPs have a clearly ongoing monitoring programme for this habitat, 5 CPs are in the planning phase, whereas implementation status is currently unknown for 4 CPs. Related to CI2, 5 CPs have a clearly ongoing monitoring programme to assess this habitat, 5 CPs are in the planning phase, whereas implementation status is currently unknown for 2 CPs.

Implementation features CI1

▪ Scales of Monitoring:

Scale	Range	Comments
Spatial	1-10 sites (3 CPs)	Not defined for 75 % of CPs monitoring this habitat
Temporal	Every 3 years[59]	Not defined for 58 % of CPs monitoring this habitat

▪ Metrics:

118. Habitat area/extent

▪ Assessment criteria and thresholds:

119. The assessment criteria may be identified as the extent of loss of the habitat type, resulting from anthropogenic pressures /physical disturbance.

120. To date, no Contracting Party has established the maximum allowable extent of habitat lost or disturbed as a proportion of the total natural extent of this biogenic habitat type in the assessment area (which should take into account regional or subregional specificities).

[59] ES: In Spain we are generally getting data every 5-6 years under the MSFD.

▪ Baselines:

121. The existence of operational baselines on habitat extent in certain areas are indicated as available for 5 CPs (42%). Considering the EU Member states, the data on range and extent of coralligenous habitat are often not readily available due to their inclusion in a broad habitat type “1170 Reefs” and reported as such for the purpose of the EU Habitat Directive.

Implementation features CI2

▪ Scales of Monitoring:

Scale	Range	Comments
Spatial	1-10 sites (7 CPs), 101-250 sites (2 CPs - Italy & France), 11-50 sites (1 CP - initially planned in Croatia), 50-60 sites (Spain)	
Temporal	2-3 years (6 CPs), every year (2 CPs), every 4-5 years (2 CPs)	Not defined for 2 CPs

▪ Metrics:

Country	Metrics
Albania	Structural and functional parameters: Species/Categories composition/abundance (semi or quantitative data), Indicators on the degree of complexity of coralligenous habitats, Indicators on coralligenous functioning: bioeroders and bioconstructors, Qualitative, semi- and quantitative indicators on the impacts of different disturbances on coralligenous communities (e.g. presence of fishing nets, invasive species, sedimentation, high diving pressure)
Algeria	Typical or sensitive species biomass, population structure, density, volume, growth and mortality rate, occupation rate
Croatia	% of necrosis and epibiosis of gorgonians, % cover of sediment, % cover of the conspicuous taxa/morphological groups including invasive algae, alpha and beta diversity
Egypt	Species composition, population abundance of selected species: population size (number of individuals), population density (number of individuals /unit area), breeding season, migration patterns, body size, age structure, sex ratio, fecundity and mortality of selected species
France	Three-dimensional structure of the habitat; Abundance of macrofauna and megafauna species; Specific richness of macrofauna and megafauna; % Cover of sessile fauna[60]
Italy	Sediment characteristics, Species richness of macrofauna and megafauna; abundance, morphometry (hight), % of epibiosis, % of necrosis, vulnerability of structuring species (entanglement); Multi-parametric index Mesophotic Assemblages Conservation Status (MACS)
Lebanon	Relative abundance (three levels of semiquantitative value are used: 1 = rare, 2 = common and 3 = abundant), dominance or frequency, specific richness, diversity indices, equitability, Margalef index/nb. habitats, vulnerability, heritage value, aesthetic value, economic importance, rarity, naturalness index and environmental value
Montenegro	no. of megabenthic species, cover of basal layer, density of erect species, height of dominant erect species, % necrosis, and litter density; If identified, red coral presence and abundance; MAES index
Morocco	Recovery rates of typical species (in particular of *Paramuricea clavata*, *Corallium rubrum* and *Astroides calycularis*), bleaching events, biometry of Corallium rubrum

[60] FR: Dataset on EBQI at French Med scale should be available following LIFE Marha programme deliverables (Astruch et al., under review).

Country	Metrics
Spain[61]	Abundance (number of individuals for each megafauna taxa, generally >3cm; ABU) Relative abundance (ABU-REL) Depth (BATH) ~~Biomass (BIOM)~~ Spatial distribution (DIST-S) Sediment characteristics (HAB-STRUCT) Hydrography of the habitat (HYDRO) Species composition (SPP-C) ~~Size (SIZE-D)~~
Tunisia	Not indicated
Türkiye	Coverage of groups and species diversity indices, TUBI

122. For the list of descriptors/metrics used to calculate ecological indices mostly adopted in the regional/national monitoring programs to evaluate environmental quality of shallow (down to 40 m depth) and deep (40-120 m depth) coralligenous habitat consult UNEP MAP (2020; in particular Table 5 and 6).

▪ Assessment criteria and thresholds

Assessment criteria	Thresholds					Comments
EQR derived from:	HIGH	GOOD	MODERATE	POOR	BAD	
MACS	≥66	56 to 65	46 to 55	36 to 45	≤35	Enrichetti *et al.* 2019
CBQI	10 to 12	7 to 9	4 to 6	N/A	0 to 3	Ferrigno *et al.* 2017
MAES	N/A	15 to 18	10 to 14	N/A	6 to 9	Canovas-Molina et al. 2016
q-MAES	N/A	10 to 12	7 to 9	N/A	4 to 6	Canovas-Molina et al. 2016
INDEX-COR	≥ 80	60 to 80	40 to 60	20 to 40	< 20	Sartoretto et al. 2017
COARSE	N/A	2 to 3	1 to 2	N/A	≤ 1	Gatti et al. 2015
ESCA	≥ 0.8	0.6 to 0.8	0.4 to 0.6	0.2 to 0.4	< 0.2	Piazzi et al. 2017
ISLA	≥ 0.8	0.6 to 0.8	0.4 to 0.6	0.2 to 0.4	< 0.2	Montefalcone et al. 2017
CAI	0.75 to 1	0.60 to 0.75	0.40 to 0.60	0.25 to 0.40	0 to 0.25	Deter et al. 2012
Cor-EBQI	7.5 to 10	6 to 7.5	4.5 to 6	3.5 to 4.5	0 to 3.5	Ruitton et al., 2014; Astruch et al., under review

▪ Baselines:

123. The availability of operational baselines relevant to CI2 is indicated by 58% of CPs which are monitoring this habitat type.

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[61] ES: It is important to know in detail how other CPs are measuring these parameters and the pressures. Main pressures affecting the Coralligenous habitats in Spain could be linked to Long line-purse nets-traps activity, scuba diving, eutrophication, climate change and invasive species. We still have to get detailed and quantitative information on how are these pressures affecting the habitats (e.g. changes in the complexity?, in the species composition? in the growth of key-structuring species?) it is imperative to determine the most significant types of data to be collected to ensure an accurate assessment of habitat status. Develop a long-term financing plan to ensure the sustainability of habitat monitoring and management efforts beyond short-term funding, for example by setting up funds dedicated to the preservation of marine ecosystems.

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Coastal detritic bottoms with rhodoliths (MC3.52)

Short description of the habitat

124. 'Rhodolith beds' are sedimentary bottoms characterised by any morphology and species of unattached non-geniculate calcareous red algae (incompletely-coated grains excluded) with >10% of live cover. The name "maërl" refers to those rhodolith beds that are composed of non-nucleated, unattached growths of branching, twig-like coralline algae (Basso *et al*. 2016). Rhodolith beds occur in coarse clean sediments of gravels, clean sands and coastal detritic areas under the influence of bottom currents, which occur either on the open coast or in tide-swept channels of marine inlets (the latter often stony). In the Mediterranean, they may be found between 20-150 m depth and are characterised by different dominant species, probably in relation to biogeography and local environmental conditions. Rhodolith beds are known to be hot-spots of biodiversity, hosting a highly diverse invertebrate community. Moreover, they are amongst the Mediterranean communities with the highest amounts and production rates of carbonates, and they provide nursery grounds for commercial fish and shellfish species. Commercial dredging, trawling fisheries, chemical pollution by organic matter and excess nutrients are the major threats identified for these habitats. Rhodolith-forming algae are likely to be also affected by the ongoing global warming and ocean acidification (Gubbay *et al*. 2016).

Contracting parties (CPs) indicating IMAP monitoring activities in the Habitat

125. Ten contracting parties namely Algeria, Croatia, France, Greece, Italy, Malta, Morocco, Spain, Tunisia and Türkiye). Among them, Türkiye is the only CP indicating monitoring programme also for infralittoral rhodolith beds.

General comment on the CI1 and CI2 IMAP implementation on the habitat

126. Related to CI1, 3 CPs have a clearly ongoing monitoring programme, 4 CPs are planning it and the status of implementation is unknown for 3 CPs. Related to CI2, 4 CPs have clearly ongoing monitoring programmes, 3 CPs are planning it and the status of implementation of indicated monitoring programmes is unknown for 3 CPs.

Implementation features CI1

▪ Scales of Monitoring:

Scale	Range	Comments
Spatial	1-10 sites (1 CP), 105 sites (Italy)	Not indicated for 80% of CPs
Temporal	3-6 years	Not indicated for 60% of CPs

▪ Metrics:

127. Habitat area/extent

128. Two adjacent rhodolith beds are considered separate if, at any point along their limits, a minimum distance of 200 m separates them (Peña and Barbara, 2008).

▪ Assessment criteria and thresholds:

129. The assessment criteria may be identified as the extent of loss of the habitat type, resulting from anthropogenic pressures /physical disturbance.

130. To date, no Contracting Party has established the maximum allowable extent of habitat lost or disturbed as a proportion of the total natural extent of this biogenic habitat type in the assessment area (which should take into account regional or sub-regional specificities).

▪ Baselines:

131. Some data are available on occurrence (e.g. Martin et al. 2014) but only 20% of CPs are indicating the existence of operational baselines on the extent of rhodolith beds.

Implementation features CI2

▪ Scales of Monitoring:

Scale	Range	Comments
Spatial	1-10 sites	Not defined for 50% of CPs with monitoring programme
Temporal	2-3 years	Not defined for 50% of CPs, 1 year for 2 CPs

Metrics:

Country	Metrics
Algeria	typical species' biomass, population structure, density, volume, growth and mortality rate, occupation rate
Croatia	to be determined
France	EBQI dedicated to Coastal Detrital Bottoms (CDB-EBQI; Astruch et al., 2023): rhodolith cover, soft macroalgae cover, filter-feeder cover, detritivores, carnivores, herbivores cover, particulate organic matter cover, etc.
Greece	Abundance of habitat types, ecological quality status, bottom trawling impact
Italy	% coverage of the living thalli (ratio alive/dead) and thickness of the living stratum, percentage of habitat affected by anthropogenic impacts, physico-chemical data (Temperature, salinity, transparency)
Malta	only habitat area, no other metrics indicated; data related to structure and function considered insufficient for the assessment
Morocco	not defined
Spain[62], [63]	Abundance (number of individuals; ABU) Relative abundance (ABU-REL) Depth (BATH) Biomass (BIOM) Spatial distribution (DIST-S)

[62] ES: Data required to estimate CI1, and the related parameters, is only available for certain areas. In a large proportion of the circalittoral bottoms, where RMBs may be found, there is no mapping of the benthic biocenosis. In the mapped areas, the impact of bottom trawling could be also assessed.

[63] ES: CI2, and some of its parameters (habitat structure, species composition and diversity), could be calculated in the mapped areas. We have some expertise on that (e.g. Barbera *et al.*, 2012, Farriols *et al.*, 2022). The potential impact of bottom trawling could be also assessed (Ordines *et al.*, 2017).

Country	Metrics
	Sediment characteristics (HAB-STRUCT) Hydrography of the habitat (HYDRO) Species composition (SPP-C) Size (SIZE-D)
Tunisia	not defined
Türkiye	Species richness, abundance, diversity index, TUBI, ALEX

▪ Assessment criteria and thresholds

132. At the moment, there are no ecological indices developed specifically to assess the status of the rhodolith beds. The CDB-EBQI aims to provide a method suitable to assess rhodolith bed ecological status (more at the scale of Coastal Detrital bottom habitat); at present, it is not yet implemented for a perennial monitoring programme. The live/dead rhodolith ratio, live rhodoliths percentage cover, associated with change in the composition of the macrobenthic community (calcareous algal engineers and associated taxa) and possibly in sedimentology may serve as the assessment criteria to reveal negative impacts on rhodolith beds (Basso *et al.* 2016). Currently, there are no defined GES class boundaries for these descriptors. In general, Basso *et al*. (2016) propose a threshold of >50% surface cover by dead rhodoliths and their fragments as a condition to identify a dead rhodolith bed (or its fossil counterpart).

▪ Baselines:

133. Very limited operational baselines exist for rhodolith beds and only 33% of CPs monitoring this habitat indicate their availability at the moment.

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Annex III. Preliminary correlation between the Barcelona Convention and EUNIS habitat classifications relating to *Posidonia*, Coralligenous and Maërl habitats

134. A preliminary cross-walk between the 2019 habitat classification of the Barcelona Convention (UNEP-MAP SPA/RAC, 2019; Montefalcone, et al., 2021) and the 2022 EUNIS classification (European Environment Agency, 2022), relating to the three habitat types considered in this report (*Posidonia*, Coralligenous, Maërl), is presented in **Table 7**. This cross-walk has been prepared on the basis of the limited descriptions available in the above-mentioned publications. Further information on the definition of each habitat type and input of Mediterranean habitat experts is needed to validate and improve this cross-walk.

***Table 7**. Preliminary cross-walk for three habitats (B1 Coralligenous, B2 Maërl, B3 Posidonia) between the Barcelona Convention (UNEP/MAP SPA/RAC 2019, Montefalcone et al., 2021) and EUNIS (2022) habitat classifications. Relevant level 2-4 habitats are included to aid understanding. Coloured cells indicate no corresponding habitat or the BC habitat code is different to the EUNIS code.*

Hab	Bar. Con. (2019)	EUNIS (2022)		
		Code	Name	Description
	INFRALITTORAL			
	MB1.5 Infralittoral rock	MB15	Mediterranean infralittoral rock	Rock and other hard substrates in the Mediterranean infralittoral zone. The lower limit depends on light penetration and is variable, from 35-40 m in very clear water to just a few metres in turbid water.
B1	*MB1.55 Coralligenous (enclave of circalittoral, see MC1.51)*			
	MB2.5 Infralittoral biogenic habitat	MB25	Mediterranean infralittoral biogenic habitat	Habitats formed by living organisms (eg calcareous algae, mussels, coralligenous bioconcretions, worm reefs) in the infralittoral zone of the Mediterranean
B3	*MB2.54 Posidonia oceanica meadows*	MB252	Biocenosis of *Posidonia oceanica*	*Posidonia oceanica* (Linnaeus) Delile is a marine angiosperm, endemic to the Mediterranean. It forms characteristic formations called 'meadows' between the surface and 30 to 40 meters down. The plant's structure shows an epigeous part, corresponding to foliar fascicles (average 30-80 cm in height) and an endogenous part, a veritable underwater terrace: the matte. This matte, composed of a tangle of rhizomes, roots and the sediment that fills in the interstices, and is specific to Posidonia oceanica meadows, presents a vertical growth that can reach 1 meter a century. These meadows, true underwater prairies, represent one of the main Mediterranean climaxes.
B3		MB2521	Ecomorphosis of striped *Posidonia oceanica* meadows	The *Posidonia oceanica* striped meadow develops between 0,5 and 3 meters down. It appears as fairly narrow (1 to 2 m wide) ribbons that are up to several dozen meters long, either rectilinear or winding but rarely ramified. The ribbons are separated by stretches of dead matte colonised by a mixed lawn made up of *Cymodocea nodosa* and *Caulerpa prolifera*. Cut into sections, the ribbons are asymmetrical with a little drop of matte on one side and a gentle slope on the other. The ribbons are dynamic structures, moving parallel to each other in the face of currents at a speed of some ten centimeters a year.

Hab	Bar. Con. (2019)	EUNIS (2022)		
		Code	**Name**	**Description**
B3	*MB2.545 Natural monuments/Ecomorphoses of Posidonia oceanica (fringing reef, barrier reef, atolls)*	MB2522	Ecomorphosis of "barrier-reef" *Posidonia oceanica* meadows	In the *Posidonia* beds of sheltered bays, the vertical growth of the rhizomes leads to a slow rise of the matte that enables the meadow to reach the surface; this structure is called a 'fringe reef'. Between the emerging front of the reef and the coast, conditions become unfavorable (great variations in salinity and temperature), and the meadow dies, leaving a sort of 'lagoon' cut off from the open sea by a 'barrier reef'. This lagoon is usually occupied by small magnoliophytes (*Cymodocea nodosa* and Zostera noltei) developing on dead matte. At the level of the barrier reef, which can be up to several meters wide, the leaves emerge and spread out on the surface of the water, particularly in spring and summer. The reef extends in a gentle slope out to sea, where it constitutes a meadow with a continuous base. The classic form of these reefs, with their front parallel to the shore, is the most widespread; however, more extensive particular structures (reef platforms) have been observed in Sicily and Corsica and many typologies have been suggested.
B3	*MB2.541 Posidonia oceanica meadow on rock*			
B3	*MB2.542 Posidonia oceanica meadow on matte*			
B3	*MB2.543 Posidonia oceanica meadow on sand, coarse or mixed sediment*			
B3	*MB2.544 Dead matte of Posidonia oceanica*	MB2523	Facies of dead "mattes" of *Posidonia oceanica* without much epiflora	This facies is characterised by a dead "mattes" of *Posidonia oceanica* without macro-epiflora.
B3	*MB2.546 Association of Posidonia oceanica with Cymodocea nodosa or Caulerpa spp.*	MB2524	Association with *Caulerpa prolifera* on *Posidonia* beds	This facies is characterised by the presence of the green alga *Caulerpa prolifera* in association with the *Posidonia oceanica* bed.
B3	*MB2.547 Association of Cymodocea nodosa or Caulerpa spp. with dead matte of Posidonia oceanica*			
	MB3.5 Infralittoral coarse sediment	MB35	Mediterranean infralittoral coarse sediment	Sedimentary habitats in the infralittoral near shore zone of the Mediteranean, typically extending from the extreme lower shore down to the lower limit for vascular plants. 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.
	MB3.51 Infralittoral coarse sediment mixed by waves	MB351	Biocenosis of Mediterranean coarse sands and fine gravels mixed by the waves	This habitat is found in coves which cut into the rocky coasts with more or less strong wave action; it goes no more than a few decimetres down. This habitat is very ill known. The population is dominated by the *Saccocirrus papillocercus* archiannelid and the *Lineus lacteus* nemertean, whose populations fluctuate strongly according to variations in the ambient factors, in particular the local hydrodynamics.
B2	*MB3.511 Association with maërl or rhodolithes (e.g. Lithothamnion spp., Neogoniolithon spp., Lithophyllum spp., Spongites fruticulosa)*	MB3511	Association with rhodolithes in coarse sands and fine gravels mixed by waves	This association occurs on coarse sands and fine gravels subjected to strong hydrodynamic action. Calcareous algae are attached to a small mineral or organic surface and then grow in successive layers to form rhodolithes of more or less nodulous shape and varying size.

Hab	Bar. Con. (2019)	EUNIS (2022)		
		Code	**Name**	**Description**
	MB3.52 Infralittoral coarse sediment under the influence of bottom currents	MB352	Biocenosis of Mediterranean coarse sands and fine gravels under the influence of bottom currents	This habitat is usually found in the Mediterranean between 3-4 meters and 20-25 meters down, but can, locally, go down to 70 meters. It lies thus on two, infra- and circalittoral, stages. It is frequent in channels between islands that are subject to frequent, violent currents, which constitute the main factor on which its existence depends. It is also found in the 'intermatte' channels dug out by the currents in the Posidonia meadows. This habitat, strictly subject to bottom currents, can change if the movement of the water is artificially or naturally modified, for example during long periods of calm weather. Its extension downwards, into the circalittoral stage, is linked to particularly intense hydrodynamic phenomena, either directly below rocky shelf-edge banks (the Banc des Blauquières) or in straits (the Bouches de Bonifacio). It may, in these conditions, present qualititative and quantitative modifications in its habitual population. Seasonal variations are marked by differences in the abundance, and the replacement, of species.
B2	*MB3.521 Association with maërl or rhodolithes (e.g. Lithothamnion spp., Neogoniolithon spp., Lithophyllum spp., Spongites fruticulosa)*	MB3521	Association with rhodolithes in coarse sands and fine gravels under the influence of bottom currents	This facies is characterised by the presence of small calcareous algae species exposed to strong bottom currents.
B2		MB3522	Association with maerl (= Association with *Lithothamnion corallioides* and *Phymatolithon calcareum*) on Mediterranean coarse sands and gravel	An association characterised by the presence of two small many-branched calcareous algae species, *Lithothamnion corallioides* and *Phymatolithon calcareum*, unattached on sediments made up of coarse sands and gravels with a high proportion of detritic elements. Given their many-branched shape, these Lithothamnia never constitute bioconstructions or rhodolithes. Small Rhodophyceae may be present as epiphytes on the Lithothamnia. A similar community can also be found as an association facies of the biocenosis of the coastal detritic bottom (MC3.523)
	CIRCALITTORAL			
	MC1.5 Circalittoral rock	MC15	Mediterranean circalittoral rock	Circalittoral rock is characterised by sciaphilic (shade-loving, that grow only in shady habitats) algae dominated communities (in contrast to photophilic algal communities of the infralittoral zone). The depth at which the circalittoral zone begins is directly dependent on the intensity of light reaching the seabed; in highly turbid conditions, the circalittoral zone may occur in shallow water.
B1	*MC1.51 Coralligenous [cliffs]*	MC151	Coralligenous biocenosis	The distribution of the coralligenous assemblage is subject to a combination of decisive biotic and abiotic factors. The main factors are light, movement of the water, temperature, the deposit of sediment and biological interactions. The coralligenous is found on rock faces or on rocks where calcareous algae can form biogenic constructions. Due to their sensitivity to light, these calcareous algae are restricted upwards by strong illumination and have an extension downwards, restricted by the quantity of luminous energy needed for their photosynthesis. The average depth of this habitat is between 30 and 90 meters. When the water is very clear, the coralligenous begins and ends very deep (60-130 meters), but when the water is turbid, it rises to shallower depths (10/15-40 meters). Such a rise may also be seen along dimly lit rock faces (north- facing, for example). The thermal scope of seasonal variation for this habitat is variable, and a certain tolerance of fluctuation in salinity has been observed; however, the sedimentation of fine particles is particularly harmful. The coralligenous can present various physionomical types between the two most typical forms on our coasts, which are: - the rock wall coralligenous which covers the rocky substrata beyond the photophilous algae, with more or less thick concretions and an abundance of big erect invertebrates, such as the *Paramuricea clavata, Eunicella spp., Leptogorgia sarmentosa* gorgonians and the Axinella

Hab	Bar. Con. (2019)	EUNIS (2022)		
		Code	Name	Description
				polypoides sponge - the coralligenous concretion forming biogenous clumps that can be several meters thick and cover big horizontal or non-horizontal surfaces. This coralligenous is a fully biogenic habitat. The essential species are the constructive *Corallinaceae* and *Peyssonneliaceae* species; the structure of these clumps is highly anfractuous, with many cavities of great richness (parts of the biocenosis of semi-dark caves).
B1	*MC1.51a Algal-dominated coralligenous*			
B1	*MC1.512a Association with Fucales or Laminariales*			
B1		MC1511	Association with *Cystoseira zosteroides*	This association is characterised by the high abundance of the brown alga *Cystoseira zosteroides*. The association can include in its higher levels both sciaphilous and photophilous species such as *Phyllariopsis brevipes, Arthrocladia villosa, Sporochnus pedunculatus, Cutleria chilosa, Dictyota dichotoma, Dictyopteris polypodioides, Halopteris filicina* and *Polysiphonia foeniculacea. Sciaphilous adnate* forms such as *Lithophyllum incrustans*, *Mesophyllum alternans* and *Peyssonnelia rosa-marina* represent a great part of the population. The association is mixed with the big erect invertebrate species of the coralligenous, like the *Axinella polypoides* sponge and the *Paramuricea clavata* and *Eunicella cavolini* gorgonians.
B1		MC1512	Association with *Cystoseira usneoides*	This association characterised by the brown alga *Cystoseira usneoides* is present in relatively deep rocky areas crossed by currents. Giaccone, who described the association, mentions the Laminaria ochroleuca, *Phyllariopsis purpurascens*, *Umbraulva dangeardii*, *Callophyllis laciniata* and *Phyllophora heredia* algae.
B1		MC1513	Association with *Cystoseira dubia*	This association characterised by the brown alga *Cystoseira dubia* occurs on hard substrata subject to weak hydrodynamics and relatively strong sedimentation. The association was described with *Nitophyllum tristomaticum*, *Peyssonnelia rubra*, *Ceramium bertholdii* and *Kallymenia patens*. According to Giaccone, only *C. dubia, N. tristomaticum* and *K. patens* are characteristic species. Three vegetal strata can be made out in the population: a raised stratum with various scattered *Cystoseira* (*C. spinosa, C. zosteroides*) and *Sargassum* (*S. acinarium, S. vulgare*); a very dense intermediary stratum with *C. dubia*, rich in epiphytes, and a crust-forming stratum of calcareous algae. A very rich fauna made up of bryozoans, molluscs and polychaetes lives in these different strata.
B1		MC1514	Association with *Cystoseira corniculata*	This association characterised by the brown alga *Cystoseira corniculata* occurs on hard substrata in the circalittoral zone.
B1		MC1515	Association with *Sargassum* spp.	This association characterised by the abundance of the brown algae *Sargassum spp*. occurs on hard substrata, simultaneously relatively deep and well-lit, in oligotrophic conditions.
B1	*MC1.513a Association with algae, except Fucales, Laminariales, Corallinales and Caulerpales*			
B1	*MC1.511a Association with encrusting Corallinales*			
B1		MC1516	Association with *Mesophyllum lichenoides*	This association characterised by the red alga *Mesophyllum lichenoides* occurs on hard substrata with strong deep currents.

Hab	Bar. Con. (2019)	EUNIS (2022)		
		Code	**Name**	**Description**
B1		MC1517	Association with *Lithophyllum stictaeforme* and *Halimeda tuna*	This association characterised by the red encrusting alga *Lithophyllum stictaeforme* (*Lithophyllum frondosum*) and the green alga Halimeda tuna is present on coralligenous horizontal formations developing within sedimentary beds affected by sea bottom currents.
B1		MC1518	Association with *Laminaria ochroleuca*	This association characterised by the brown alga *Laminaria ochroleuca* occurs on hard or detritic substrata composed by sparse rocks located at 30 - 100 metres depth in areas affected by strong currents and the Atlantic influx (e.g. Strait of Messina, Sea of Alboran, Algerian coasts). Stipes that can be 6 meters high and fronds in wide blades that can form a continuous canopy; densities of the order of one adult per 2 square meters or more. The substratum population is sciaphilous, with the substrata and spikes heavily covered in calcareous algae, sponges, bryozoans and ascidians. The three-dimensional development of this kelp offers habitats to a diversified fish fauna.
B1	*MC1.514a Association with non-indigenous Mediterranean Caulerpa spp.*			
B1	*MC1.51b Invertebrate-dominated coralligenous*			
B1	*MC1.511b Facies with small sponges (sponge ground, e.g. Ircinia spp.)*			
B1	*MC1.513b Facies with Hydrozoa*			
B1	*MC1.514b Facies with Alcyonacea (e.g. Eunicella spp., Leptogorgia spp., Paramuricea spp., Corallium rubrum)*			
B1		MC1519	Facies with *Eunicella cavolini*	A raised stratum of *Eunicella cavolini* on a surface that is often built into a concretion by algae associated with various animal species such as the crust-forming and erect bryozoans *Schizomavella spp., Pentapora fascialis, Turbicellepora avicularis, Celleporina caminata* and *Myriapora truncata*, Serpulidae, cnidarians like *Alcyonium coralloides, Alcyonium acaule*, *Leptopsammia pruvoti* and *Caryophyllia smithii*, ascidians like *Halocynthia papillosa* and *Microcosmus sabatieri*.
B1		MC151A	Facies with *Eunicella singularis*	This facies is characterised by the high density of colonies of the gorgonian (sea-fan) *Eunicella singularis*. Often associated with erect brown algae.
B1		MC151B	Facies with *Paramuricea clavata*	This facies is characterised by the high density of colonies of the gorgonian (red sea-fan) *Paramuricea clavata*. The lower stratum is very rich; there are found the cnidarians *Caryophyllia smithii, Hoplangia durotrix, Leptopsammia pruvoti, Corallium rubrum*, the bryozoans *Celleporina caminata, Schizomavella mamillata, Smittina cervicornis, Myriapora truncata*, Serpulidae, the sponges *Ircinia variabilis, Spongia officinalis, Sarcotragus spinosulus, Scalarispongia scalaris, Aplysina cavernicola, Penares euastrum* and *Agelas oroides*, and the molluscs *Thylacodes arenarius* and *Lithophaga lithophaga*. An intermediary level includes invertebrates colonising parts of the branches, such as the cnidarian *Alcyonium coralloides*, the bryozoans *Adeonella calveti, Turbicellepora avicularis, Reteporella spp*. and *Pentapora fascialis*, and the molluscs *Pteria hirundo* and *Anomia ephippium*.
B1	*MC1.515b Facies with Ceriantharia (e.g. Cerianthus spp.)*			

Hab	Bar. Con. (2019)	EUNIS (2022)		
		Code	**Name**	**Description**
B1	*MC1.516b Facies with Zoantharia (e.g. Parazoanthus axinellae, Savalia savaglia)*	MC151C	Circalittoral facies with *Parazoanthus axinellae*	This facies is characterised by the high density of the cnidarian (sea anemone) *Parazoanthus axinellae*.
B1		MC151D	Association with *Rodriguezella strafforelli*	This association populates hard poorly-lit substrata, in a sheltered environment, at about 25-45 metres depth. The association was described in 1975 by Augier and Boudouresque and contains as other characteristic plant species *Blastophysa rhizopus, Ceramium bertholdii, Polysiphonia subulifera, Rodriguezella pinnata, Spermothamnion johannis* and *Sphacelaria plumula*.
B1		MC151E	Facies with *Leptogorgia sarmentosa*	This facies is characterised by the high density of colonies of the gorgonian (sea-fan) *Leptogorgia sarmentosa (syn Lophogorgia sarmentosa)*. Big *Leptogorgia sarmentosa* gorgonians with thin branches that are usually developed at several levels; yellow to orange color, forming sparse groups on rocky beds with or without concretions, or on substrata scattered over loose beds, from 15 to 300 meters down.
B1		MC151F	Facies with *Anthipatella subpinnata* and sparse red algae	This facies, characterised by the colonial black coral *Antipathella subpinnata*, occurs on hard bottoms with different sedimentation rate and relatively dim light, generally observed on subhorizontal faces of large boulders, from 50m depth.
B1	*MC1.512b Facies with large and erect sponges (e.g. Spongia lamella, Sarcotragus foetidus, Axinella spp.)*	MC151G	Facies with massive sponges and sparse red algae	Large sponges belonging to species *Sarcotragus foetidus* or *Spongia lamella* creates facies on patchy hard substrata of continous hard substrata.
B1	*MC1.517b Facies with Scleractinia (e.g. Dendrophyllia spp., Leptopsammia pruvoti, Madracis pharensis)*			
B1	*MC1.518b Facies with Vermetidae and/or Serpulidae*			
B1	*MC1.519b Facies with Bryozoa (e.g. Reteporella grimaldii, Pentapora fascialis)*			
B1	*MC1.51Ab Facies with Ascidiacea*			
B1	*MC1.51c Invertebrate-dominated coralligenous covered by sediment*			
B1	*See MC1.51b for examples of facies*			
B1	*MC1.52 Shelf edge rock*			
B1	*MC1.52a Coralligenous outcrops*			
B1	*MC1.521a Facies with small sponges (sponge ground)*			
B1	*MC1.522a Facies with Hydrozoa*			
B1	*MC1.523a Facies with Alcyonacea (e.g. Alcyonium spp., Eunicella spp., Leptogorgia spp., Paramuricea spp., Corallium rubrum)*			

Hab	Bar. Con. (2019)	EUNIS (2022)		
		Code	Name	Description
B1	*MC1.524a Facies with Antipatharia (e.g. Antipathella subpinnata)*			
B1	*MC1.525a Facies with Scleractinia (e.g. Dendrophyllia spp., Madracis pharensis)*			
B1	*MC1.526a Facies with Bryozoa (e.g. Reteporella grimaldii, Pentapora fascialis)*			
B1	*MC1.527a Facies with Polychaeta*			
B1	*MC1.528a Facies with Bivalvia*			
B1	*MC1.529a Facies with Brachiopoda*			
B1	*MC1.52b Coralligenous outcrops covered by sediment*			
B1	*See MC1.52a for examples of facies*			
B1	*MC1.52c Deep banks*			
B1	*MC1.521c Facies with Antipatharia (e.g. Antipathella subpinnata)*			
B1	*MC1.522c Facies with Alcyonacea (e.g. Nidalia studeri)*			
B1	*MC1.523c Facies with Scleractinia (e.g. Dendrophyllia spp.)*			
	MC2.5 Circalittoral biogenic habitat	MC25	Mediterranean circalittoral biogenic habitat	This habitat is present in the Mediterranean on hard rocky and/or biogenic horizontal substrata formed by coralligenous formations developed within sedimentary beds, up to 100 metres in depth, in clear waters with moderate hydrodynamic action. Coralligenous concretions are found on rock faces or on rocks where calcareous algae can build biogenic constructions.
B1	*MC2.51 Coralligenous platforms*	MC251	Coralligenous platforms	These are coralligenous horizontal formations developing within sedimentary beds subject to currents, at up to at least 100 metres depth in clear waters. These formations are not usually built on rock substrata but result from the active development of constructor organisms (e.g. calcified algae, hard-skeleton invertebrates) from scattered elements on loose beds, shells, stones, and graves. The thickness of these coralligenous formations can vary between a few centimeters and several meters. This type of coralligenous then constitutes slab platforms, thus giving its name to this very specific facies.
B1	*MC2.511 Association with encrusting Corallinales*			
B1	*MC2.512 Association with Fucales*			
B1	*MC2.513 Association with non-indigenous Mediterranean Caulerpa spp.*			
B1	*MC2.514 Facies with small sponges (sponge ground, e.g. Ircinia spp.)*			

Hab	Bar. Con. (2019)	EUNIS (2022)		
		Code	Name	Description
B1	*MC2.515 Facies with large and erect sponges (e.g. Spongia lamella, Sarcotragus foetidus, Axinella spp.)*			
B1	*MC2.516 Facies with Hydrozoa*			
B1	*MC2.517 Facies with Alcyonacea (e.g. Alcyonium spp., Eunicella spp., Leptogorgia spp., Paramuricea spp., Corallium rubrum)*			
B1	*MC2.518 Facies with Zoantharia (e.g. Parazoanthus axinellae, Savalia savaglia)*			
B1	*MC2.519 Facies with Scleractinia (e.g. Dendrophyllia spp., Madracis pharensis, Phyllangia mouchezii)*			
B1	*MC2.51A Facies with Vermetidae and/or Serpulidae*			
B1	*MC2.51B Facies with Bryozoa (e.g. Reteporella grimaldii, Pentapora fascialis)*			
B1	*MC2.51C Facies with Ascidiacea*			
	MC3.5 Circalittoral coarse sediment	MC35	Mediterranean circalittoral coarse sediment	Mediterranean circalittoral coarse sands, gravel and shingle generally in depths of over 15-20m. Characteristic species are red algae species of the family Corallinaceae; Bivalves: *Atrina pectinata, Venus casina, Dosinia exoleta, Donax variegatus, Glycymeris glycymeris, Laevicardium crassum*; Echinoderms: *Spatangus purpureus*; Hydrozoans: *Lytocarpia myriophyllum*; Polychaetes: *Sigalion squamosus, Armandiapolyophthalma*; Ophiuroids: *Ophiopsila annulosa*; and Crustaceans: *Anapagurus breviaculeatus, Thia scutellata*.
B2	*MC3.52 Coastal detritic bottoms with rhodoliths*	MC352	Assemblages of Mediterranean coastal detritic bottoms biocenosis with rhodolithes	These circalittoral assemblages occur on coarse sand or gravel affected by important seafloor currents. This habitat is known to be a hot-spot of biodiversity, hosting a high diverse invertebrate community. Moreover, it is one of the Mediterranean communities with the highest amount and production rates of carbonates, and it provides nursery grounds for commercial fish and shellfish species.
B2	*MC3.521 Association with maërl (e.g. Lithothamnion spp., Neogoniolithon spp., Lithophyllum spp., Spongites fruticulosa)*	MC3521	Association with rhodolithes on coastal detritic bottoms	This association characterised by "balls" of calcareous encrusting algae occurs on coastal detritic bottoms.
B2	*MC3.522 Association with Peyssonnelia spp.*	MC3522	Association with *Peyssonnelia rosa-marina*	This association on coastal detritic bottoms is characterised by the abundance of the red alga *Peyssonnelia rosa-marina*.
B2		MC3523	Association with maerl (*Lithothamnion corallioides* and *Phymatholithon calcareum*) on coastal dendritic bottoms	An association characterised by the presence of two small many-branched calcareous algae species, *Lithothamnion corallioides* and *Phymatolithon calcareum*, unattached on sediments made up of coarse sands and gravels with a high proportion of detritic elements. Given their many-branched shape, these Lithothamnia never constitute bioconstructions or rhodolithes. Small Rhodophyceae may

Hab	Bar. Con. (2019)	EUNIS (2022)		
		Code	Name	Description
				be present as epiphytes on the Lithothamnia. A similar community also occurs on coarse sediments (MB3.522).
B2	*MC3.523 Association with Laminariales*			
B2	*MC3.524 Facies with large and erect sponges (e.g. Spongia lamella, Sarcotragus foetidus, Axinella spp.)*			
B2	*MC3.525 Facies with Hydrozoa*			
B2	*MC3.526 Facies with Alcyonacea (e.g. Alcyonium spp., Paralcyonium spinulosum)*			
B2	*MC3.527 Facies with Pennatulacea (e.g. Veretillum cynomorium)*			
B2	*MC3.528 Facies with Zoantharia (e.g. Epizoanthus spp.)*			
B2	*MC3.529 Facies with Ascidiacea*			

Annex IV. Parameters and metrics used by Contracting Parties for the three habitat types

135. Based on the information available in Garrabou & Kipson (2023), a summary of the parameters monitored and indicators being used by Contracting Parties for IMAP is provided in **Table 8**. The table has been updated by a number of CPs via the OWG, but further updating would be useful to aid understanding of the level of commonality in monitoring for each habitat.

Table 8*. Overview of parameters/metrics currently monitored by Contracting Parties (based on Garrabou & Kipson, 2023, and updated by the OWG, with additional information added as footnotes). The first three parameters (habitat extent/area, spatial distribution and upper/lower depth limits) are relevant for CI1; the remaining parameters are relevant for CI2.*

Parameter	B1 Coralligenous	B2 Maërl	B3 Posidonia
Habitat distribution and extent (CI1)			
Habitat area/extent	CY[64] ES[65] (Habitat mapping and area-surface estimations of Coralligenous-related habitats) FR: updated maps (SURFSTAT, Medtrix platform[66]) IT	EL, IT, MT (area)	CY (surface area – Km^2) IT, EL (abundance of habitat type) FR: updated maps (SURFSTAT, Medtrix platform)
Spatial distribution	CY[67]	ES[68], IT, EL	CY, IT, ES, EL (accurate and reliable habitat

[64] CY: Coralligenous habitat mapping has been carried out in the Republic of Cyprus from 50 to the 250m depth zone via MBES and backscatter data analyses. Ground-truthing surveys for validating the data are planned to be carried out in the following 1-2 years.

[65] ES: mapping has only been done in some Marine Protected Areas during different EU projects - LIFE INDEMARES and LIFE INTEMARES. Some of those MPAs are Seco de los Olivos - Chella Bank (de la Torriente et al., 2019), Menorca channel (Barberá et al., 2012), Cap de Creus (Sardá et al., 2012; Lo Iacono et al., 2012). Habitat area-surface and extent is probably one of the most difficult parameters to obtain extensively at a scale of Assessment Area since it involves modelling which need different seabed data that are difficult to obtain (multibeam-backscatter-Side Scan Sonar at a good resolution).

[66] FR: Recently, another updated map is provided by the French Office of Biodiversity: Tempera et al. (2024).

[67] CY: Coralligenous habitat mapping has been carried out in the Republic of Cyprus from 50 to the 250m depth zone via MBES and backscatter data analyses. Ground-truthing surveys for validating the data are planned to be carried out in the following 1-2 years.

[68] ES: In Spain, the distribution area of RMBs across the continental shelf is unknown. The only mapping of RMBs covering the whole continental shelf off Iberian Peninsula and Balearic Islands was developed within the European Marine Strategy Framework Directive (Serrano *et al.*, 2012). However, it was a very broad scale mapping, developed from MEDITS surveys data (bottom trawl gear sampling), which allows identifying potential areas where RMBs are located (Cape Palos and Balearic Islands), but it is not enough detailed to estimate habitat extent and much less monitoring. Taking into account the patchiness distribution of MRBs, the sampling method applied in MEDITS surveys (Spedicato *et al.*, 2019) is not appropriated for their mapping. Detailed mapping of the benthic biocenosis, including RMBs, are available in very few areas:
Menorca Channel (Balearic Islands): During the LIFE+ INDEMARES (Barbera *et al.*, 2012). This mapping has been updated by Farriols *et al.* (2024) during the SosMed project (NextGenerationEU funds).
Continental shelf southern Mallorca (Balearic Islands): During the DRAGONSAL project (Domínguez *et al.*, 2014; non-published report). The map of benthic biocenosis was included in Del Valle & Pons (2019).
Murcia Region (southeastern Iberian Peninsula): Within the REGINA-MSP Project (Regions to boost National Maritime Spatial Planning; https://www.regina-msp.eu/) it has been compiled and modeled the mapping of RMBs in some areas off Murcia, with special emphasizes to their potential overlapping with aquiculture activities (Aguado-Giménez & Ruiz-Fernández, 2012).
Seamounts of the Mallorca Channel (Balearic Islands). During LIFE IP INTEMARES project (Massutí *et al.*, 2022). A paper on habitat mapping will be published soon. Catalan coast (northeastern Iberian Peninsula): the project "Map of the Marine Habitats of Catalonia", co-funded by the Autonomous Government of Catalonia and FEMPA (European Union) and

	IT, EL, ES (presence of different types of Coralligenous Habitats using scuba diving transects in infralittoral locations and ROV transects in Circalittoral and Bathyal locations) FR: updated maps (SURFSTAT, Medtrix platform)		mapping; geographical distribution boundaries) FR: updated maps (SURFSTAT, Medtrix platform)
Upper & lower depth limits			AL, CY, DZ, FR, IT (type of lower limit), ME (type of lower limit), ES, EL (type of lower limit) FR: Micro cartography by photogrammetry (TEMPO network), *Posidonia* monitoring network (Corsica)
Condition of the habitat's typical species and communities (CI2)			
Habitat quality indices	Aesthetic value: LB CAI "dynamic of coralligenous" index based on % of necrosis (RECOR monitoring network)[69]: FR Cor-EBQI, Ecosystem-based quality index designed for Coralligenous (Astruch et al., under review)[70]: FR Habitat complexity indicators: AL Diversity indices: HR (alpha & beta diversity), LB, TR, ES Economic importance: LB Environmental value: LB Equitability: LB	ALEX: TR Diversity indices (species richness): TR Ecological quality status: EL TUBI: TR BENTIX, diversity (Shannon, Margalef), species richness: EL Ecosystem-based quality index for Coastal Detrital bottoms, including maerl and rhodolith associations (ACDSea project): FR[71]	Diversity indices (species richness): TR EEI (ecologic evaluation index): TR POMI (Posidonia oceanica Multivariate Index): AL, ES, HR, ME (modified POMI) PREI (*Posidonia oceanica* Rapid Easy Index): CY, FR, IT, MT, EL Valencian CS: ES WePOSI (Weighted Posidonia oceanica Index): EL BIPO - Biotic index using *Posidonia oceanica (*Lopez y Royo *et al*., 2010 used in

developed between 2021 and 2023, its objective has been the mapping the benthic habitats between 0 and 50 m depth. For more information: https://mediambient.gencat.cat/ca/05_ambits_dactuacio/patrimoni_natural/sistemes_dinformacio/habitats/habitats-marins/projecte-mapa-dels-habitats-marins-de-catalunya/index.html.
Currently is developing the BIODIV_A5.3 project (NextGenerationEU funds). The mapping and characterization of RMBs around Mallorca and Menorca and in an area southeastern Iberian Peninsula (Murcia Region) is being made, from submarine images and flora and fauna samples obtained from dredges and beam trawl. The results of this project will be available from middles 2026.

[69] Deter, J., Descamp, P., Ballesta, L., Boissery, P., & Holon, F. (2012). A preliminary study toward an index based on coralligenous assemblages for the ecological status assessment of Mediterranean French coastal waters. Ecological indicators, 20, 345-352.

[70] FR: For Coralligenous, need to mention here or in the text the reference of Di Camillo et al. (2023) which benchmarks Coralligenous/mesophotic reef index highlighting the need for a unified approach at basin scale.
Di Camillo, C. G., Ponti, M., Storari, A., Scarpa, C., Roveta, C., Pulido Mantas, T., ... & Cerrano, C. (2023). Review of the indexes to assess the ecological quality of coralligenous reefs: towards a unified approach. *Frontiers in Marine Science, 10,* 1252969.

[71] Astruch, P., Orts, A., Schohn, T., Belloni, B., Ballesteros, E., Bănaru, D., ... & Daniel, B. (2023). Ecosystem-based assessment of a widespread Mediterranean marine habitat: The Coastal Detrital Bottoms, with a special focus on epibenthic assemblages. Frontiers in Marine Science, 10, 1130540. https://doi.org/10.3389/fmars.2023.1130540.

	Functioning bioeroders and bioconstructors indicators: AL Habitat vulnerability heritage index: LB MACS (multi-parametric index Mesophotic assemblages conservation status): IT MAES index: ME Margalef index/nb: LB Naturalness index: LB Rarity: LB TUBI: TR	ES[72]	the frame of the MSFD): leaf surface, shoot density, mapping of the depth limit (typology of depth limit and condition of shoot): FR
Pressures - sources of disturbances	AL (indicators of impacts of different disturbances: (fishing nets, invasive species, sedimentation, high diving pressure) HR (% cover of invasive species) ME (litter density) ES IT (litter distribution, composition, density and distribution) impact, MACS index)	EL (bottom trawling impact, eutrophication) IT (% of habitat affected by anthropogenic impacts) ES (litter[73], bottom fishing)[74]	ES (% invasive & opportunistic species) IT EL
Habitat level			
Physical/chemical characteristics	ES (sediment characteristics, depth, hydrography – temperature, salinity) FR (3-D structure, % cover of sediment) HR (% cover of sediment) IT (depth, % cover of sediment)	EL (abundance of habitat types) IT (physico-chemical data – temperature, salinity, transparency) ES (depth, sediment characteristics,[75] hydrography)	EL (ecosystem structure) ES (%N, %P, metals, isotopic nitrogen) HR (N content in epiphytes)

[72] ES: In Spain, habitat quality of RMBs (e.g. rhodoliths coverage, density, species richness of benthic flora and fauna, diversity indices, rhodoliths morphology) have been only assessed in the Balearic Islands: Menorca Channel (Barbera *et al.*, 2012, Farriols *et al.*, 2022, 2024) and southern Mallorca (Domínguez *et al.*, 2014).

[73] DZ: Debris can disrupt maerl growth by covering the substrate and limiting access to light. Abundance and type of debris should be monitored regularly to assess environmental impact and guide management action.

[74] ES: Spain is obtaining abundance (and density) of different types of litter and human activities indicators (fishing nets, etc.) from scuba-diving techniques in 50 metres transects in the infralittoral and 100 metres ROV transects in the circalittoral and bathyal.

VMS data are analysed at a 5x5 km grid (1x1 km grid in some MPAs) in order to map fishing activities such as bottom trawling, long line, among others.

% cover and biomass of some invasive species have been obtained in infralittoral and circalittoral bottoms, including some areas with coralligenous bottoms...see Rueda et al (2023) (https://www.mdpi.com/1424-2818/15/12/1206).

Within the context of the European Marine Strategy Framework Directive, the environmental status of benthic habitats in circalittoral sedimentary seabed off Iberian Peninsula and around the Balearic Islands has been assessed using the Sentinel of Seabed (SoS) indicator (Calero *et al.*, 2024), also called BH1 in OSPAR. It has been estimated from MEDITS data and considering bottom trawl fishing effort (signals from Vessel Monitoring by satellite System). However, it has been made at the level of EMODNET Broad Habitat Types, no for biogenic habitats, including RMBs. In order to be able to assess these beds, their mapping will first be necessary.

[75] ES: Within the current BIODIV_A5.3 project, mentioned above, bathymetric and backscatter data are obtained from multibeam echosounder along the continental shelf around Mallorca and Menorca (Balearic Islands). In this area, seabed surface sediments characteristics, including grain size distribution and organic matter contain, are also analysed.

Community level			
Species composition of community	AL EG ES[76] FR (macrofauna & megafauna) LB ME (no. of species, presence of red coral) IT (macrofauna & megafauna)	ES TR EL	DZ (associated flora and fauna) EG (species composition) TR EL (associated flora and fauna)
Species abundance within community	AL (semi or quantitative) EG (of selected species) ES (number of individuals, relative abundance) IT (number of individuals/ colonies of habitat-forming species and relative abundance) HR (% cover of conspicuous taxa/morphological groups) FR (macrofauna & megafauna, % cover of sessile fauna, erect bryozoans) LB (relative abundance, dominance or frequency) ME (red coral abundance, cover of basal layer, density of erect species, height of dominant erect species) TR (coverage of groups and species)	ES (number of individuals, relative abundance, size) TR (abundance) EL: (relative abundance of tolerant and sensitive taxa)	EG (of selected species) ES (*Pinna nobilis* and other habitat-typical species) EL (associated fauna – selected species)
Biomass of community or of specific species	DZ (of typical & sensitive species)	DZ (of typical species) ES EL: community biomass	Posidonia leaf biomass: CY, FR, IT, EL Epiphyte biomass or cover: AL, CY, FR, EL
Population level (for selected species)			
Live cover %	FR: % of biobuilders, % of erect bryozoans IT (% epibiosis of habitat-forming species)	IT (% cover of living thalli, thickness of living stratum)	AL, CY, DZ, ES, HR, IT (meadow composition, continuity), ME, SI, TR, EL
Dead cover %	IT (% of dead habitat-forming species)	IT (ratio live/dead)	Dead matte cover: AL, IT, ME, EL
Population structure, density, volume, occupation rate	DZ (Population structure, density, volume, occupation rate) EG (density of individuals) ES (size of specific species[77])	DZ (population structure, density, volume, occupation rate)	Shoot density: AL, CY, DZ, EG (population density – number of individuals/unit area), ES, FR, HR, IT, ME, SI, TR, EL

[76] ES: mostly megafauna (size >3-4 cm) and some macrofauna.
[77] ES: Size measurements of specific Coralligenous species have only been done in specific MPAs and sites. Under the MSFD monitoring programs, we are not taking measurements of individual/colonies for assessment purposes.

	MA (biometry of *Corallium rubrum*) IT (population structure and density of habitat-forming species)		
Growth, fecundity and mortality	DZ (growth & mortality rate) EG (of selected species, body size, age structure, sex ratio) MA (bleaching events, (recovery rates of typical species, particularly *Paramuricea clavata, Corallium rubrum, Asteroides calycularis*);	DZ (growth & mortality rate)	CY (flowering events) EG (of selected species, body size, age structure, sex ratio, breeding season) EL, IT (flowering events, lepidochronological measures)
Leaves			AL (leaf morphometry & foliar production; state of apex per shoot; Coefficient A % of broken leaves (without apex)) CY (leaf surface area per shoot) DZ (mean size) EL (leaf morphometry) FR (no. of leaves per shoot, length of leaves) HR (leaf surface) IT
Rhizomes			AL (rhizome production; % of plagiotropic shoots) HR (sucrose content, δ 15N & δ 34S isotopic ratio, Pb content) IT (% of plagiotropic shoots) EL (% of plagiotropic shoots)
Necrosis	HR (% necrosis of habitat-forming species) ME (% necrosis)		AL CY, HR (% on leaves) EL
Migration patterns	EG		EG

Annex V. Use of the fields in data standards B1, B2 and B3

136. Nine Contracting Parties have submitted data into the IMAP Info System in the period up November 2024 for one or more of the three benthic habitat types considered in this report. **Table 9** shows the fields within each of the data standards B1, B2 and B3 which contain data, giving an indication of the extent of their use and the availability of data from the monitoring programmes.

137. The following Contracting Parties submitted data:

a. B1 Coralligenous – Israel (IS), Morocco (MA), Montenegro (ME);
b. B2 Maërl – Spain (ES), Malta (MT);
c. B3 *Posidonia* – Egypt (EG), Spain (ES), Italy (IT), Montenegro (ME), Malta (MT), Slovenia (SI), Tunisia (TN).

***Table 9**. Fields in each data standard (B1 Coralligenous, B2 Maerl, B3 Posidonia) for which Contracting Parties have submitted data (up to November 2024). Fields in red are not mandatory in the data standard. Cells in grey indicate the field is not part of the data standard. Cells in beige have no data submitted.*

Table	Field	B1 Coralligenous	B2 Maërl	B3 Posidonia
Area	CountryCode	IS, MA, ME	ES, MT	EG, ES, IT, ME, MT, SI, TN
	AreaID	IS, MA, ME	ES, MT	EG, ES, IT, ME, MT, SI, TN
	AreaName	IS, MA, ME	ES, MT	EG, ES, IT, ME, MT, SI, TN
	Region	IS, MA	ES, MT	EG, ES, IT, ME, MT, TN
	Latitude	IS, MA, ME	ES, MT	EG, ES, IT, ME, MT, TN
	Longitude	IS, MA, ME	ES, MT	EG, ES, IT, ME, MT, TN
	GISfile	MA	ES, MT	EG, ES, IT, ME, MT
	DTMfileMultibeam	MA	MT	IT, ME, MT
	FileSidescansonar		MT	IT, ME, MT
	MPAName	IS, MA, ME	MT	EG, IT, ME, MT, TN
	SIC-ZPSName			IT, ME, MT
	Remarks	IS, MA	MT	EG, IT, MT
Site	CountryCode	IS, MA, ME	ES, MT	EG, ES, IT, ME, MT, SI, TN
	AreaID	IS, MA, ME	ES, MT	EG, ES, IT, ME, MT, SI, TN
	SiteID	IS, MA, ME	ES, MT	EG, ES, IT, ME, MT, SI, TN
	SiteName	IS, MA, ME	ES, MT	EG, ES, IT, ME, MT, SI, TN
	Year		ES, MT	
	Month		ES, MT	
	Day		ES, MT	
	Time		ES, MT	
	Latitude	IS, MA, ME	ES, MT	EG, ES, IT, ME, MT, SI, TN
	Longitude	IS, MA, ME	ES, MT	EG, ES, IT, ME, MT, SI, TN
	SCI_Name			ES, IT, ME, MT, SI, TN
	Artificialization			EG, ES, MT

Table	Field	B1 Coralligenous	B2 Maërl	B3 Posidonia
	AnthropogenicAction			EG, ES, IT, MT, TN
	Pollution			EG, ES, MT
	Habitatmapfile		ES, MT	
	Remarks	IS	MT	IT, ME
Transect_ROV	CountryCode	IS, MA, ME	ES	EG, ES, IT, ME, MT, SI, TN
	SiteID	MA, ME		EG, IT, ME, SI
	TransectID	MA, ME		EG, IT, ME, SI
	TransectName	MA, ME		EG, IT, ME, SI
	Year	MA, ME		EG, IT, ME, SI
	Month	MA, ME		EG, IT, ME, SI
	Day	MA, ME		EG, IT, ME, SI
	Time	ME		EG, IT, ME, SI
	LatitudeSTART	MA, ME		EG, IT, ME, SI
	LongitudeSTART	MA, ME		EG, IT, ME, SI
	LatitudeEND	MA, ME		EG, IT, ME, SI
	LongitudeEND	MA, ME		EG, IT, ME, SI
	Habitatmapfile	MA		
	StudyTypology			EG, IT, ME, SI
	GISfile	MA		IT, ME
	Videofile			IT, ME
	GPSfile			IT, ME
	EpibiosisTot	ME		
	NecrosisTot	ME		
	MPAName			EG, IT, ME
	SICName			IT, ME
	Remarks	MA, ME		EG, IT
ReliefSurf_ROV	CountryCode	IS, MA, ME		
	ReliefSurfaceID	MA		
	ReliefSurfaceName	MA		
	TransectID	MA		
	Latitude	MA		
	Longitude	MA		
	SampleDepth	MA		
	BottomType	MA		
	CoralPresence	MA		
	Exposure	MA		
	Slope	MA		

Table	Field	B1 Coralligenous	B2 Maërl	B3 Posidonia
	Sedimentation	MA		
	Biocoverage	MA		
	Remarks	MA		
Habitat_ROV	CountryCode		MT, ES	
	TransectID		MT	
	PhotoID			
	Year		MT	
	Month		MT	
	Day		MT	
	Time		MT	
	Latitude		MT	
	Longitude		MT	
	SampleDepth			
	Coverage		MT	
	Morphotype			
	RatioLiveDead			
	Remarks		MT	
Sample	CountryCode		MT, ES	
	SiteID		MT, ES	
	SampleID		MT, ES	
	Latitude		MT, ES	
	Longitude		MT, ES	
	Year		MT, ES	
	Month		MT, ES	
	Day		MT, ES	
	Time		MT, ES	
	SampleDepth		ES	
	SampleMet		MT, ES	
	PhotoName			
	Coverage		ES	
	Thickness		ES	
	Morphotype		ES	
	RatioLiveDead		ES	
	GrainSizeC		ES	
	GrainSizeG		ES	
	GrainSizeS		ES	
	GrainSizeP		ES	

Table	Field	B1 Coralligenous	B2 Maërl	B3 Posidonia
	Remarks		MT	
Sediment	CountryCode			EG, ES, IT, ME, MT, TN
	AreaID			EG, IT
	AreaName			EG, IT
	SiteID			EG, IT
	SiteName			EG, IT
	Latitude			EG, IT
	Longitude			EG, IT
	TransectID			EG, IT
	StationTypology			EG, IT
	GrainSizeC			EG, IT
	GrainSizeG			EG, IT
	GrainSizeS			EG, IT
	GrainSizeP			EG, IT
	TotalOrganicCarbon			IT
	Remarks			IT
Physico-Chemical	CountryCode		ES	EG, ES, IT
	SiteID			
	SampleID			
	NatonalStationID			EG, IT
	Year			EG, IT
	Month			EG, IT
	Day			EG, IT
	Time			EG, IT
	WaterSampleID			
	Temperature			
	Salinity			
	Secchi depth			
	TransectID			EG, IT
	SiteTypology			EG, IT
	Determinand_Nutrients			IT
	Unit_NutrientsSeawater			EG, IT
	LOD_LOQ_Flag			
	Concentration			EG, IT
	SampleDepth			EG, IT
	Method_Chl-a			IT
	Remarks			IT

Table	Field	B1 Coralligenous	B2 Maërl	B3 Posidonia
Floristic_sample	CountryCode		MT, ES	
	SampleID		MT, ES	
	Phylum		MT, ES	
	Class		MT, ES	
	Species		MT, ES	
	NewTaxon			
	Authors			
	Remarks			
Shoots	CountryCode			EG, ES, IT
	AreaID			EG, IT
	AreaName			EG, IT
	SiteID			EG, IT
	SiteName			EG, IT
	Latitude			EG, IT
	Longitude			EG, IT
	TransectID			EG, IT
	StationTypology			EG, IT
	AreaTypology			EG, IT
	RepNumber			EG, IT
	ShootNumb			EG, IT
	LepidochronologicalYear			IT
	RhizomIntactUpToBase			EG, IT
	AnnualRhizProd			IT
	AnnualRhizElong			IT
	NumberLeafShootYear			IT
	RhizomeLength			EG, IT
	RhizAge			IT
	YoungLeavesWidth			EG, IT
	YoungLeavesLength			EG, IT
	IL_Width			EG, IT
	IL_Length			EG, IT
	FoliarNecrosisLength_IL			IT
	AL_Width			EG, IT
	AL_Length			EG, IT
	FoliarNecrosisLength_AL			IT
	BaseLength_AL			IT
	AverageNumberLeavesShoot			EG, IT

Table	Field	B1 Coralligenous	B2 Maërl	B3 Posidonia
	Coefficient_A_AL			IT
	Coefficient_A_IL			IT
	IL_MaxLength			IT
	LeafSurfaceShoot			IT
	LeafBiomassShoot			IT
	BiomassEpiphytes			IT
	LeafProduction_SY			IT
	Remarks			ES, IT
Measures	CountryCode			EG, ES, IT, ME, MT, SI, TN
	AreaID			EG, ES, IT, ME, MT, TN
	AreaName			EG, ES, IT, ME, MT, TN
	SiteID			EG, ES, IT, ME, MT, TN
	SiteName			EG, ES, IT, ME, MT, TN
	Latitude			EG, ES, IT, ME, MT, TN
	Longitude			EG, ES, IT, ME, MT, TN
	TransectID			EG, ES, IT, ME
	StationTypology			EG, ES, IT, ME, MT, TN
	AreaTypology			EG, ES, IT, ME, MT
	RepNumber			EG, ES, IT, ME, MT, TN
	ShootDensity			EG, ES, IT, ME, MT, TN
	Depth			EG, ES, IT, ME, MT, TN
	LowerLimitType			EG, ES, IT, ME, MT, TN
	BaringOrthotropicRhizome			EG, ES, IT
	BaringPlagiotropicRhizome			EG, ES, IT
	BaringMeadow			EG, ES, IT, TN
	BearingPlagiotropicRhizomes			EG, ES, IT
	Remarks			EG, ES, IT, ME, MT
Estimations	CountryCode			EG, ES, IT, ME, MT, SI, TN
	AreaID			EG, ES, IT, ME, MT, TN
	AreaName			EG, ES, IT, ME, MT, TN
	SiteID			EG, ES, IT, ME, MT, TN
	SiteName			EG, ES, IT, ME, MT, TN
	Latitude			EG, ES, IT, ME, MT, TN
	Longitude			EG, ES, IT, ME, MT, TN
	TransectID			EG, ES, IT, ME
	StationTypology			EG, ES, IT, ME, MT, TN
	AreaTypology			EG, ES, IT, ME, MT

Table	Field	B1 Coralligenous	B2 Maërl	B3 Posidonia
	RepNumber			EG, ES, IT, ME, MT
	ContinuityMeadows			EG, ES, IT, ME, MT, TN
	DeadMatteCover			EG, ES, IT, ME, MT
	AlivePosidonia_oceanicaCover			EG, ES, IT, ME, MT, TN
	Caulerpa_racemosaCover			EG, ES, IT, ME, MT
	Cymodocea_nodosaCover			EG, IT, MT
	SubstratumType			EG, ES, IT, ME, MT, TN
	DisturbanceSource			EG, ES, IT, ME, TN
	MeadowComposition			EG, IT
	PresenceInvasiveAlgae			EG, ES, IT, ME
	FloweringPresence			EG, IT, ME, TN
	Remarks			ES, IT, ME, MT
Megabenthos_ROV	CountryCode	IS, MA, ME		
	TransectID	MA, ME		
	Phylum	MA, ME		
	Class	MA, ME		
	Species	MA		
	NewTaxon	MA		
	Authors	MA		
	Coverage	MA		
	EpibiosisCoverage	ME		
	NecrosisCoverage			
	SpecAbundance	ME		
	EpibiosisSpec			
	NecrosisSpec			
	EntrapmentNum	ME		
	Remarks	MA, ME		
Megabenthos_CI_ROV	CountryCode	IS, MA, ME		
	TransectID	ME		
	Phylum	ME		
	Class	ME		
	Species	ME		
	NewTaxon			
	Authors			
	ColonIndID			
	EpibiosisCI	ME		
	NecrosisCI	ME		

Table	Field	B1 Coralligenous	B2 Maërl	B3 Posidonia
	Morphometry_h	ME		
	Remarks			
Plot_Diver	CountryCode	IS, MA, ME		
	PlotID	MA		
	PlotName	MA		
	TransectID	IS, MA		
	Latitude	IS, MA		
	Longitude	IS, MA		
	PhotoID	IS		
	SampleDepth	IS, MA		
	BottomType	IS, MA		
	Slope			
	Exposure			
	CalcareousMatrix			
	MaxHeightSE	MA		
	NumIDSup			
	NumTot			
	Phylum	IS, MA		
	Class	IS, MA		
	Species	IS, MA		
	NewSpecies	IS, MA		
	Authors	IS, MA		
	SpecAbundance	MA		
	EpibiosisSpec			
	NecrosisSpec			
	Morphometry_h			
	NecrosisPlotSub			
	InvasiveSpecPerc			
	InvasiveSpecRelAbun			
	SludgePerc			
	BioBuilderSpecPerc			
	BryoPerc			
	AbioticPerc			
	Temp			
	Salinity			
	SecchiDiskDepth			

Table	Field	B1 Coralligenous	B2 Maërl	B3 Posidonia
	Remarks[78]	MA		
Macrofauna_sample	CountryCode		ES, MT	
	SampleID		ES	
	Phylum		ES	
	Class		ES	
	Species		ES	
	NewTaxon			
	Authors			
	Remarks			
DebType	CountryCode	IS, MA, ME	ES	
	TransectID	ME		
	DebType	ME		
	DebAbundance	ME		
	Remarks	ME		

[78] Field not in data standard B1, but used by Morocco