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Agenda Item 5: **Monitoring and assessment elements for the IMAP common indicators (CI1 and CI2) on marine benthic habitats**

Monitoring and assessment elements for the IMAP common indicators (CI1 and CI2) on benthic habitats

SPA/RAC
Tunis, 2023

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).

The present document provides and analysis of the implementation status of two IMAP Common Indicators (CIs) related to benthic habitats: CI1 - Habitat distributional range and CI2 - Condition of the habitat's typical species and communities to evaluate the possibility to propose monitoring and assessment elements of these 2 CI.

This document was prepared with the support of the Biodiversity Online Working Group (OWG) benthic habitats and is submitted to this CORMON meeting for review and consideration for the way forward in the new IMAP cycle to enhance the implementation of the monitoring and assessment of the benthic habitats towards achieving the Good Environmental Status (GES) in the Mediterranean Sea and costs.

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I. Background

1. The Integrated Monitoring and Assessment Programme (IMAP) of the Barcelona Convention Ecosystem Approach process aims to monitor biodiversity and non-indigenous species, pollution and marine litter, coast and hydrography in an integrated manner (UN Environment/MAP, 2017). As such, IMAP aims to facilitate the implementation of article 12 of the Barcelona Convention and several other monitoring related provisions under different Protocols with the main objective to assess and take measures to achieve the Good Environmental Status (GES) across the Mediterranean Sea.

2. In the scope of the UNEP/MAP-SPA/RAC Programme of Work (2020-2021 and 2022-2023) and with the financial support of the EU funded project IMAP-MPA, SPA/RAC has been working on the elaboration of assessment criteria, thresholds and baseline values for habitats and species with adequate data availability following the recommendations of the 2017 Mediterranean Quality Status Report (2017 MED QSR, Decision IG.23/6).

3. In this regard, the main goal of this work is to assess the implementation status of two IMAP Common Indicators (CIs) related to benthic habitats: CI1 - Habitat distributional range and CI2 - Condition of the habitat's typical species and communities to evaluate the possibility to propose monitoring and assessment elements of these 2 CI.

II. About this document

4. The consultants have been assigned by the SPA/RAC to evaluate the implementation status for the two IMAP CIs related to benthic habitats: CI1 - Habitat distributional range and CI2 - Condition of the habitat's typical species and communities (focusing on Priority 1 from the reference list of the UN Environment/MAP 2017 taking into account the Barcelona Convention updated list of main benthic habitats (Montefalcone et al. 2021)). In particular, the assignment is focused on:

- scales of monitoring
- scales of assessment and assessment criteria; and
- threshold and baseline values based on the available data.

5. This document describes the methodological approach and the results obtained regarding the identified key elements for the successful implementation of the CI1 and CI2 across the Mediterranean.

6. The ultimate goal is to promote that all habitats and typical species included in the Reference List of Habitats and Species (IMAP 2017) taking into account the Barcelona Convention updated list of main benthic habitats (Montefalcone et al. 2021) maintain or reach the Good Environmental Status (GES) pursued by the Contracting Parties to the Barcelona Convention under the Ecosystem Approach (EcAp) and in line with the Marine Strategy Framework Directive (MSFD).

III. Methodology

7. The proposed methodology has been designed to support the implementation of the IMAP Common Indicators (CIs) related to benthic habitats:

- CI1 *Habitat distributional range*
- CI2: *Condition of the habitat's typical species and communities*

8. The definition of common indicator in the Barcelona Convention framework (see below) guided and inspired the design of the proposed methodology and work plan for the development of scales of monitoring and assessment, assessment criteria and for identification of baselines and thresholds.

9. Definition of Common indicator in the Barcelona Convention Framework "…a common indicator is an indicator that summarizes data into a simple, standardized, and communicable figure and is ideally applicable in the whole Mediterranean basin, or at least on the level of sub-regions, and is monitored by all Contracting Parties. A common indicator is able to give an indication of the degree of threat or change in the marine ecosystem and can deliver valuable information to decision makers" (IMAP 2017)

10. For the identification of the key elements required for the implementation of the IMAP CI1 and CI2, the following main stages were implemented:

STAGE 1. Information compilation. Compile the relevant documentation on the IMAP and MSFD (and related Action plans, directives, selected national technical reports) as well as the scientific literature that can support the implementation of CI1 and CI2. In addition, a contact list including key actors in the implementation of the IMAP and MSFD as well as specialists on selected habitats and associated typical species was built. This list included the experts of the Biodiversity OWG on benthic habitats (informal Online Working Group) with members from different Contracting Parties. This stage continued also during STAGE 2 and STAGE 3 since new documents and experts were continuously identified from the document analysis and consultation with experts.

Outcomes:

- List of reference documents (Cf. Annex 1)
- List of relevant contacts for the consultation process (Cf. Annex 2)

STAGE 2. Information review and synthesis. For the review different domains of information regarding the scales of monitoring, scales of assessment, assessment criteria, threshold and baseline data have been extracted from the relevant documents found during the STAGE 1. This information was included in two separate spreadsheets (one for each CI) for each country and priority benthic habitat (i.e. priority level 1, according to UN Environment/MAP 2017 considering as well the Barcelona Convention updated list of main benthic habitats (Montefalcone et al. 2021)). From this effort, we were able to explore the information available as well as the information gaps in a synthetic way. Besides, these spreadsheets were the basis for the consultation processes (STAGE 3) with the experts in view to validate and/or complement the information extracted from the documentation analysis. Finally, the information collected has been the basis to develop "IMAP Habitat templates", i.e. a series of synthetic documents gathering the key information on the CI1 and CI2 for the different habitats.

Outcomes:

- List of definitions of main key elements to be considered in the IMAP implementation. CI1 (Cf. Annex 3) and CI2 (Cf. Annex 4)
- Spreadsheet gathering the information for CI1 and CI2 implementation by the Contracting Parties: CI1 Annex 3 and CI2 Annex 4
- Gap analysis on CI1 and CI2 implementation
- Development of the "IMAP Habitat templates" (cf. Annex 5)

STAGE 3. **Consultation with experts**. Based on the information gathered in STAGE 2 a consultation process was initiated with experts on the IMAP and MSFD implementation and specialists of the Reference list of habitats and typical species. In the first step, the experts were contacted to request any document describing the implementation plan and the results on IMAP CI1 and CI2 or their equivalents

from the MSFD for the European Union countries experts. In the second step, an online meeting with the OWG (Online Working Group) experts was organized to present the approach and the preliminary outcomes. After this meeting the experts were requested to review, complement and validate the information included in the spreadsheets. As a final step, several bilateral meetings with the experts were organized to clarify the information provided. The final goal was to gather the most updated and comprehensive information on the implementation status of the CI1 and CI2 in different countries, i.e. Contracting Parties of the Barcelona Convention.

Outcomes:

- Number of experts contacted / answers received
- Updated list of reference documents Annex 1
- Updated list of relevant contacts for the consultation process Annex 2

STAGE 4. Information analysis and synthesis. The information gathered in STAGE 2 which has been reviewed, complemented and validated during the consultation process in STAGE 3 was the basis to provide an overview for the selected habitats on: i) the implementation level of the CI1 and CI2 across the Contracting Parties, ii) identify the main features and methodological approaches proposed and implemented by the contracting parties with emphasis on the scales of monitoring, scales of assessment and assessment criteria and threshold and baseline values, and iii) identify the main gaps of knowledge to be addressed in those habitats for which key information is currently missing. Finally, the key elements of the CI1 and CI2 implementation were included in the IMAP Habitat templates (one for each selected habitat) developed for this assignment.

Outcomes:

- Assessment of the implementation level of CI1 and CI2 in the Contracting Parties
- Identify the main features and methodological approaches for the CI1 and CI2 proposed and/or implemented by the Contracting Parties
- Develop the "IMAP Habitat templates"
- Report on the main gaps of knowledge

11. In this assignment we will focus our tasks to identify the key elements and methodological approaches for the following items:

- Scales of monitoring
- Scales of assessment and assessment criteria
- Threshold and baseline values based on the available data.

Habitats examined

12. The selection of the habitats for the assessment for the implementation of IMAP CI1 and CI2 related to marine benthic habitats was guided by their inclusion as Priority 1 from the reference list of the UN Environment/MAP 2017, taking into account the Barcelona Convention updated list of main marine habitats and in agreement with the OWG experts (UN Environment/MAP 2017, Montefalcone et al. 2021). The description of the selected habitats is included in the corresponding Habitat templates and the references therein. The final Habitat list is included in Table 1.

Table 1. List of Barcelona Convention updated list of main habitats selected for the assessment of IMAP CI1 and CI2.

Broad habitat types	Barcelona Convention updated list main habitats selected for the assessment
Mediolittoral hard substrate	MB1.51a Well illuminated infralittoral rock, exposed MA2.5 Littoral biogenic habitat
Infralittoral hard substrate	MB1.51 Algal-dominated infralittoral rock MB2.53 Reefs of *Cladocora caespitosa*
Infralittoral soft sediment	MB2.54 Posidonia oceanica meadow MB5.521 Association with indigenous marine angiosperms MB3.511 Association with maerl or rhodoliths
Circalittoral hard substrate	MC1.5 Circalittoral rock MC2.51 Coralligenous platforms
Circalittoral sediment	MC3.52 Coastal detritic bottoms with rhodoliths
Bathyal	Upper bathyal Lower bathyal Only Bathyal since most countries do not distinguish between upper and lower Bathyal

IV. Results and discussion

1. Information compilation and contact experts

13. **Documents on IMAP CI1 and CI2 compilation**. Overall, around 100 documents have been screened, including national monitoring programmes, guidelines, technical reports, the official journals of the EU and peer-reviewed scientific publications. As of the beginning of 2022, documents that outline the national monitoring programmes specifically in view of IMAP needs were available for 9 Contracting Parties, namely Morocco, Algeria, Tunis, Libya, Egypt, Israel, Lebanon, Montenegro, and Albania. For the Contracting Parties to the Barcelona Convention that are also member states of the EU, documents and monitoring programmes related to the implementation of the EU Directives i.e. the Marine Strategy Framework Directive (MSFD), the Water Framework Directive (WFD) and the Habitat Directive (HD) were checked. Moreover, two online platforms have been consulted: the Article 17 web tool on member states' assessments of conservation status of species and habitats under Article 17 of the Habitats Directive and the Marine Strategy Framework Directive's (MSFD) reporting data explorer (WISE Marine - Marine Information system for Europe) as well as the EMODnet broad-scale seabed habitat map for Europe (EUSeaMap). The list of documents and web tools has been provided in Annex 1 with an indication of their relevance to the current assignment. The progress of Türkiye on IMAP implementation mostly stemmed from the efforts to strengthen the integration of IMAP provisions into the national monitoring programmes through the implementation of the EU-funded Project entitled "Technical Assistance for capacity building on Marine Strategy Framework Directive in Türkiye (2015-2017)", as indicated by UNEP/MAP (2019). Although no official document was available in English to date, the work within this assignment was greatly supported by 2 Turkish experts. In the case of Bosnia and Herzegovina the work towards IMAP set up is underway in the scope of the Coastal Area Management Programme (CAMP) but at the moment of this report preparation no further information

was available (A. Aldažuz, *pers. comm.*). Finally, no relevant documents for the implementation of the national monitoring programmes focusing on benthic marine habitats were identified for 4 Contracting Parties, namely Bosnia and Herzegovina, Libya, Syria, and Monaco either for CI1 or CI2 or both.

14. **Contact with experts.** Direct contacts have been attempted with 43 experts from 18 Contracting Parties. No contacts were available from Libya, Syria, and Monaco. Additional 2 experts were providing inputs based on requests of already involved French national experts, for CI1. The list of contacted experts is provided in the Annex 2.

15. An online meeting with the Online Working Group of national experts on benthic habitats was organized. Experts from six Contracting Parties, namely France, Italy, Lebanon, Slovenia, Spain and Türkiye fully participated in the consultation process, initiated through the participation in the online meeting where selection of the habitats was discussed and instructions on completing spreadsheets (see below) were given. The main results of the meeting with the experts were i) the update of the list of priority habitats targeted for the assessment following the Barcelona Convention updated list main marine habitats (Montefalcone et al. 2021), ii) the inclusion of the Bathyal habitats in the assessment and iii) the modification in the spreadsheets prepared for the data compilation (see below) and iv) finally, setting the main deadlines to review, update and provide further information (documents) already extracted from the documents compiled for the different habitats (see above). After the meeting, all the materials presented and a link to the meeting recording were shared with all OWG experts, including those that could not attend the meeting in view to enlarge the group of experts able to participate in the review process, as well as other national experts on targeted habitats were contacted in order to compile information on the implementation of the monitoring protocols.

16. **Information compilation on the monitoring activities for CI1 and CI2 by Contracting Parties.** Two google spreadsheets, one for each Common Indicator, have been created to organize information extracted from the documents collected (e.g. scientific literature, reports) and to collect experts' inputs in a structured way. Each broad habitat type (as defined in the Table 1 of this document and indicated in the spreadsheets) had a dedicated sheet (6 per spreadsheet), collecting information on different aspects of monitoring implementation elements (columns) for the 21 Mediterranean Contracting Parties to the Barcelona convention (rows). A total of 25 and 23 elements (columns) for CI1 and CI2 were defined, respectively. These elements were fully described in a dedicated "Read-me" file within each spreadsheet. Whenever possible, inputs were organized in categories and could have been selected from a drop-down menu to ensure the homogeneity in the information compilation. Bearing in mind that the information was collected for each Contracting Party to the Barcelona Convention (21 in total) and selected sub-habitat category (11) (according to the Table 1) we obtained two data matrices with more than 10000 data entries (about 5000 for each CI). Through the document, we will refer to the ***Habitat Monitoring Protocol*** as the information collected on how the countries are implementing the monitoring activities for each selected habitat, corresponding to the information provided in each row of the two compiled spreadsheets. Likewise, we will refer to **National Monitoring Programs** as the group of *Habitat Monitoring Protocols* that the Contracting Parties are implementing for the selected habitats.

Table 2. List of implementation elements considered for each Habitat Monitoring Protocol for the IMAP indicators CI1 and CI2.

The information collected is included in the CI1 and CI2 spreadsheets (for description of elements refer to Annex 3 and Annex 4).

Monitoring implementation elements considered for each Habitat Monitoring Protocol (HMP)	
CI1	**CI2**
Main Habitat - BC updated list	Main Habitat - BC updated list
Sub-habitat categories BC updated list	Sub-habitat categories BC updated list
Sub-habitat categories extracted from documents	Sub-habitat categories extracted from documents
Implementation status	Implementation status
Spatial scale Monitoring (N of monitored areas or km2)	Spatial Scale Monitoring (N of sites/areas)
Estimation % of total extent of the habitat monitored	Monitoring include MPA sites
Monitoring include MPA sites	Temporal Scale Monitoring frequency (years)
Temporal Scale Monitoring frequency (years)	Metrics
Scales of Assessment	Implementation year start
Scales of Assessment: N of Subdivisions of coastal waters	Scales of Assessment
Seabed habitat mapping method	Scales of Assessment: N of Subdivisions of coastal waters
Assessment criteria availability	Assessment criteria availability
Assessment criteria	Assessment criteria
Thresholds values	Thresholds values availability
Implementation year start	Thresholds values
Baseline	Baseline
Baseline data	Baseline data
Mapping human activities data	Reference docs
Mapping human activities data - further details	Links to EU MSFD, WFD, HD

Reference docs	Comments
Links to EU MSFD, WFD, HD	Expert review
Comments	Expert(s) contact(s) (Name & e-mail)
Expert review	Expert comments
Expert(s) contact(s) (Name & e-mail)	
Expert comments	

2. Assessment of the implementation level of CI1 and CI2 by the Contracting Parties

17. For each country (21) and for each of the eleven habitats selected for the assessment (following the Barcelona convention main habitat updated list, Table 1), we extracted the information available from the "*Habitat monitoring protocols"* included in the *National monitoring programs*.

18. Most of the selected habitats were present in the 21 countries. However, Bathyal habitat is absent in Slovenia and Bosnia and Herzegovina. Likewise, the presence of the MC3.52 Coastal detritic bottoms with rhodoliths was not confirmed in Slovenia at the time of the preparation of this report, though recent research confirmed now its presence (B. Mavrič *pers. comm*). Moreover, *Posidonia oceanica* meadows are not present in Israel, Lebanon and Syria (Telesca *et al.* 2015) and MC1.5 Circalittoral rock in Israel is represented by specific kurkar ridges i.e sandstone conglomerates while there is no specific mention of the coralligenous bioconcretions.

19. The information on the monitoring activities for 11 habitats implemented by countries were analyzed, information for 231 *Habitat Monitoring Protocols* were collected (we will use HMP acronym to refer to them) per the 2 CI analyzed, thus a total of 462 HMPs. More precisely and bearing in mind the absence of 3 habitats in 5 countries (see above), the total number of Habitat Monitoring Protocols screened was 452.

20. Overall, the level implementation of monitoring activities related to CI1 and CI2 is low since most of the monitoring programs are not started for both CIs. In fact, only 98 Habitat Monitoring Protocols for both CI are being implemented, which represents about 40% of the total (Figure 2.1 and 2.4). Besides, within those considered as implemented, only 36 (15%) and 56 (25%) are effectively ongoing for CI1 and CI2, respectively, while the others are still in the planning or unknown phase of implementation (Figure 2.1 and 2.4).

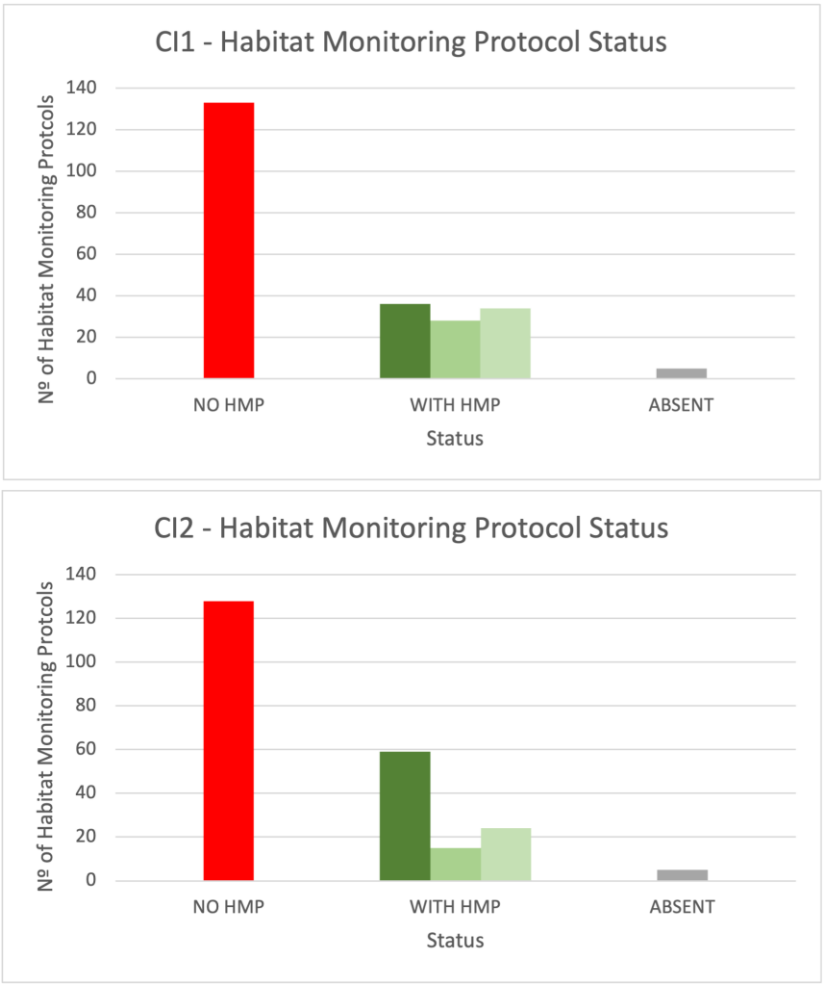
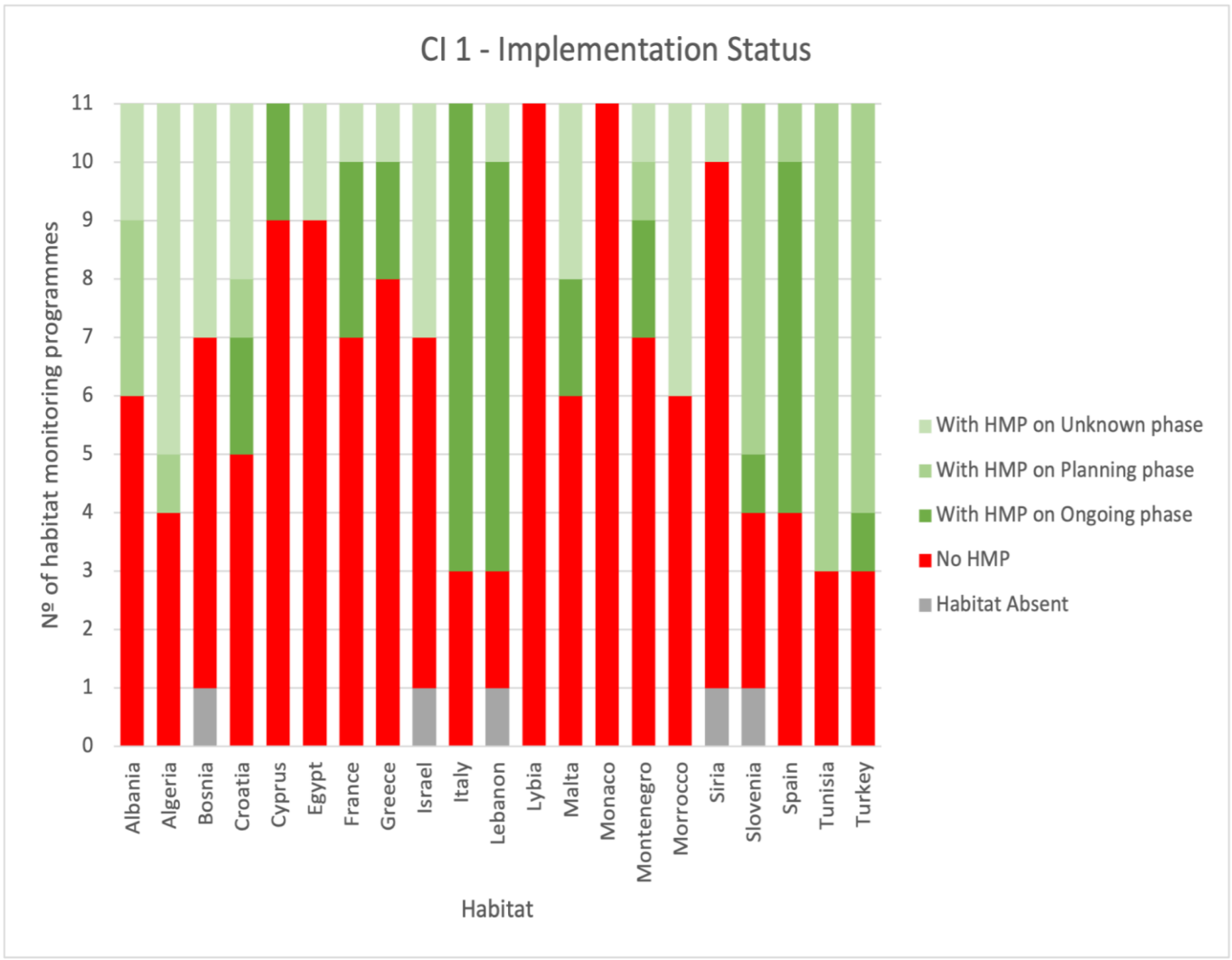


Figure 2.1. *Implementation status of the IMAP Habitat Monitoring Protocols on CI1 (above) and CI2 (down) pooling information from the 21 countries contracting parties to the Barcelona convention. Within the category "With HMP" dark green corresponds to ongoing HMP, medium green corresponds to HMP in planning phase, and light green corresponds to unknown phase.*

21. At the **country level**, the implementation status of 11 Habitat Monitoring Protocols (corresponding to the 11 selected habitats for the assessment) was analysed for the 21 Contracting Parties, except for Bosnia and Herzegovina, Israel, Lebanon, Syria and Slovenia for which the HMP screened is 10 since one of the target habitats are absent from these countries (see above).

22. From the information collected from the National Monitoring Programs for CI1 and CI2, we found information on Habitat Monitoring Protocols for all countries except for Libya and Monaco for CI1 and for Bosnia and Monaco for CI2 (Figure 2.2.).



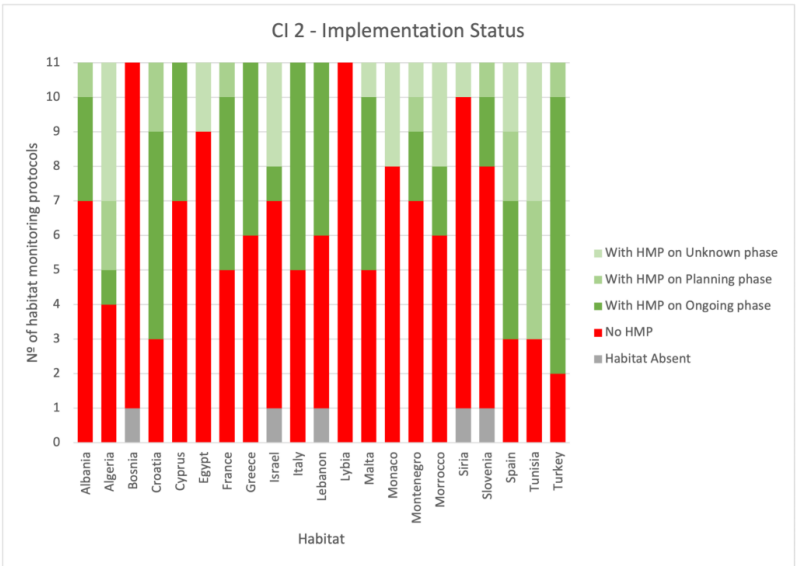
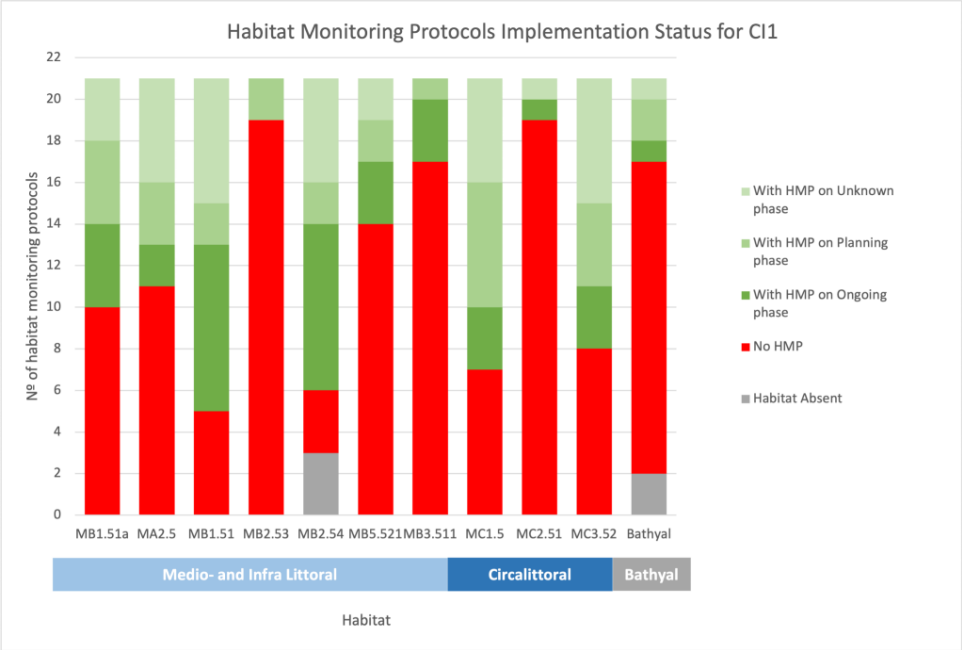


Figure 2.2. *Implementation status of Habitat Monitoring Protocols for the IMAP indicators CI1(above) and CI2 (down) per each of the 21 countries Contracting Parties to the Barcelona convention.*

23. For CI1, 13 countries (about 60%) lack a Habitat Monitoring Protocol for 6 or more habitats and only 8 countries (about 40%) have HMP for more than 6 habitats. However, even within this last group, only 3 countries (Italy, Lebanon and Spain) have HMPs in an ongoing phase in 6 or more habitats (Figure 2.2). In fact, HMP in the ongoing phase was reported in only 11 countries but in most of the cases did not cover more than 3 habitats, with a maximum of 8 habitats (Italy). For the remaining 8 countries the HMPs are in planning or unknown phases, ranging in number from 1 to 8, but most of them corresponded to the unknown implementation phase i.e. we found some information on the existence of protocol but we could not determine the current implementation status (Figure 2.2 and 2.4). Thus, the figures on the ongoing HMPs may be higher. For three countries we could not find any information on the CI1 implementation status (Libya, Monaco and Syria).

24. For CI2, 12 countries (about 55%) lack of Habitat Monitoring Protocol for 6 or more habitats and 9 countries have HMPs for more than 6 habitats. However, only 3 countries (Croatia, Italy and Türkiye) have HMPs in an ongoing phase in 6 or more habitats, with Türkiye having HMPs for 9 habitats. In fact, HMP in the ongoing phase was reported in 15 countries, thus a bit larger compared with CI1 implementation. Besides, at least 10 countries are covering 3 or more habitats with a maximum of 8 habitats (Türkiye). For the remaining 4 countries only having HMPs in planning or unknown phase, the HMP included from 1 to 4 habitats (Figure 2.2 and 2.4). It is noteworthy that if we include the HMP in the planning phase more than 50% of countries (10) include 5 habitats or more in their National Monitoring Programs. For four countries we could not find any information on the CI2 implementation status (Bosnia, Monaco, Libya and Syria).

25. In summary, only 4 countries show a high level of HMP implementation, i.e. ongoing activities covering 6 or more habitats. None of the countries conduct monitoring activities covering all considered habitats, neither for CI1 nor CI2. Comparing both CIs, the implementation status of CI2 is higher than for CI1, i.e. more countries having ongoing monitoring activities.



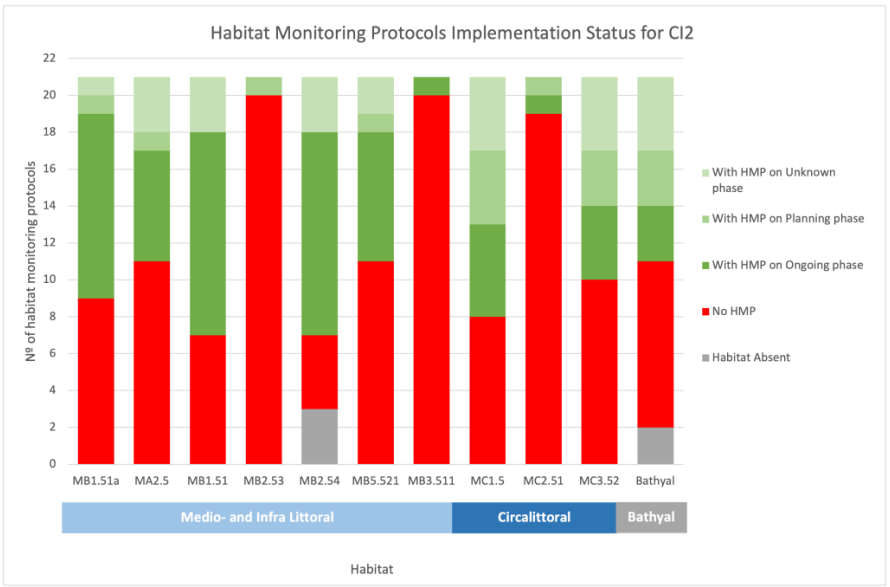


Figure 2.3. *Implementation status of Habitat Monitoring Protocols for the IMAP indicators CI1(above) and CI2 (down) for the 11 selected habitats covering from the mediolitoral to bathyal stages.*

26. The assessment at the habitat level showed that National monitoring programs cover all considered habitats for both CIs. Overall, we examined 98 Habitat Monitoring Protocols for each CI, resulting in an average of about 9 HMP for CI1 and CI2 per habitat (Figure 2.3 and 2.4). However, for 6 habitats HMPs were absent in more than 50% of the analyzed National Monitoring Programs related to CI1 and CI2 (Figure 2.3 and 2.4).

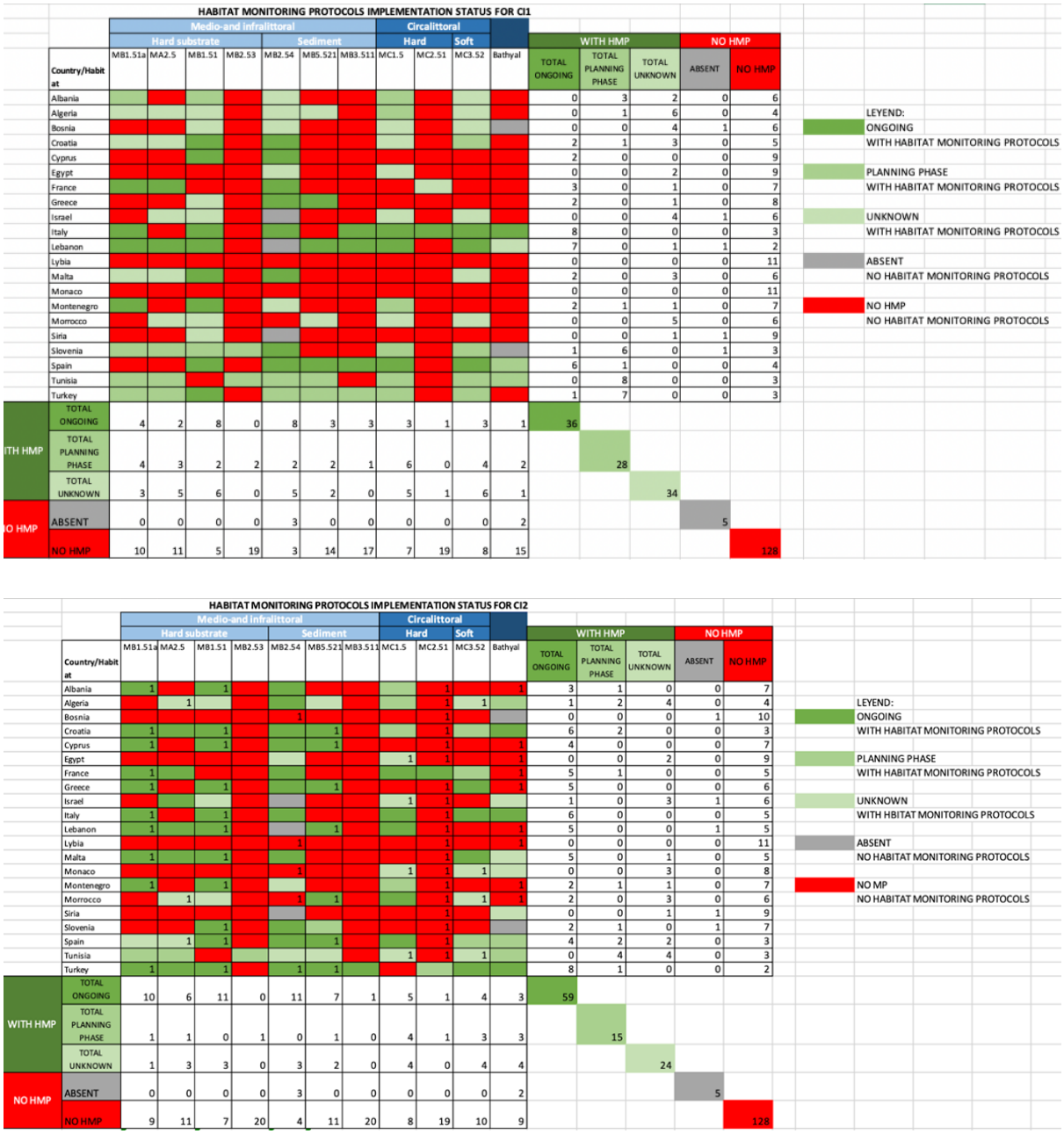
27. Regarding the monitoring activities on CI1, from the 98 HMPs examined only 36% were in the ongoing implementation phase whereas the rest of corresponding HMPs were in the planning or unknown phase (Figure 2.3 and 2.4). Almost 80% of the ongoing HMPs were implemented in the Medio- and infralitoral stage dominated by macroalgal species and the seagrasses. More precisely, within these stages the habitats [MB1.51a Well illuminated infralittoral rock, exposed, MB1.51 Algal-

dominated infralittoral rock and MB2.54 Posidonia oceanica meadow] have been selected by the countries to implement their ongoing monitoring activities (Figure 2.3 and 2.4). In the circalittoral zone, the most of the ongoing monitoring efforts were focused on the coralligenous and circalittoral rhodolith beds (MC1.5 and MC3.52) while the lowest effort was invested in monitoring of bathyal habitats. The remaining 74% of HMPs on CI1 are in planning and unknown phase, in general, across the habitats following the same pattern found for onoging HMP (Figure 2.3 and 2.4).

28. Regarding the monitoring activities for CI2, out of the 98 HMPs examined only 60% were in the ongoing implementation phase whereas the rest of corresponding HMPs were in the planning or unknown phase (Figure 2.3). As for CI1, almost 80% of the ongoing HMPs were implemented in the Medio- and infralittoral stage dominated by macroalgal species and the seagrasses. Within these stages the habitats [MB1.51a Well illuminated infralittoral rock, exposed, MB1.51 Algal-dominated infralittoral rock and MB2.54 Posidonia oceanica meadow] have been selected by the countries to implement their ongoing monitoring activities (Figure 2.3). In the circalittoral zone, the most of the ongoing monitoring efforts were focused on the coralligenous and circalittoral rhodolith beds (MC1.5 and MC3.52) while the lowest effort was invested in monitoring of bathyal habitats. The remaining 40% of HMPs on CI2 are in planning or unknown phase, in general, across the habitats following the same pattern found for onoging HMP (Figure 2.3 and 2.4).

29. These differential monitoring efforts across habitats are likely related with the methodological readiness and cost-effectiveness of methodological approaches available to conduct the monitoring activities in the different habitats (UN Environment/MAP 2016). For instance, it is noteworthy the case of Posidonia oceanica meadows habitats, for which there is an excellent background, and most countries have qualified experts to conduct the monitoring activities. On the other hand, it is obvious, for instance, that the methods to assess the condition of Bathyal habitats require access to equipment (e.g. ROVs) and research vessels able to operate in these habitats.

30. In summary, at habitat level, only about half of the analyzed habitats show a high level of HMP implementation, i.e. ongoing activities conducted by 10 or more countries. No habitat is covered by all countries for any of the CIs considered. Comparing both CIs, the implementation status of CI2 is higher than for CI1, i.e. more habitats having ongoing monitoring activities.



HABITAT MONITORING PROTOCOLS IMPLEMENTATION STATUS FOR CI1

		Medio-and infralittoral							Circalittoral				WITH HMP			NO HMP	
		Hard substrate				Sediment			Hard		Soft						
	Country/Habitat	MB1.51a	MA2.5	MB1.51	MB2.53	MB2.54	MB5.521	MB3.511	MC1.5	MC2.51	MC3.52	Bathyal	TOTAL ONGOING	TOTAL PLANNING PHASE	TOTAL UNKNOWN	ABSENT	NO HMP
	Albania												0	3	2	0	6
	Algeria												0	1	6	0	4
	Bosnia												0	0	4	1	6
	Croatia												2	1	3	0	5
	Cyprus												2	0	0	0	9
	Egypt												0	0	2	0	9
	France												3	0	1	0	7
	Greece												2	0	1	0	8
	Israel												0	0	4	1	6
	Italy												8	0	0	0	3
	Lebanon												7	0	1	1	2
	Lybia												0	0	0	0	11
	Malta												2	0	3	0	6
	Monaco												0	0	0	0	11
	Montenegro												2	1	1	0	7
	Morrocco												0	0	5	0	6
	Siria												0	0	1	1	9
	Slovenia												1	6	0	1	3
	Spain												6	1	0	0	4
	Tunisia												0	8	0	0	3
	Turkey												1	7	0	0	3
WITH HMP	TOTAL ONGOING	4	2	8	0	8	3	3	3	1	3	1	36				
WITH HMP	TOTAL PLANNING PHASE	4	3	2	2	2	2	1	6	0	4	2		28			
WITH HMP	TOTAL UNKNOWN	3	5	6	0	5	2	0	5	1	6	1			34		
NO HMP	ABSENT	0	0	0	0	3	0	0	0	0	0	2				5	
NO HMP	NO HMP	10	11	5	19	3	14	17	7	19	8	15					128

LEYEND:
ONGOING
WITH HABITAT MONITORING PROTOCOLS
PLANNING PHASE
WITH HABITAT MONITORING PROTOCOLS
UNKNOWN
WITH HABITAT MONITORING PROTOCOLS
ABSENT
NO HABITAT MONITORING PROTOCOLS
NO HMP
NO HABITAT MONITORING PROTOCOLS

HABITAT MONITORING PROTOCOLS IMPLEMENTATION STATUS FOR CI2

		Medio-and infralittoral							Circalittoral				WITH HMP			NO HMP	
		Hard substrate				Sediment			Hard		Soft						
	Country/Habitat	MB1.51a	MA2.5	MB1.51	MB2.53	MB2.54	MB5.521	MB3.511	MC1.5	MC2.51	MC3.52	Bathyal	TOTAL ONGOING	TOTAL PLANNING PHASE	TOTAL UNKNOWN	ABSENT	NO HMP
	Albania	1		1						1		1	3	1	0	0	7
	Algeria		1							1	1		1	2	4	0	4
	Bosnia					1				1			0	0	0	1	10
	Croatia	1		1			1			1			6	2	0	0	3
	Cyprus	1		1			1			1		1	4	0	0	0	7
	Egypt								1	1		1	0	0	2	0	9
	France	1										1	5	1	0	0	5
	Greece	1		1			1			1		1	5	0	0	0	6
	Israel								1	1			1	0	3	1	6
	Italy	1		1						1			6	0	0	0	5
	Lebanon	1		1			1			1		1	5	0	0	1	5
	Lybia					1				1		1	0	0	0	0	11
	Malta	1		1						1			5	0	1	0	5
	Monaco					1			1	1	1		0	0	3	0	8
	Montenegro	1		1						1		1	2	1	1	0	7
	Morrocco		1			1	1			1	1	1	2	0	3	0	6
	Siria									1			0	0	1	1	9
	Slovenia			1						1			2	1	0	1	7
	Spain		1	1			1			1			4	2	2	0	3
	Tunisia								1	1	1		0	4	4	0	3
	Turkey	1		1		1	1						8	1	0	0	2
WITH HMP	TOTAL ONGOING	10	6	11	0	11	7	1	5	1	4	3	59				
WITH HMP	TOTAL PLANNING PHASE	1	1	0	1	0	1	0	4	1	3	3		15			
WITH HMP	TOTAL UNKNOWN	1	3	3	0	3	2	0	4	0	4	4			24		
NO HMP	ABSENT	0	0	0	0	3	0	0	0	0	0	2				5	
NO HMP	NO HMP	9	11	7	20	4	11	20	8	19	10	9					128

LEYEND:
ONGOING
WITH HABITAT MONITORING PROTOCOLS
PLANNING PHASE
WITH HABITAT MONITORING PROTOCOLS
UNKNOWN
WITH HBITAT MONITORING PROTOCOLS
ABSENT
NO HABITAT MONITORING PROTOCOLS
NO MP
NO HABITAT MONITORING PROTOCOLS

Figure 2.4. *Implementation status of IMAP Habitat Monitoring Protocols on CI1 (above) and CI2 (down) per country and habitats.*

31. Regarding the year of implementation, considering the ongoing and planned Habitat Monitoring Protocols for IMAP CI1 and CI2, for more than 40% of HMPs examined there was no information on the implementation year for both indicators. For those HMPs with information on the implementation year, about 20% of the CI1 HMP started in 2004-2011 while the rest of HMP started in the following considered periods, about 15% in 2012-2017 and 2018-2023, respectively (Figure 2.5). For CI2, the pattern is similar to CI1, although the HMP started two years later, in 2006, and the first period, 2006-2011, concentrates the starting of the largest number of HMP with a slight decrease in the following periods (Figure 2.5).

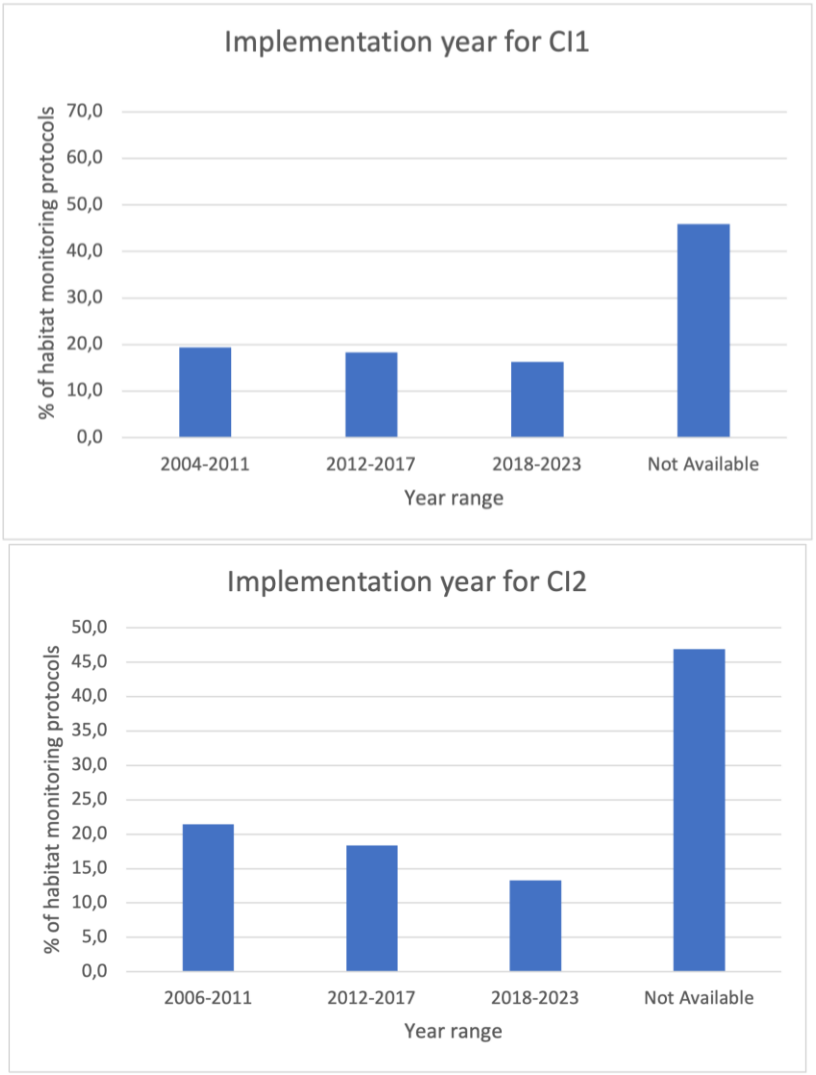


Figure 2.5. *Implementation year of ongoing and planned IMAP Habitat Monitoring Protocols on IMAP CI1(above) and CI2 (down). (Percentages are calculated considering the total of HMPs in ongoing, planning and unknown phases)*

32. Regarding the information on the implementation year of monitoring activities per country, it was missing for about 45% of HMPs both for CI1 and CI2. Besides, for 7 countries for which we found information on HMP, there was no information on the implementation year for both indicators (Algeria, Bosnia) or in one of the two CIs examined (Egypt, Greece, Morocco, Syria, Tunisia). Overall, we found information for 13 and 14 countries' national monitoring programs for CI1 and CI2, respectively (Figure 2.6). From these, 8 countries (~60%) started their monitoring activities in some of the habitats more than 15 years ago (during the period 2006-2011), 4 countries (~30%) started less than 10 years ago while the remaining countries started their monitoring activities back 5 years ago or plan to do it in the next years (Figure 2.6). It is noteworthy that for 5 and 6 countries with HMP ongoing and/or planned for CI1 and CI2, respectively, we did not find any information about the implementation year (Figure 2.6). In general, in most countries the implementation of the Habitat Monitoring Protocols span across the two or three periods considered.

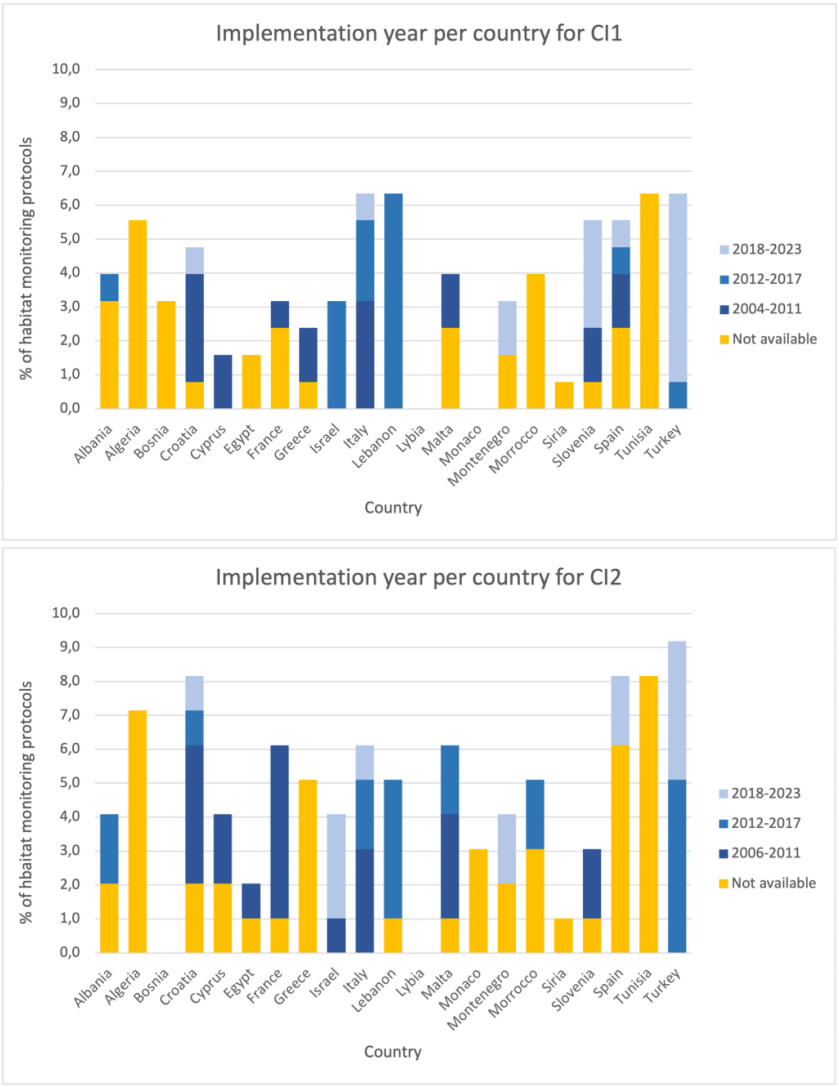


Figure 2.6. *Implementation year of ongoing and planned per country of IMAP Habitat Monitoring Protocols on CI1 (above) and CI2 (down). (Percentages are calculated considering the total of HMPs in ongoing, planning and unknown phases).*

33. Regarding the information on the start of monitoring implementation period per habitat, it was missing for about 45% of HMPs, both for CI1 and CI2. In general, monitoring of mediolitoral and infralitoral habitats started during the first period considered, i.e. 2004/6-2012 specially for CI2, while in deeper habitats, circalittoral and bathyal zones, the implementation started in the following periods or are planned to start in the next years (Figure 2.7). In general, in most habitats the implementation of the Habitat Monitoring Protocols span across the two or three periods considered. Finally, it is noteworthy that the lack of information on the implementation year concerns all habitats regardless of the indicator considered (Figure 2.7).

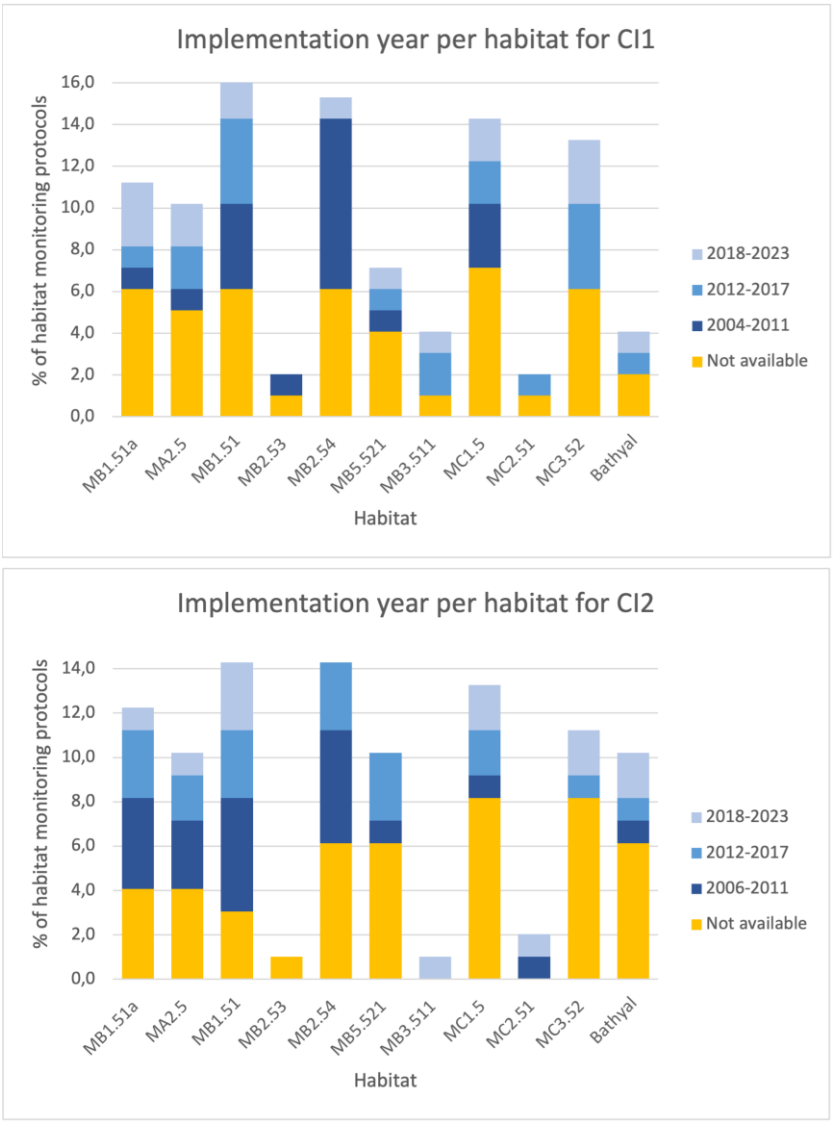


Figure 2.7. *Implementation year of ongoing and planned per habitat of IMAP Habitat Monitoring Protocols on CI1 (above) and CI2 (down). (Percentages are calculated considering the total of HMPs in ongoing, planning and unknown phases).*

3. Implementation features CI1

34. In this section, we describe the main features of the Habitat Monitoring Protocols defined by Barcelona Contracting Parties to monitor IMAP CI1 "Habitat distributional range" in the selected 11 habitats. The information presented was extracted from HMPs in the ongoing, planned and unknown implementation status, that is a total of 98 out of 221 HMP that should be implemented. It is important to highlight that we found different levels of information for the different HMPs, for instance for some HMPs we found information on both spatial and temporal scales implemented while for the others only information on the one or the other. As a consequence, the total number of HMP with information may vary across the different implementation features explored.

35. As a general comment, from the reports and information collected for CI1, most countries reported mapping activities conducted in different habitats. However, it seems that not real monitoring actions are being implemented, i.e. habitat mapping is not being repeated over time. This point should further be discussed and clarified with the countries in view to adapt the monitoring activities for CI1.

36. In general, there are three main mapping techniques that have been used and that can be combined: 1) optical-based techniques using remote sensing instruments such as satellites and drones; 2) acoustic-based techniques using remote sensing instruments such as side scan sonars and 3) field-based techniques conducted through visual surveys, diving, snorkeling and ecological monitoring (UNEP-MAP 2020). The selection of mapping methods to evaluate changes/losses in habitat extent depend mainly on depth of occurrence and resolution/precision needed – a thorough overview is available in updated Guidelines for monitoring marine vegetation in the Mediterranean (UNEP-MAP 2020).

Spatial scales

37. From the information collected it was difficult to provide a consistent synthesis of the spatial scales used in the assessment of CI1. In fact, the information on the spatial scales was absent for about 85% of Habitat Monitoring Protocols screened (Table 3) . For the remaining HMPs (about 15%) two main units were used i.e. number of sites for 23 HMPs and km2 mapped; besides some Contracting Parties indicated the % of the total extent of the habitat monitored (Table 3). The number of indicated monitoring sites are in general lower than 10, while for HMPs providing the total surface mapped it varied greatly - from 0,01 to 48400 km2. More surprisingly, the information on the total extent ranged from 56 to 100% of the habitat. Overall, the scarcity of information hindered any further analysis of spatial scale features. It seems that we need further contacts with the Contracting Parties to clarify more precisely the spatial scales addressed for CI1 monitoring activities. We recommend working with countries to establish the reporting unit in the spatial scales for the implementation of CI1.

Table 3. Spatial scales indicated in the Habitat Monitoring Protocol for the IMAP indicator CI1 for the corresponding list of main habitats selected for the assessment. The habitats nomenclature corresponds to the Barcelona Convention updated list.

Habitat	Nº Habitat Monitoring Protocols (Range of Nº of monitored sites)	Nº Habitat Monitoring Protocols (Nº of km2 monitored)	Nº Habitat Monitoring Protocols (Estimation % of total extent of the habitat monitored)	No information on spatial scales monitored
MB1.51a Well illuminated infralittoral rock	3 (1-12)	0	4 (70-100%)	16
MA2.5 Littoral biogenic habitat	4 (1-6)	0	2 (70-100%)	16
MB2.53 Reefs of Cladocora caespitosa	0	0	0	21
MB1.51 Algal-dominated infralittoral rock	3 (5-several)	1 (0.01 km2)	3 (70-100%)	14
MB2.54 Posidonia oceanica meadow	1 (1)	6 (0.007-48400 km2)	5 (56-100%)	14
MB5.521 Association with indigenous marine angiosperms	2 (1-4)	0	0	19

MB3.511 Association with maerl or rhodoliths	1 (1)	0	0	20
MC1.5 Circalittoral rock	4 (1-9)	1 (0.05 km2)	0	17
MC2.51 Coralligenous platforms	1 (27)	0	0	19
MC3.52 Coastal detritic bottoms with rhodoliths	2 (3-105)	0	0	19
Bathyal	1 (5)	0	0	20

Temporal scales

38. Overall, in about 60% of the 98 Habitat Monitoring Protocols for CI1 the temporal scale of the monitoring activities was not indicated (Figure 3.1). Among the HMPs providing the information, the most common temporal scale to conduct monitoring activities was every 3 years (30%), followed by every 6 years (7%) and 1 and 2 years (Figure 3.1).

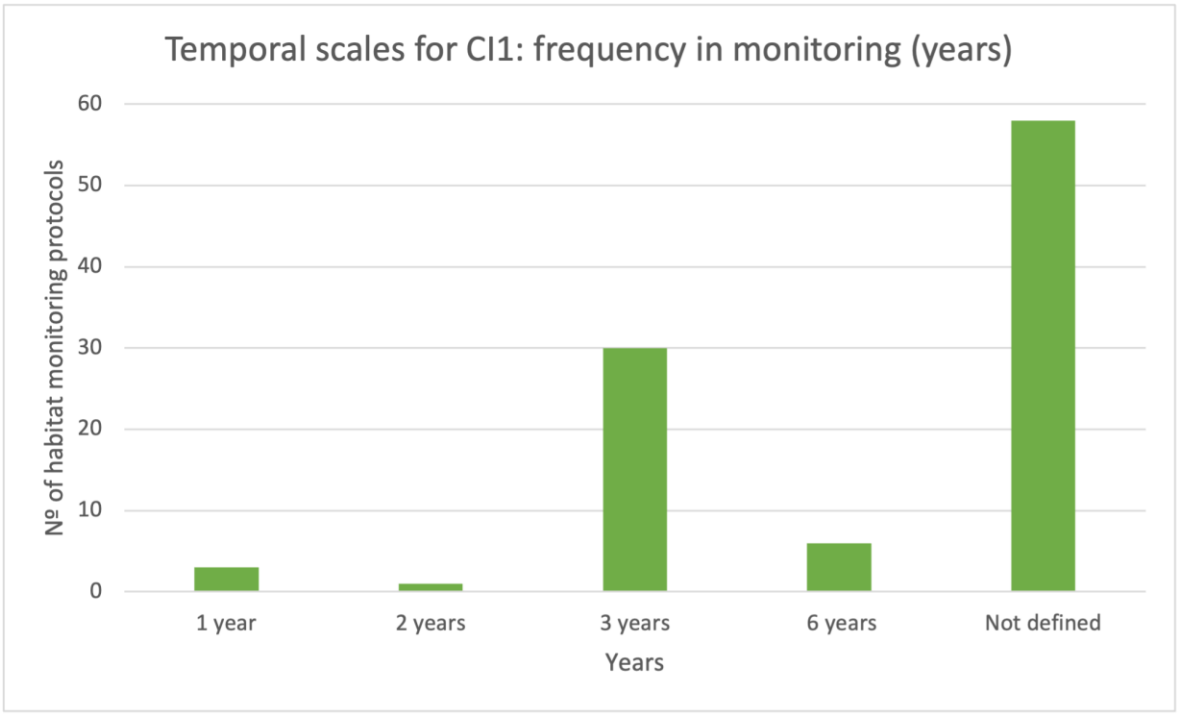


Figure 3.1. *Temporal scales (frequency of monitoring) in ongoing and planned Habitat Monitoring Protocols for the IMAP CI1.*

39. Regarding the temporal scales of HMP per country for which we found information on ongoing or planned monitoring programs for CI1, most countries (10) did not report information on temporal scales (Figure 3.2). Only three countries (France, Italy and Türkiye) provided information on the temporal scales for all HMPs that they are implementing for CI1. For the rest of the countries (6) we found partial information and most of them are using similar temporal scales for their HMPs. It is noteworthy that Lebanon is implementing 3 HMPs for CI1 on an annual basis (Figure 3.2).

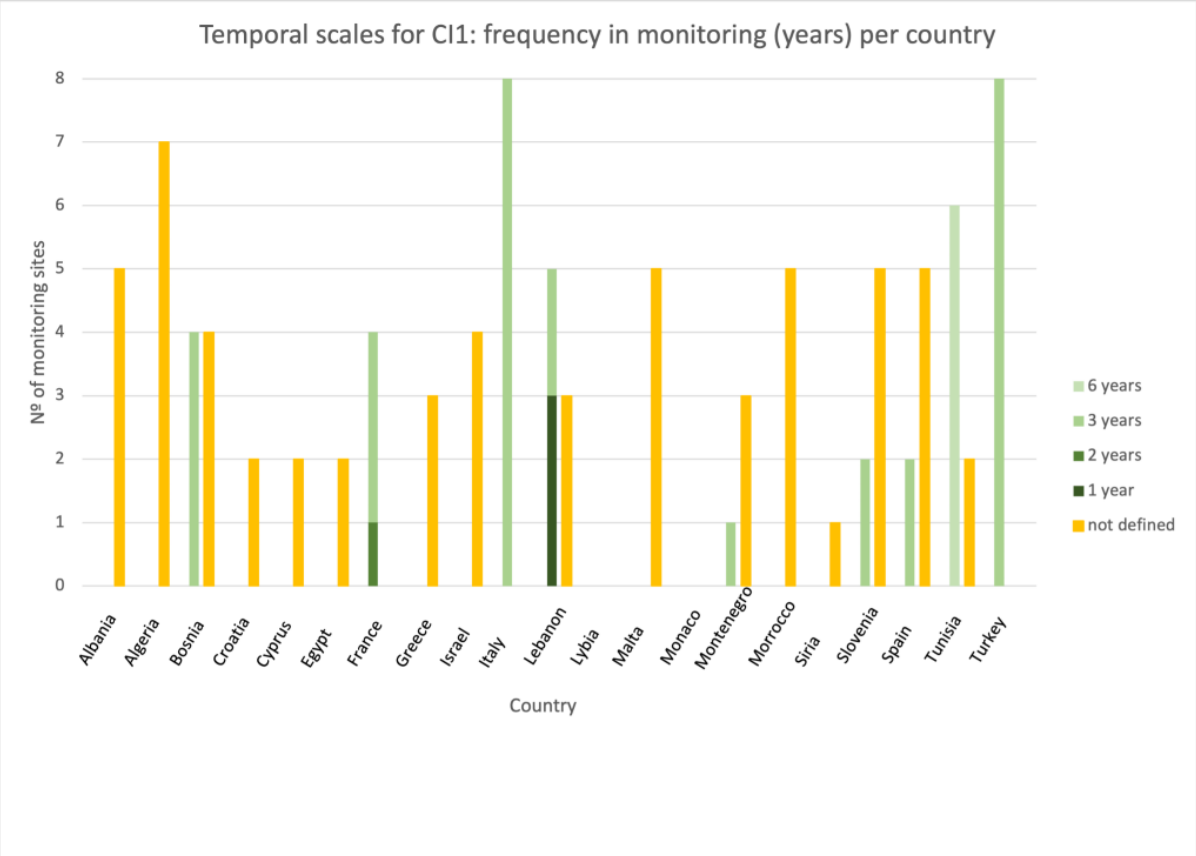


Figure 3.2. *Temporal scales (frequency of sampling) by country in ongoing and planned Habitat Monitoring Protocols for the IMAP CI1.*

40. Regarding the temporal scales of HMP per habitat for which we found information relevant for CI1, in general medio-littoral and infralittoral habitats showed monitoring activities every 1 to 3 years while in deeper habitats, circalittoral and bathyal, the most common frequency of monitoring is 3 years and more (Figure 3.2). The HMPs dedicated to "MB1.51a Well illuminated infralittoral rock, exposed" and "MB2.54 Posidonia oceanica meadow" in the infralittoral zone and the "MC1.5 Circalittoral rock" for the circalittoral zone were the ones for which we found more information on temporal scales. It is noteworthy that in the case of the habitat "MB1.51 Algal-dominated infralittoral rock" for which the maximum number of HMPs (16) was found, for most of them the information on temporal scales was not defined (Figure 3.3)

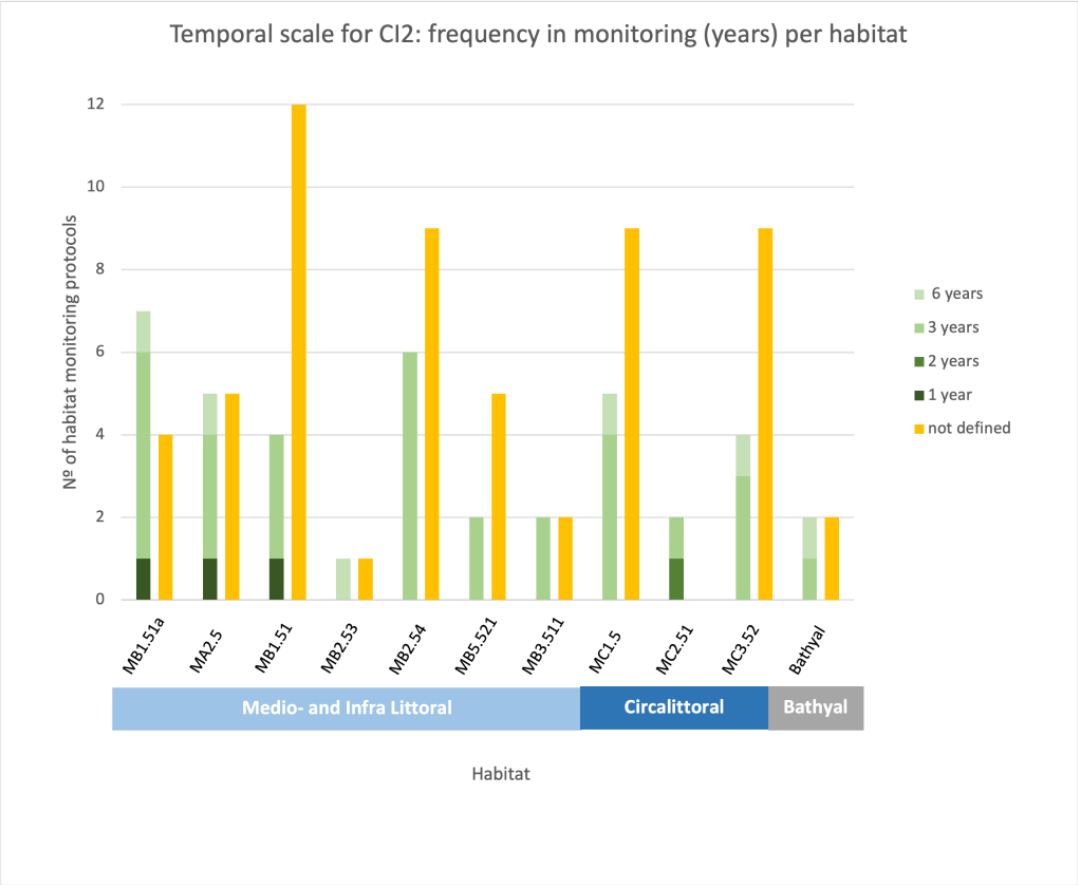


Figure 3.3. *Temporal scales (frequency of sampling) by habitat in ongoing and planned Habitat Monitoring Protocols for the IMAP CI1.*

Assessment criteria

41. Overall, about 60% of the Habitat Monitoring Programs have identified the assessment criteria (Figure 3.4). For the medio- and infralittoral habitats dominated by macroalgal species and seagrasses, for four habitats the Assessment criteria is available for more than 50% of the HMPs. Moreover, for the habitat "MB1.51a Well illuminated infralittoral rock, exposed" all HMPs have an Assessment criterion, mainly based on the CARLIT (Ballesteros et al. 2007). However, for the "MB2.54 Posidonia oceanica meadow" 7 out of 8 HMPs have no Assessment criteria. For the other two habitats considered in the medio- and infralittoral, it is noteworthy that for the "MB1.51 Algal-dominated infralittoral rock" only 6 out of 16 (about 35%) of HMPs defined the Assessment criteria (Figure 3.4). Related to the 4 habitats considered for the Circalittoral and Bathyal zone about 50% of the corresponding HMPs have identified assessment criteria (Figure 3.4).

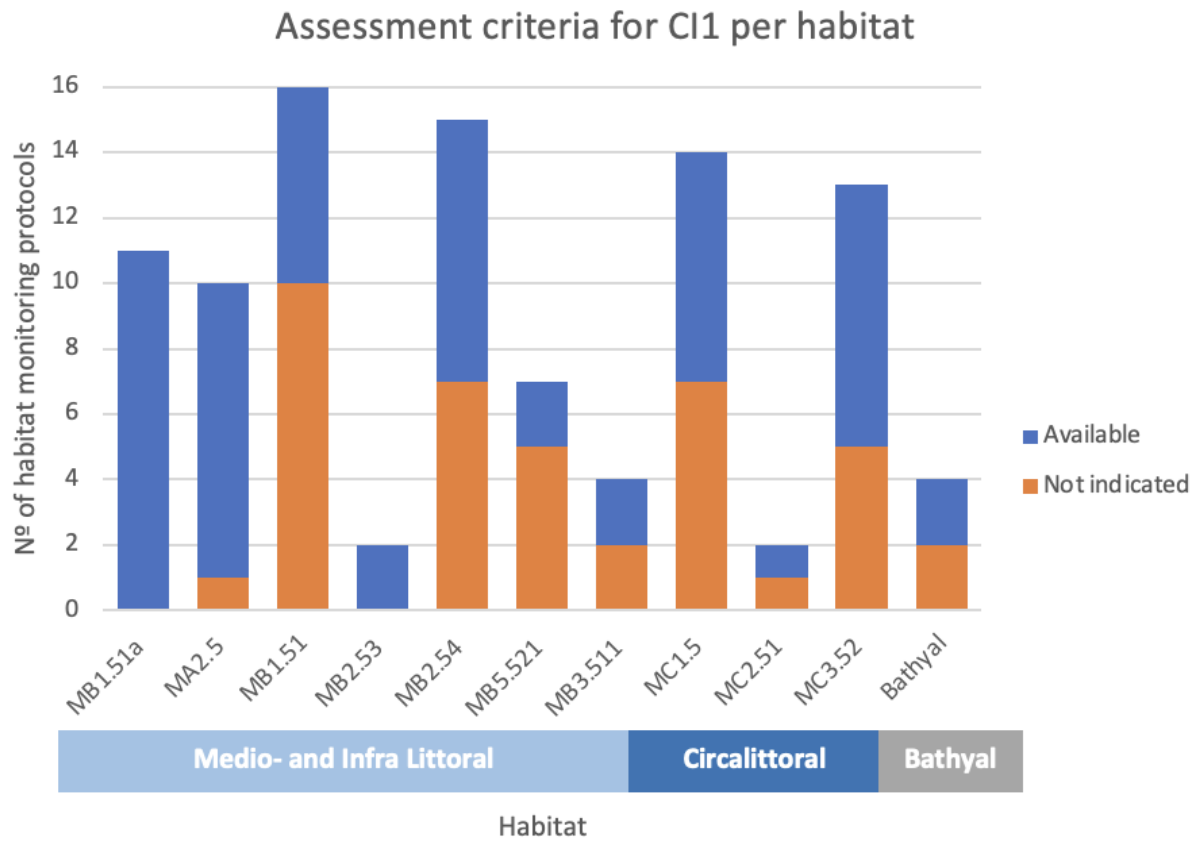


Figure 3.4. *Availability of Assessment criteria for IMAP CI1 in ongoing and planned Habitat Monitoring Protocols for the selected priority habitats.*

42. When indicated, habitat distribution and extent change/loss is the most frequently reported CI1 assessment criteria by Contracting Parties. At the level of classification of priority habitats considered here (based on Barcelona Convention Habitat Updated list, Montefalcone et al. 2021) it is noteworthy to mention that every 6 years Mediterranean EU member states have the obligation to explicitly report on habitat range and area for Posidonia oceanica meadows (priority habitat 1120) in the scope of the EU Habitat Directive, and to assess their trends. Unfortunately, other considered habitats are included in broader habitat types, hence data on their distributional range and trends are not readily available.

43. For all habitats except Bathyal ones, Spain specifies bathymetric and geographic range, area significantly affected by human activities and area subjected to physical damage as considered metrics to assess CI1. Although rarely any specifics on methodology are provided, indicated ones imply extraction of data on the habitat distributional range either from results of direct habitat mapping or the EUSeaMap broad scale predictive model and, its adjustment by descriptors D6C3 and D6C5 related to the Spatial extent adversely affected by disturbance (physical or otherwise) and D6C4 - Extent of loss of habitat type (in the case of MSFD), as outlined for Malta (ERA 2020).

Thresholds values

44. Regarding the Threshold values for the evaluation of the GES status in terms of habitat distributional range (CI1), most of the Habitat Monitoring Programs implemented by the Contracting Parties have not indicated them. In fact, only 6 out 97 (about 6%) of the HMPs, mainly corresponding to the medio- and infralittoral stage, indicated the availability of thresholds values (Figure 3.5).

However, none of the habitat monitoring protocols indicating the availability of thresholds for any of considered priority benthic habitats explicitly indicate threshold values for achieving GES in terms of habitat distributional range (CI1).

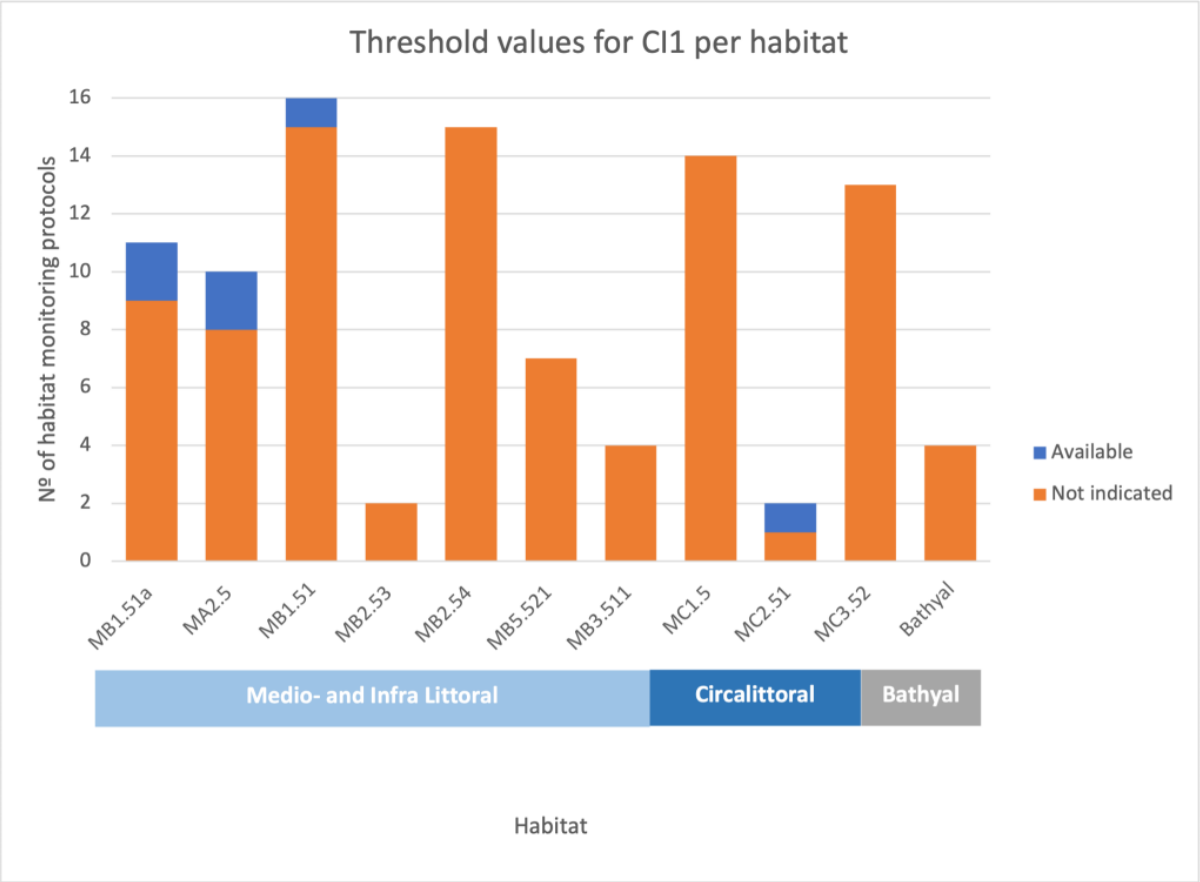


Figure 3.5. *Availability of Thresholds values for IMAP CI1 in ongoing and planned Habitat Monitoring Protocols the selected priority habitats.*

Baselines

45. Concerning the availability of Baselines to evaluate the status in terms of CI1 "Habitat Distributional range", regardless of the habitat considered, most Habitat Monitoring Protocols lack Baselines (Figure 3.6). For the HMPs with Baselines most of them correspond to Operational baselines and only one HMP considers Historical baseline (Figure 3.6). The HMPs for the habitat "MB1.51 Algal-dominated infralittoral rock" and "MB2.54 Posidonia oceanica meadow" were the only ones for which more than 50% of the HMPs implemented have Baselines (Figure 3.6).

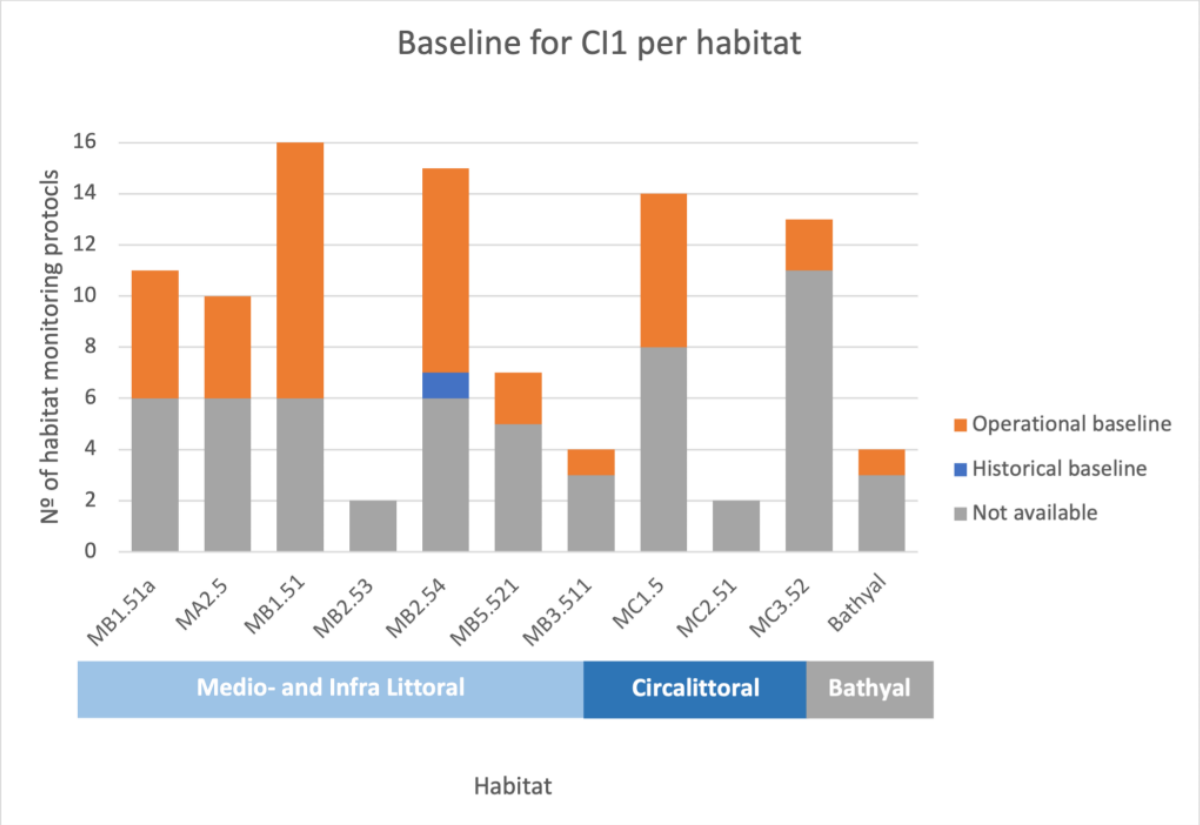


Figure 3.6. *Availability of Baseline for IMAP CI1"Habitat distributional range" in ongoing and planned Habitat Monitoring Protocols for the selected priority habitats.*

4. Implementation features CI2

46. In this section, we describe the main features of the Habitat Monitoring Protocols defined by Barcelona Convention Contracting Parties to monitor IMAP CI2 "Condition of the habitat's typical species and communities" in the selected 11 habitats. The information presented was extracted from HMPs in ongoing, planned and unknown implementation status, that is a total of 98 out of 221 HMPs that should be implemented. It is important to highlight that we found different levels of information for the different HMPs, for instance for some HMPs we found information on both spatial and temporal scales while for the others we found information only on one or the other. As a consequence, the total number of HMPs with information may vary across the different implementation features explored.

Spatial scales

47. For CI2 more than 40% of monitoring programs encompass 1 to 10 monitoring sites, while about 10% include between 11 and 50 sampling sites (Figure 4.1). Finally, about 10% include more than 50 sampling sites. It is noteworthy that in this last group of programs about 5% of monitoring programs include more than 100 sampling sites. Finally, more than 30% of monitoring programs did not include specific information on the number of sampling sites (Figure 4.1).

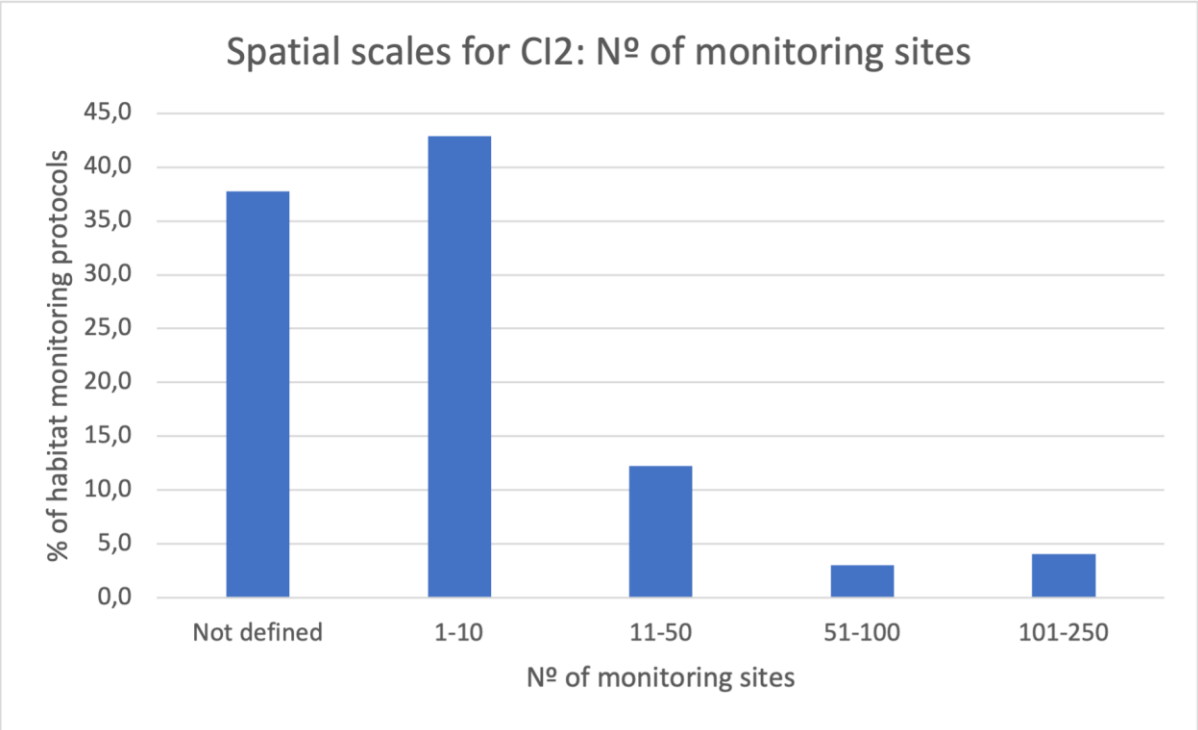


Figure 4.1. *Spatial scales (number of sites) in ongoing and planned Habitat Monitoring Protocols for the IMAP CI2, pooling data from all HMPs.*

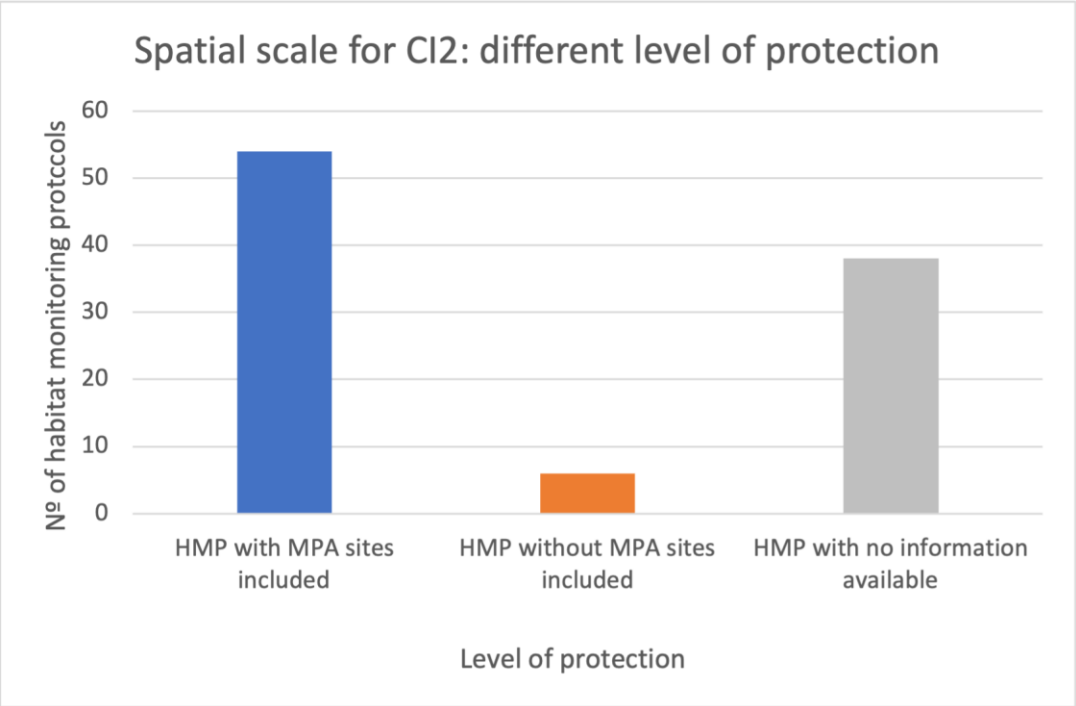


Figure 4.2. *Number of ongoing and planned Habitat Monitoring Protocols for the IMAP CI2 including sites with different degrees of protection.*

48. About 60% of the HMPs include information on the distribution of sampling sites across the different levels of protection, and among them most include both marine protected areas (National parks, Natura 2000, fishing marine reserves etc…) and unprotected sites. However, for almost 40% this information is missing (Figure 4.2).

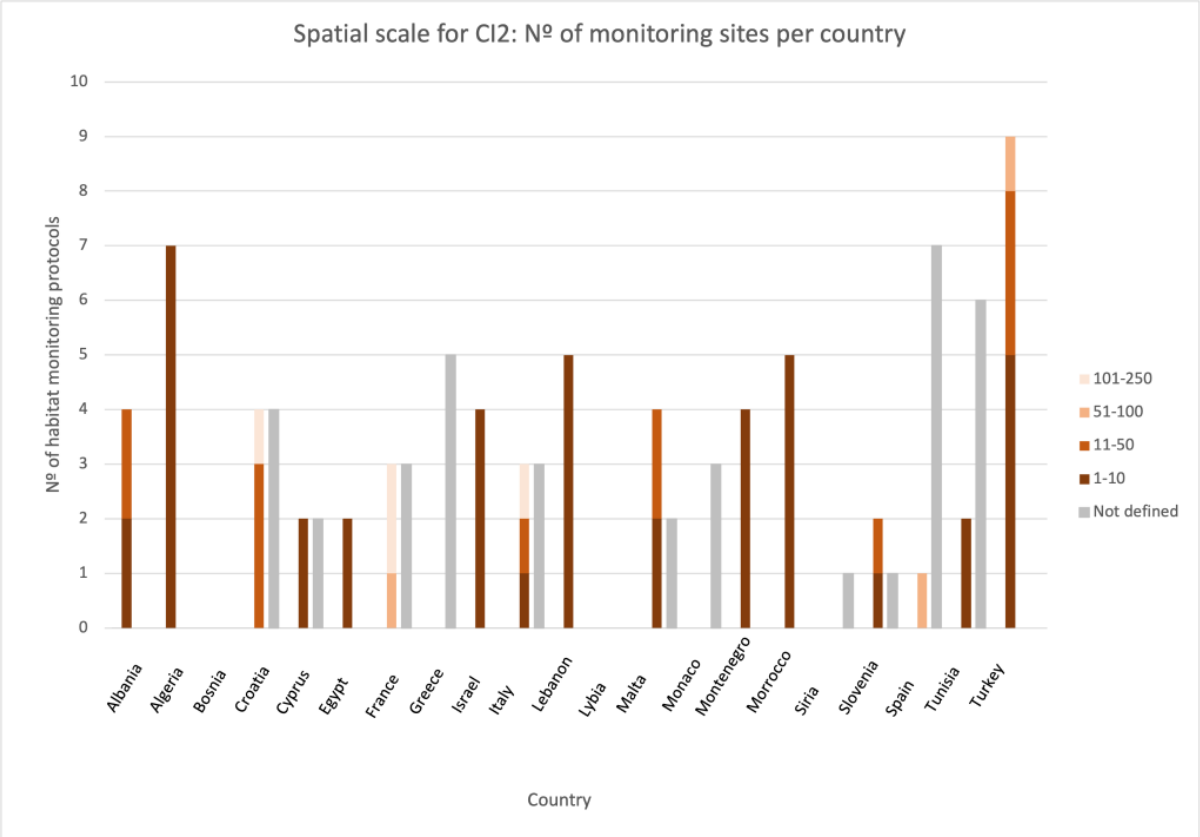


Figure 4.3. *Spatial scales (number of sites) in ongoing and planned Habitat Monitoring Protocols for the IMAP CI2 in each country.*

49. For HMPs of more than 50% of countries the number of monitoring sites could not be identified and among them two countries (Greece and Monaco) have not defined the number in any of their HMPs. Five countries consider only 1-10 monitoring sites in their habitat monitoring protocols for all HMPs implemented (Algeria, Egypt, Lebanon, Montenegro and Morocco). Three other countries (Albania, Malta, Slovenia) combine HMPs implemented at 1-10 sites with others implemented at 11-50 monitoring sites. Finally, five countries (Croatia, France, Italy, Spain and Türkiye) also include HMPs with more than 50 monitoring sites and among them France is conducting the largest effort with two monitoring programs implemented at more than 100 sites (Figure 4.3). However, this figure may change with newly acquired information since, as mentioned above, for 50% of the countries the number of sites included in the remaining 28 HMP could not be identified (Figure 4.3).

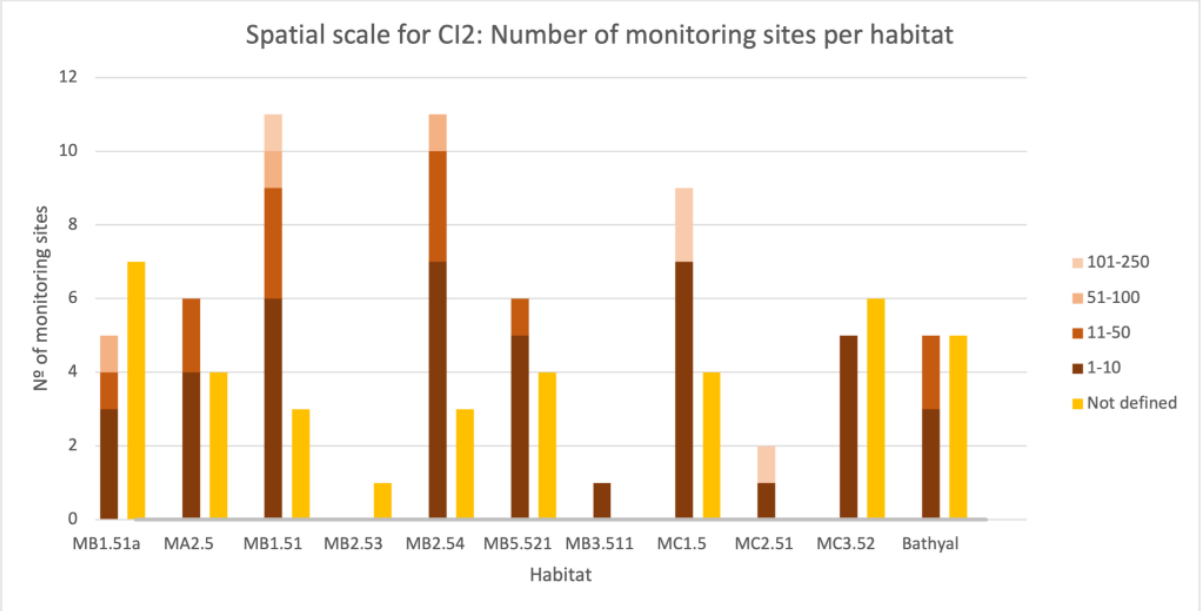


Figure 4.4. *Spatial scales (number of sites) in ongoing and planned monitoring programs for the IMAP CI2 in each of the eleven priority habitats selected.*

50. From the medio-littoral to the bathyal zone, regardless of the habitat considered, most of the Habitat Monitoring Protocols include a reduced number of sampling sites (1-10 sites) followed by HMPs with 11-50 sampling sites (Figure 4.4). Among the HMPs that consider more than 50 sampling sites we found two infralittoral habitats dominated by macrophytes (MB1.51a Well illuminated infralittoral rock, exposed; MB2.54 Posidonia oceanica meadow), while the programs with more than 100 sites include only one infralittoral habitat, MB1.51 Algal-dominated infralittoral rock and two circalittoral habitats, MC1.5 Circalittoral rock and MC2.51 Coralligenous platforms.

Temporal scales

51. In about 70% of 98 HMPs for CI2 the temporal scale of the monitoring activities was indicated (Figure 4.5). The most common frequency of sampling across all programs is 2-3 years (35%), followed by 20% of programs with annual monitoring. Less than 10 programs conduct the sampling every 4 years or more. As in the case of many other features examined, a non-negligible percentage (30%) of the HMPs did not indicate information on the sampling frequency (Figure 4.5).

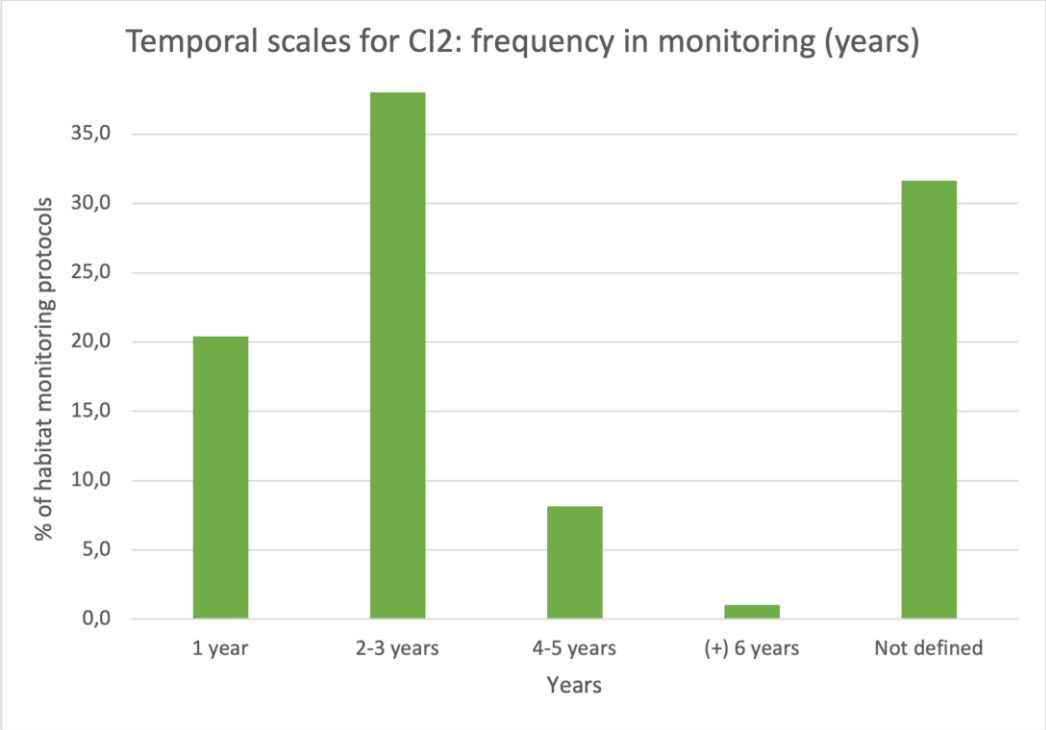


Figure 4.5. *Temporal scales (frequency of sampling) of Habitat Monitoring Protocols for the IMAP CI2 pooling data from all HMPs.*

52. Regarding the temporal scales of HMPs per country for which we found information on ongoing or planned monitoring programs for CI2, most countries (14) did not report information on temporal scales in all or some of their implemented HMPs (Figure 4.6). Only five countries (Algeria, Italy, Lebanon, Montenegro and Morocco) provided information on the temporal scales for all HMPs that they are implementing for CI2 (Figure 4.6). For the rest of the countries (8) we found partial information. For most countries monitoring temporal scales for their HMPs is 2-3 years. It is noteworthy that at least 4 countries (Albania, Algeria, Lebanon and Morocco) are implementing or are planning to implement some HMPs for CI2 on the annual basis (Figure 4.6).

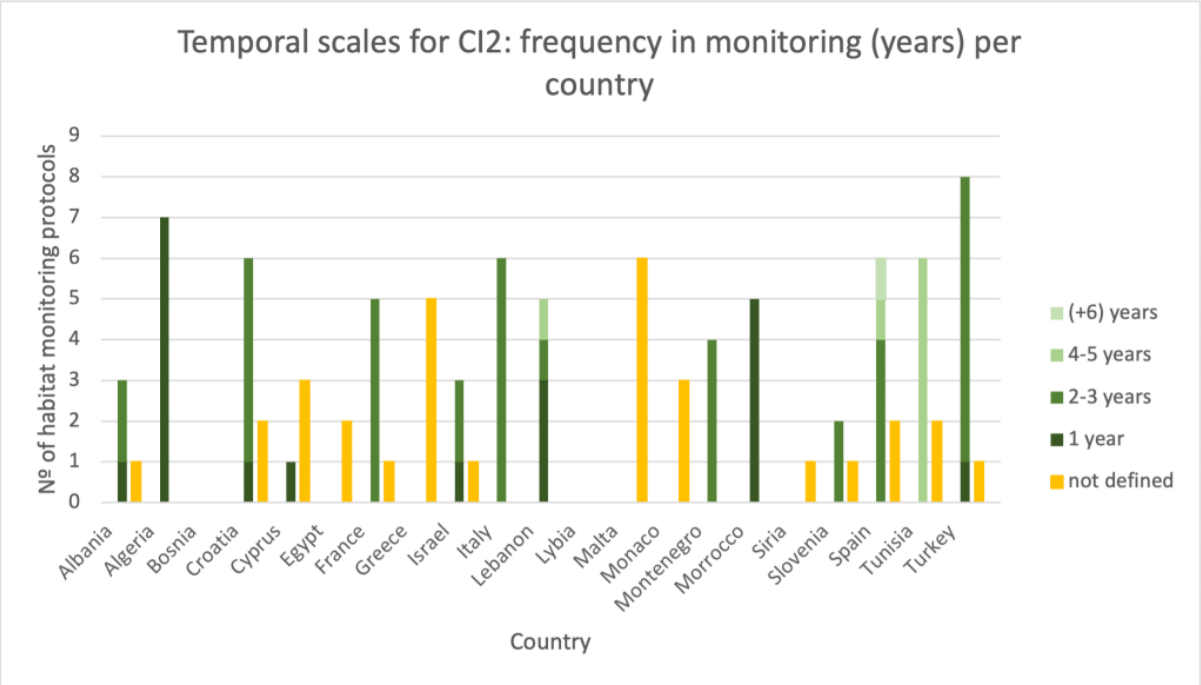


Figure 4.6. *Temporal scales (frequency of sampling) in ongoing and planned Habitat Monitoring Protocols for the IMAP CI2 in the national monitoring programs.*

53. Regarding the temporal scales of HMPs per habitat for which we found information relevant to CI2, in general medio-and infralittoral habitats showed monitoring activities every 1 to 3 years while in deeper habitats, circalittoral and bathyal, the most common frequency of monitoring is 3 years or greater (Figure 3.2). The HMPs dedicated to "MB1.51a Well illuminated infralittoral rock, exposed" and "MB2.54 *Posidonia oceanica* meadow" in the infralitoral zone and the "MC1.5 Circalittoral rock" in the circalittoral zone were the habitats for which we found more information on temporal scales. It is noteworthy that in the case of the habitat "MB1.51 Algal-dominated infralittoral rock" for which we found the maximum number of HMPs (16) for most of them the information on temporal scales was not defined (Figure 4.7)

54. Overall, there are no major differences in the monitoring frequency across habitats since most of the Habitat Monitoring Protocols conduct sampling campaigns every - 3 years (Figure 4.7). However, in the medio- and infralittoral habitats dominated by macroalgal species the frequency is, in general, higher than in habitats dominated by seagrasses and those dwelling in the circalittoral and bathyal zones (Figure 4.7). In fact, among these two groups of habitats there is a shift from less than 3 years to more than 4 years in the monitoring frequency. Despite this, it is noteworthy that 4 Habitat Monitoring Protocols in the coralligenous rock (MC1.5) and in the bathyal are monitored annually (Figure 4.7). Bearing in mind the trends in the dynamics of the key species and disturbance regimes along depth (Garrabou et al. 2002, Teixido et al. 2011, Ballesteros et al. 2009, Montero-Serra et al. 2018), reducing the frequency of monitoring following the depth gradient seems adequate and cost-effective. The HMPs dedicated to "MB1.51a Well illuminated infralittoral rock, exposed" and "MB2.54 *Posidonia oceanica* meadow" in the infralittoral zone as well as the "MC1.5 Circalittoral rock" in the circalittoral zone were the habitats for which we found more information on temporal scales (Figure 4.7). Finally, for 31 HMPs, from shallow to deep bathyal zones we could not find information regarding the temporal frequency in monitoring.

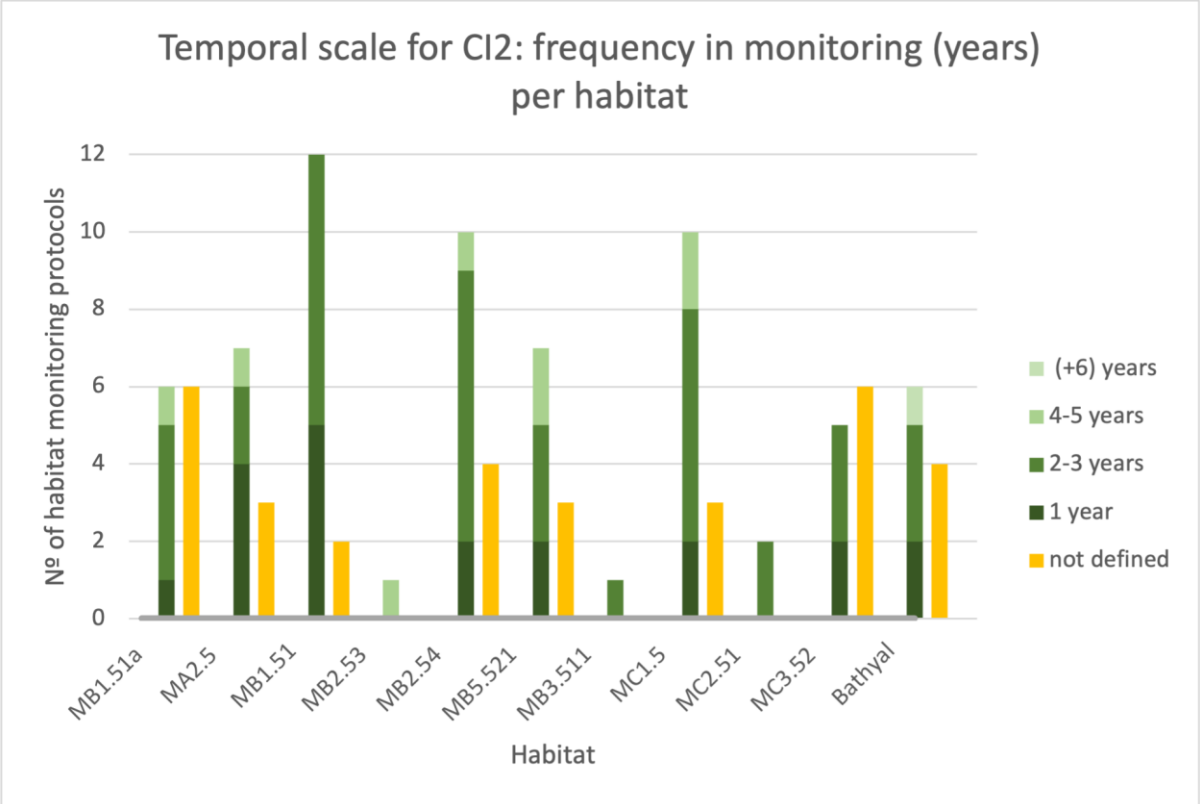


Figure 4.7. *Temporal scales (frequency of sampling) of Habitat Monitoring Protocols for the IMAP CI2 in each of the selected eleven priority habitats.*

Assessment criteria

55. Regarding the Assessment criteria for the evaluation of the GES status in terms of the "Condition of the habitat's typical species and communities" (CI2), about 50% of the Habitat Monitoring Protocols implemented by the Contracting Parties parties have indicated them (Figure 4.8). Focusing on the availability for the 11 selected priority habitats, for those dwelling in the medio- and infralittoral habitats dominated by macroalgal species and seagrasses, most Habitat Monitoring Protocols have identified the Assessment criteria for CI2 (Figure 4.8), especially those ones for the habitats "MB1.51a Well illuminated infralittoral rock, exposed", "MB1.51 Algal-dominated infralittoral rock" and the "MB2.54 Posidonia oceanica meadow". However, for deeper habitats, circalittoral and Bathyal we found the reverse pattern with most of the monitoring programs lacking assessment criteria (Figure 4.8).

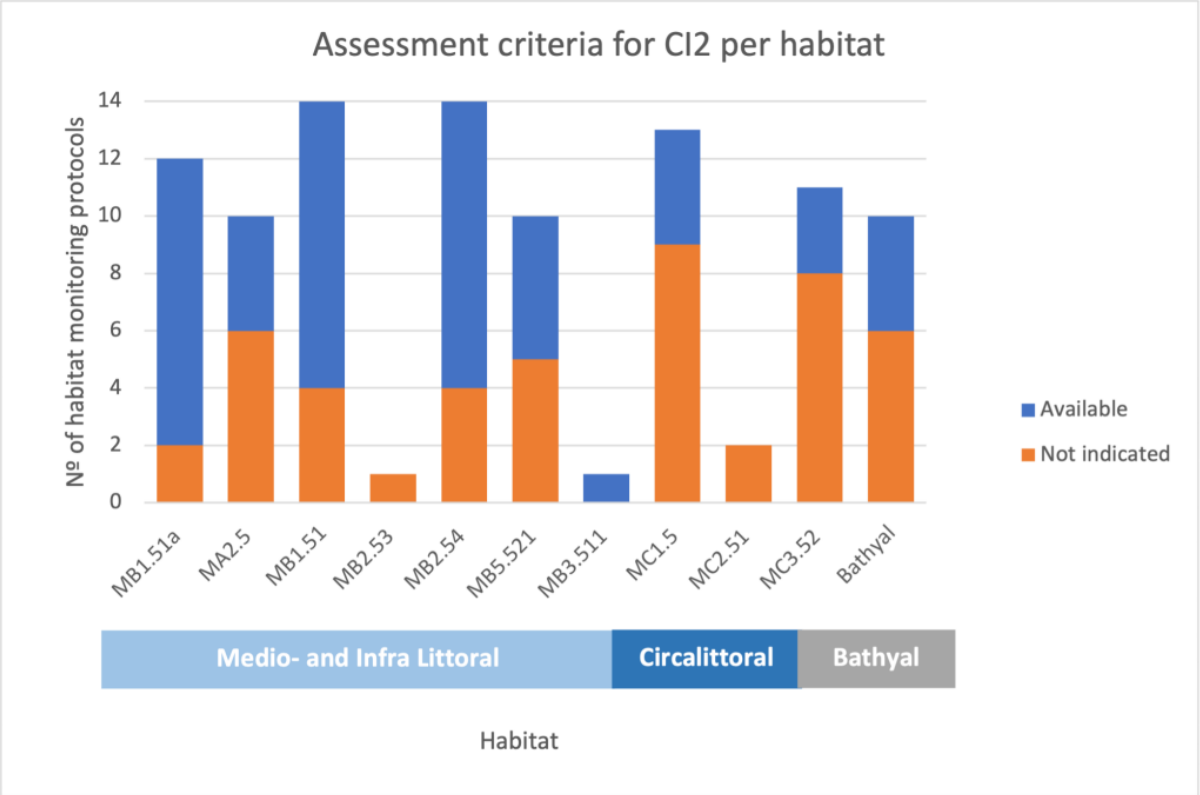


Figure 4.8. *Availability of Assessment criteria for IMAP CI2 in Habitat Monitoring Protocols developed for the selected priority habitats.*

Thresholds values

56. Regarding the Threshold values for the evaluation of the GES status in terms of the "Condition of the habitat's typical species and communities" (CI2), about 50% of the Habitat Monitoring Programs implemented by the Contracting Parties have indicated them (Figure 4.9). This figure is in agreement with the availability of Assessment criteria (see above), although the number of Habitat Monitoring Protocols without information on Threshold values is slightly higher than for the Assessment criteria (Figure 4.9). This would indicate that for some HMPs despite having identified the Assessment criteria, the threshold values are not being determined.

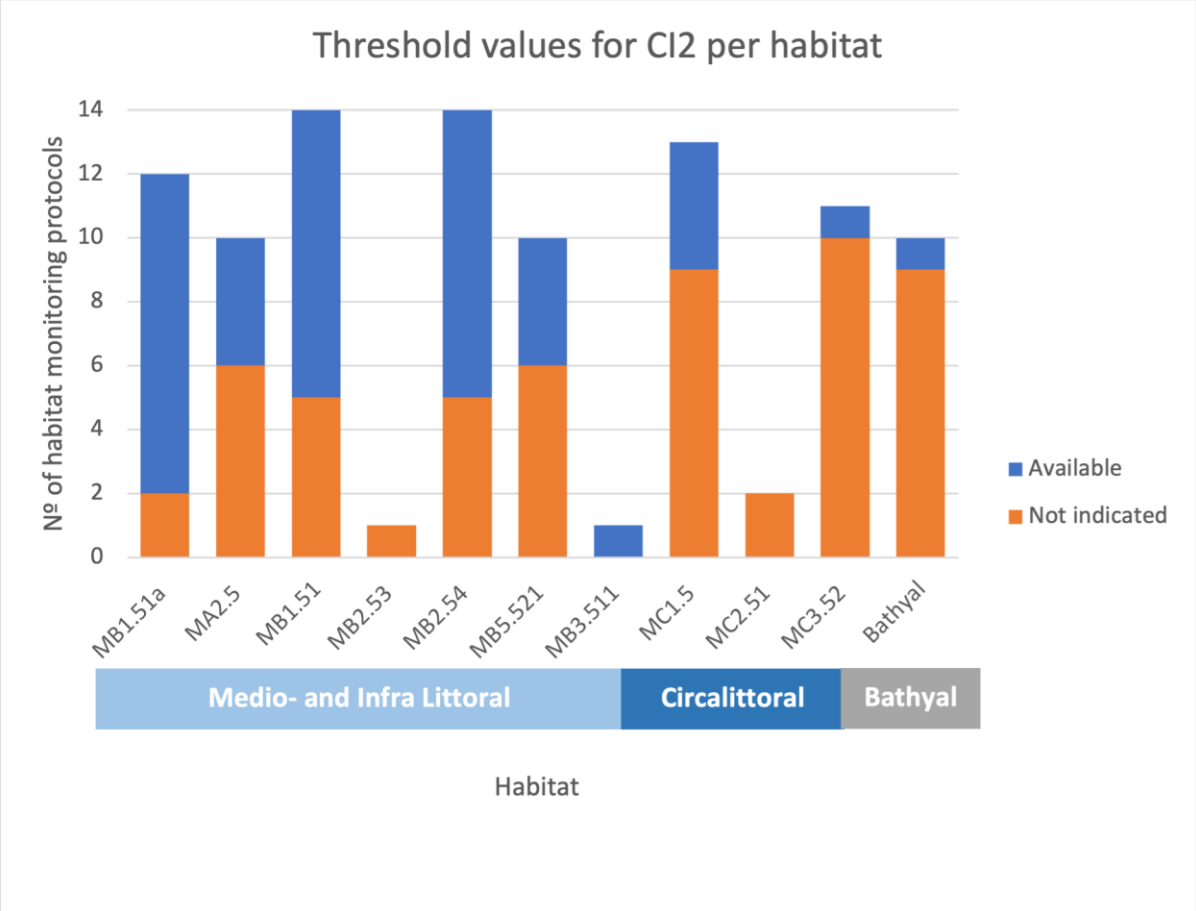


Figure 4.9. *Availability of Threshold values in the Habitat Monitoring Protocols for the IMAP CI2 across the selected priority habitats.*

Baselines

57. Regarding the availability of Baselines to evaluate the status in terms of the CI2 "Habitat's typical species and communities", conversely to CI1, about 60% of the Habitat Monitoring Protocols indicated to have Baseline information, most of them Operational baseline, while for the remaining 40% Baselines were not available (Figure 4.10). The HMPs for the habitat "MB1.51 Algal-dominated infralittoral rock", "MB2.54 *Posidonia oceanica* meadow" and "MC1.5 Circalittoral rock" were the only ones for which more than 50% of the HMPs implemented have defined Baselines (Figure 4.10).

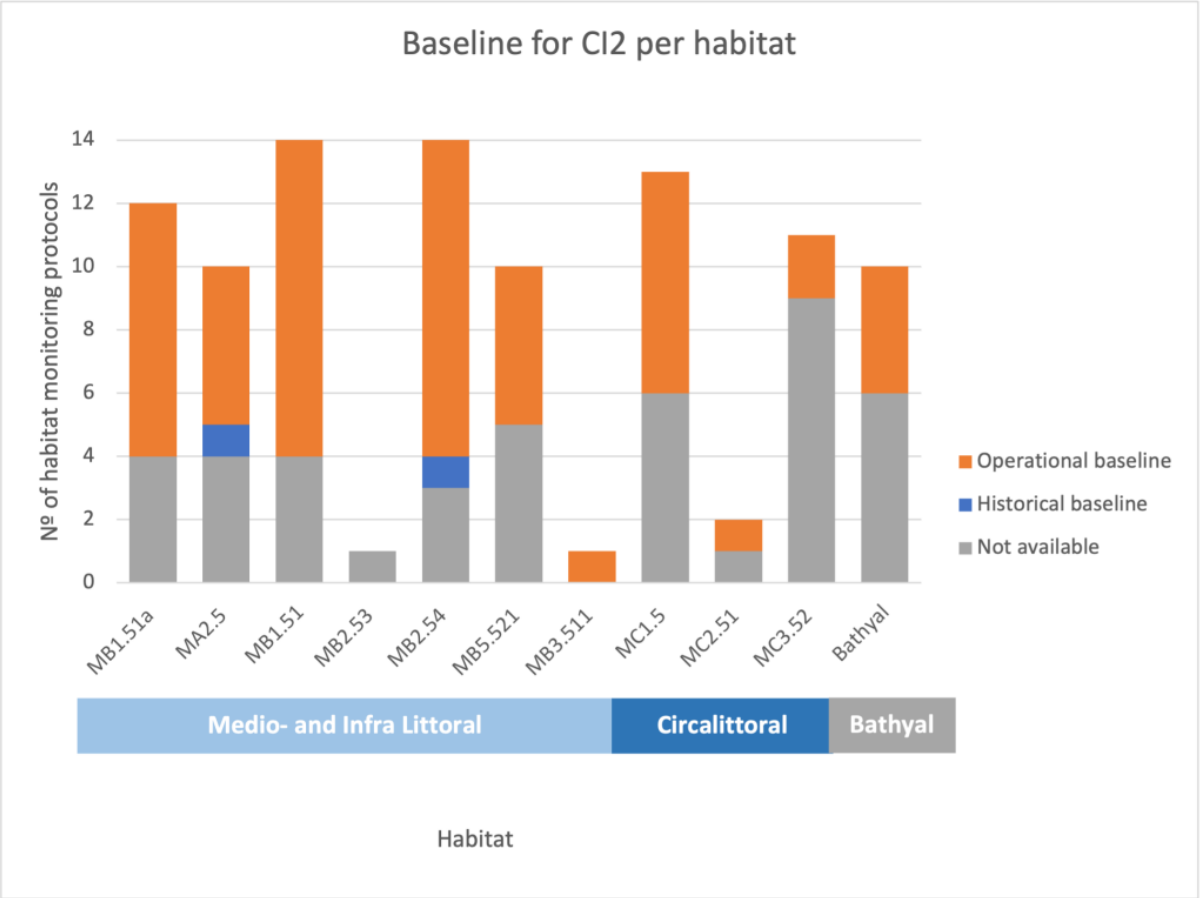


Figure 4.10. *Availability of Baselines in Habitat Monitoring Protocols programs for the IMAP CI2 across the selected priority habitats.*

V. Main gaps of knowledge & recommendations way forward

58. This report analysed the information on the implementation status of the IMAP CIs indicators related to marine habitats: CI1 - Habitat distributional range and CI2 - Condition of the habitat's typical species and communities. The analysis was based on an extensive documentation research (more than 100 technical reports and scientific literature) and consultation process with the national experts (43 from 18 Contracting Parties) on the IMAP and MSFD implementation and specialists of the Reference list of habitats and typical species (tens of meetings, e-mail exchanges, development of collaborative tools).

59. For this assessment 11 main habitats from the Barcelona Convention updated list were selected ranging from rocky, biogenic and sediment benthic communities dwelling from the Mediolittoral to the Bathyal zone. These 11 habitats were considered Priority 1 level according to UN Environment/MAP 2017. We contend that this selection provides a good assessment on the overall implementation status and how the different Barcelona Convention Contracting Parties are conducting the monitoring activities focusing on scales of monitoring, scales of assessment and assessment criteria; and threshold and baseline values based on the available data. To organize the data collection, we designed spreadsheets to gather the information on monitoring activities for each selected habitat. Overall, 10000 features were searched to characterize the corresponding Habitat Monitoring Protocols for each habitat and Contracting Party. This is the first time that a report on the status and the features of the implementation of the IMAP CI1 and CI2 indicators has been produced. As a first attempt, due to the

information found and the methodological approach chosen it is likely that we were not able to capture all the dimensions of the monitoring activities by the Contracting Parties. Therefore, we recommend to pursue further consultation with contracting parties, especially with those CP that were not able to participate actively in the consultation process conducted for the elaboration of this report. We contend that current document and proposed methodology can constitute a good basis for the next steps and works on IMAP for benthic habitats to be undertaken by the online working group on- identification of needs for further updates, discussions, development and adaptation. As for all other biodiversity components, a more synthetic and operational guideline on monitoring should be produced to be applicable through IMAP and data gathering for the next assessment rounds. The proposed IMAP Habitat Templates should provide a good basis as well to develop more operational guidelines.

60. Despite the potential updates in the current version document, we argue that the report already allowed to identify some general patterns in the features of monitoring schemes as well as some recommendations to improve future assessments on the implementation of CIs related to benthic marine habitats in the future. These issues are addressed in this final section.

Low level of implementation of IMAP monitoring activities

61. One of the main conclusions found is the low level of implementation of monitoring for CIs related to benthic habitats. In fact, information were only found for 98 out of the 221 Habitat Monitoring Protocols that should be implemented for each CI screened. Besides, a closer look indicated that only a fraction, about 20% of those were in fact being effectively ongoing while the rest were declared as being in a planning phase or unknown phase for both CIs. We expect that these low figures on the effective implementation level will increase once the Contracting Parties provide the corresponding reports. In any case, these findings clearly reflect one of the major problems encountered during this assessment, the difficulty to access the information on the monitoring schemes and their implementation status.

62. It is noteworthy that none of the 21 Contracting Parties is conducting monitoring activities in all of the 11 priority habitats considered for this analysis. Most countries (13 and 12 for CI1 and CI2 respectively) lack a Habitat Monitoring Protocol for 6 or more habitats. Again, when we focus on the ongoing monitoring activities the figures are even lower. In fact, most frequently countries with ongoing monitoring activities cover only 3 habitats. However, Italy and Türkiye with 8 and 9 HMPs (for CI1 and CI2 respectively) are the countries with the highest level of ongoing monitoring implementation.

63. For both CIs considered, there were no large differences in the level of implementation. However, focusing on ongoing monitoring activities, the implementation status of CI2 was higher than for CI1. In fact, the monitoring actions for CI1 implies conducting habitat mapping surveys. These surveys usually need the deployment of “heavy” equipment at the sea (boats, side scan sonar, ROVs etc…) usually for long periods of time, over large areas. Besides, it is recommended to perform ground truthing with the support of diving teams and ROV missions (e.g. UNEP-MAP 2020). Meanwhile, CI2 monitoring actions, in general, require the intervention in more limited areas and using “light” methods (e.g. different modalities of visual census) specially in the shallow-water habitats. Overall, thus, the differential operational cost may explain the lower implementation of CI1 compared to CI2. Some Contracting Parties included as CIs monitoring the activities funded by different EU projects to support habitat mapping and IMAP implementation.

64. While this funding is an excellent opportunity to define and set the basis for the National Monitoring Programmes, it is recommended to prioritize the question of long-term funding schemes for the full IMAP implementation.

Habitats monitoring activities implementation

65. Most of the ongoing HMPs for CI1 and CI2 are focused on the habitats dwelling in the Medio- and infralittoral zone dominated by macroalgal species and the seagrass meadows. Among them the habitats [MB1.51a Well illuminated infralittoral rock, exposed, MB1.51 Algal-dominated infralittoral rock and MB2.54 *Posidonia oceanica* meadow] have been selected by most Contracting Parties to conduct their monitoring activities. For habitats developing in deeper zones, the most of the ongoing monitoring efforts were concentrated on the coralligenous [MC1.5 Circalittoral rock and MC2.51 Coralligenous platforms] and circalittoral rhodolith beds [MC3.52MC3.52 Coastal detritic bottoms with rhodoliths] while the lowest efforts were focused on the habitats from the Bathyal zone. These differential monitoring efforts across habitats are likely related to the methodological readiness and cost-effectiveness of methodological approaches available to conduct the monitoring activities in the different habitats (UN Environment/MAP 2016). As pointed above, field operational costs in the mediolittoral or shallow infralittoral are lower compared to methods to monitor deeper habitats. Besides, for the shallow infralittoral, more specifically, biogenic and rocky algal dominated habitats as well as the seagrass meadows, the implementation of the EU Water Framework Directive boosted the efforts to define standard monitoring methods to assess the status of the habitats. As a result, the IMAP CIs implementation benefited from these efforts. It is worth noting that many EU and non-EU Contracting Parties adopted similar methods, among them the most widespread is the CARLIT method for mediolittoral and shallow infralittoral algal dominated habitats (Ballesteros et al. 2007) and the use of POMI and PREI ecological indices for *Posidonia oceanica* meadows (UNEP-MAP 2020; European Commission 2018).

66. It is recommended to encourage the adoption of harmonized monitoring approaches. This harmonization of monitoring methods offers multiple advantages for the Contracting Parties such as the availability of tested monitoring materials, trained staff, and the possibility of sharing experiences. A harmonized approach at the Mediterranean level allows to obtain a more reliable global view on the ecological status of the habitats. Currently, there are also several indices developed to assess the ecological status of coralligenous habitat (summarized in UNEP-MAP 2020) but the harmonization of monitoring approaches at the Mediterranean level is yet to be achieved). It is recommended to follow the lessons learnt from widely applied monitoring protocols like CARLIT, for the development of harmonized monitoring protocols, focussing the harmonization efforts on the habitats considered as Priority Level 1 according to UN Environment/MAP 2017.

Implementation Habitat Monitoring Protocols (HMP) features

Spatial scales

67. In general, the information on the spatial scales considered in the HMP for CI1 was very limited (about 15% of HMPs). Besides, the Contracting Parties reported the information in two units i.e number of sites and surface covered by monitoring mapping activities, which makes it difficult to define any pattern. However, from the information collected, it seems that there exists some confusion in reporting the spatial scales for CI1. In fact, despite that both the number of sites is lower than 10 and surface area covered are lower than few km2, some Contracting Parties indicate that the monitoring activities cover between 70-100% of the total extent of the habitat monitored. Bearing in mind that for many countries, there is lack of the information on comprehensive habitat mapping along their coasts, it is very likely that information provided is a misinterpretation rather than a real figure. Besides, some Contracting Parties indicate that mapping activities were conducted in the framework of projects with the support

of SPA/RAC. These projects provided the opportunity to conduct habitat mapping in some areas/sectors. However, we should consider that these activities were more related to information acquisition rather than monitoring activities on CI1.

68. Considering the high costs of conducting mapping activities, it is recommended focussing monitoring actions on a set of few km2 sectors along the coasts instead of attempting to monitor the total extent of the habitat distribution. This would allow detailed mapping of the habitats and facilitate monitoring of their extent and condition over time. Only for those habitats which are rare and display a restricted spatial distribution, we would recommend covering the total extent of the habitat. This could be the case for some marine angiosperms. Such strategy, which combines mapping of defined areas and the total extent of rare habitats, would allow to reduce costs and to ensure the implementation of recurrent monitoring of the same areas. Moreover, such strategy would allow to plan the monitoring of different sectors during the 6 years evaluation period.

69. Regarding the spatial scales covered by CI2 monitoring activities, most of the implemented HMPs include between 1 and 10 monitoring sites. However, for some habitats the number of monitoring sites can reach up to 100 or even more. It is noteworthy that Croatia, France and Italy are the only Parties including more than 100 monitoring sites in HMPs on mediolittoral and infralittoral rock (MB1.51 Algal-dominated infralittoral rock and MB1.51a Well illuminated infralittoral rock, exposed) and France and Italy also invest such efforts in monitoring of coralligenous (MC1.5 Circalittoral rock and MC2.51 Coralligenous platforms).

70. Bearing in mind the hundreds and thousands of kilometres of coastline for most Contracting Parties, for instance, 1-10 monitoring sites were indicated for some HMPs in Algeria, Italy, Morocco, Türkiye, and Tunisia, it is recommended enlarging the number of monitoring sites. In general, we consider that HMPs with less than 50 monitoring sites for CI2 may not be able to provide a robust and representative view on the ecological status of the monitored habitats. The exemption would be habitats with restricted distribution and extent and/or countries with limited coastline extension.

71. We recommend to the Contracting Parties to define a minimum range of monitoring sites for the different habitats based on the total habitat cover and coastline extension in the different countries. Bearing in mind that most of the HMPs include monitoring sites within marine protected areas, it is recommended pursuing and enlarging this approach. Including MPA's sites can provide multiple benefits, since this can support MPAs monitoring actions, while also enabling a comparison with the non-protected sites and thus providing information about baselines.

Temporal scales

72. For both CI1 and CI2, the most common temporal scale indicated is 2-3 years. Conducting monitoring activities every 2-3 years is adequate to track potential changes in the environmental status of the habitats. In addition, episodic events such as mass mortalities, proliferation of filamentous algae can occur, and the monitoring protocols should be able to assess their effects with 2-3 years monitoring frequency. Of course, monitoring on an annual basis would be ideal but the associated organization level and operational costs may result in a lower spatial and habitat resolution.

73. It is recommended that the Contracting Parties should find the right trade-off between spatial and temporal resolution according to the resources allocated (e.g. staff, equipment, vessels etc..) in order

to maximize the number of monitoring sites at least two times during the 6 year evaluation period, if possible.

74. We recommend planning to conduct the monitoring activities on a specific habitat in the same year (within the 6-year period) instead of conducting the surveys over different years. This would allow acquiring information over the same years across the Contracting Parties and reducing the potential sources of variability linked to the different annual conditions. Alternatively, Contracting Parties may organize their monitoring activities covering all targeted habitats by sectors that are visited every 3 years.

Metrics, Assessment criteria, Thresholds, Baselines

75. Although significant progress has been made related to the habitat mapping methodologies, large areas of the Contracting Parties still remain to be mapped. Monitoring efforts on CI1 are based on tracking the basic metric: the habitat area/extent. Even though this is a very essential metric, depending on the habitat mapping techniques (methods, spatial resolution etc…) used, reliable reporting on CI1 may be compromised. Beyond the technical issues, despite all efforts it was found that different management bodies (e.g. national, regional, MPAs) are using different habitat classifications to evaluate the habitat extent of priority habitats. For instance, the Contracting Parties members of EU often map and report meadows of marine angiosperms other than *Posidonia oceanica* [Association with indigenous marine angiosperms (MB5.521)] within broader habitat types e.g. the EU Habitat Directive types 1130 Estuaries, 1150 Coastal lagoons, 1160 Large shallow inlets and bays and 1110 Sandbanks that are slightly covered by seawater all the time. Therefore, by including different habitat types, the information on their true habitat extent, although it may be existent, is not readily available to evaluate the proposed Assessment criteria for CI1: the extent of loss of the habitat type, resulting from anthropogenic pressures/physical disturbance. To date, none of the Contracting Parties has established the threshold on the maximum allowable extent of any habitat lost or disturbed as a proportion of the total natural extent (which should take into account regional or sub-regional specificities). Finally, most baselines indicated by Contracting Parties correspond to operational baselines. For instance, the cartography resulting from the CARLIT implementation for MB1.51a Well illuminated infralittoral rock, exposed and MA2.5 Littoral biogenic habitat (carried out to fulfil WFD and/or MSFD reporting requirements in the EU countries or within dedicated research projects).

76. To enhance the implementation of CI1 monitoring activities, we recommend pursuing the harmonization efforts on the implementation of habitat mapping across the Contracting Parties. Considering the recommendations of SPA/RAC, special attention should be given to provide the information following the definition of priority habitat types classification (UN Environment/MAP 2017, SPA/RAC–UN Environment/MAP 2019, Montefalcone et al. 2021).

77. For CI2 different metrics are available for some of the habitats analysed. However, the development of these metrics is more advanced and widespread for three groups of habitats i.e. Mediolittoral and Infralittoral hard substrates habitats [MB1.51a Well illuminated infralittoral rock, exposed, MA2.5 Littoral biogenic habitat, MB1.51 Algal-dominated infralittoral rock], infralitoral soft sediment [MB2.54 *Posidonia oceanica* meadow and MB5.521 Association with indigenous marine angiosperms] and Circalitoral hard substrate [MC1.5 Circalittoral rock and MC2.51 Coralligenous platforms]. For the rest of habitats, the consensus on what metrics to measure largely depends on the Contracting Parties evidencing a clear lack of consensus.

78. The *Assessment criteria* on the habitat status are derived from the calculation of different indices: medio- and upper infralittoral rock (e.g. CARLIT), seagrass meadows (mainly *P. oceanica* e.g. PREI, POMI) and Coralligenous habitats (e.g. INDEX-Cor, MACS) (Ballesteros et al. 2007, Gobert et al. 2009, Romero et al. 2007, Benett et al. 2011, Sartoretto et al. 2017, Enrichetti et al. 2019; see full list of references in IMAP Habitat templates) and most of them have associated Ecological Quality Reference and the corresponding Thresholds. For the vast majority of habitats, the Contracting Parties are using operational Baselines.

79. At the present state of knowledge and following UNEP-MAP (2020) recommendations, it is difficult to prefer one index over the other, as it has not yet been possible to compare all of them over several sites and to start intercalibration processes. For this reason, we **recommend** establishing a minimum set of metrics to be measured for each habitat across Contracting Parties. From this minimum set of metrics Contracting Parties will be able to combine them as well as with other potential metrics to calculate the already available indices or new ones to be proposed in the future for the Assessment criteria.

80. We recommend that the definition of these basic set of metrics should be the result of the consensus of habitat experts from different Contracting Parties. This should ensure their wider adoption at the Mediterranean level.

81. Since the indices based on a high number of metrics usually imply excessive costs in terms of acquisition time and the budget required for their implementation, we recommend selecting those indices requiring the most cost-effective metrics.

Towards harmonized Habitat Monitoring Protocols

82. In this assignment the monitoring activities conducted by Contracting Parties on 11 priority habitats were analyzed. Given that the selected habitats dwell in very contrasted environments and display high diversity of key taxa, providing recommendations on the specific methods to be adopted for the selected habitat was beyond the scope of this report. We recommend establishing dedicated CI1 and CI2 working groups by habitats with the participation of habitat experts from different Mediterranean areas, to discuss and identify the minimum common set of features of the habitat monitoring protocols to be implemented by the Contracting Parties. These working groups should provide technical and operational science-based and cost-effective directions including intercalibration exercises. Furthermore, the working groups should provide an estimation of the implementation costs and dedicated capacity building programs and materials for the selected habitats. We contend that these outputs will ensure the harmonized implementation of CI1 and CI2 monitoring activities across the Mediterranean. As highlighted in previous sections, for some habitats the adoption of coherent approaches is already advanced. We encourage following the lessons learnt from the implementation of the most widespread methodologies (e.g. CARLIT, Ballesteros et al. 2007).

83. In the meantime, we summarized in the IMAP Habitat templates the main features and methods currently implemented by the Contracting Parties. We contend that these templates may serve as a good starting point and guidelines for the development of harmonized Habitat Monitoring Protocols to be developed by the Mediterranean habitat experts.

Information and reporting system

84. The main difficulty encountered during the preparation of the present assignment was to find information on the CI1 and CI2 IMAP monitoring activities by the different Contracting Parties. In fact, despite that we allocated much more time than originally planned to the information compilation stage, the documents and reports found did not provide comprehensive information on the monitoring schemes adopted nor on their implementation status; not dare to say about the monitoring outcomes. These difficulties were already anticipated in the work plan, but the magnitude of the unreachable information was much larger than expected. We counted with the precious cooperation of the benthic habitat experts group designed by the Contracting Parties. We want to thank the assistance of the SPA/RAC officers in organizing the contacts as well as to the national experts that participated in the meetings and provided inputs to our different requests of information. However, the rate of response of national experts was very low (about 30%). From the discussions with the experts, it was also clear that due to high diversity of habitats concerned by the CI1 and CI2, the Contracting Parties rely on the support of different groups to implement the monitoring activities. As a result, the designated experts do not always have the information on the methods adopted for all targeted habitats.

85. We recommend establishing two common repositories, one containing the description of the Habitat Monitoring Protocols (on the basis developed in this assignment) by the different Contracting Parties. A second repository should include the results of the implementation of the monitoring activities. Some efforts are already ongoing regarding the reporting of monitoring data into the IMAP Info System for 3 specific habitat's types (Posidonia, Coralligenous and Mearl), however there is still a big information gap to fill. Beyond the interest of having a one-point entry to access the information on benthic habitat monitoring activities, we contend that these repositories should enhance the coordination of the CI1 and CI2 monitoring activities within the Contracting Parties. We recommend establishing an operational task force on CI1 and CI2 IMAP monitoring activities to take advantage of the expertise and available knowledge in each Contracting Party. Likewise, it is recommended enhancing the capacity building and exchange of best practices at the national, sub-regional and regional level through specific training sessions and meetings. The implementation of these recommendations will ensure a more efficient implementation of CI1 and CI2 monitoring activities by Contracting Parties while facilitating the assessment at Mediterranean level by the periodic Mediterranean Quality Status Report.

86. Considering the ongoing work on the development of the EO6, it is recommended that the IMAP for EO1 (benthic habitats) and EO6 should become more closely aligned, as has been done under the MSFD through the 2017 GES Decision. This could, for example, be achieved through:

a. Merging the two EOs (only as regards seabed habitats for EO1), through use of a common set of habitat types;
b. Aligning the scales and areas for assessment between EO1 and EO6;
c. Reusing indicators, or the underlying data, from EO1 (CI1 and CI2) for EO6 purposes.

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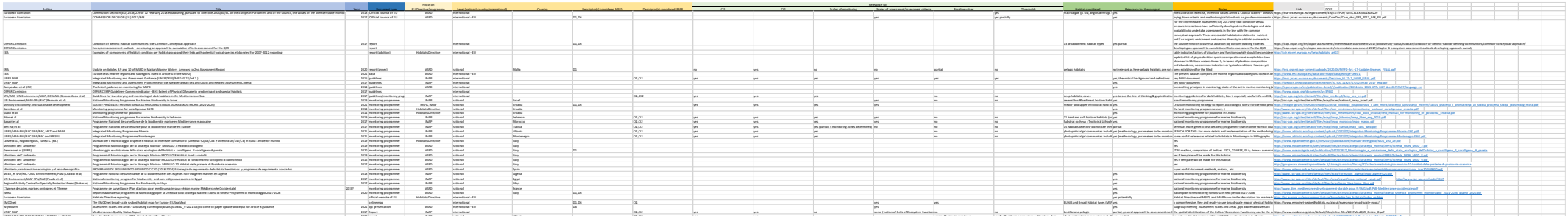
Annex I
List of documents

The excel document is available in this link: https://docs.google.com/spreadsheets/d/183rdSOqX9lBIvQDqkdKtssM1sGF8h4Mc/edit#gid=1017113235



Annex II
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Croatia	Srđana Rožić Martina Marić	Ministry of Economy and Sustanable Development Ministry of Economy and Sustanable Development
Cyprus	Antonis Petrou Lavrentios Vasiliades	AP Marine Environmental Consultancy Ltd Department of Fisheries & Marine Research
France	Alexandre Robert Dorothée Vincent	National Institute of Ocean Science (IFREMER) The French Biodiversity Agency
Egypt	Mustafa Mokhtar Fouda Mohamed Said Abdelwarith	Ministry of Environment Egyptian Ministry of State For Environmental Affairs
Greece	Vasilis Gerovasileiou Maria Salomidi Nadia Papadopoulou	Ionian University, Department of Environmental Sciences Hellenic Center for Marine Research (HCMR) Hellenic Center for Marine Research (HCMR)
Italy	Francesco Rende Sabrina Agnesi Aldo Annunziatellis Michela Angiolillo Michela Giusti Eva Salvati Leonardo Tunesi Giulia Mo	The Italian Institute for Environmental Protection and Research (ISPRA) The Italian Institute for Environmental Protection and Research (ISPRA) The Italian Institute for Environmental Protection and Research (ISPRA) The Italian Institute for Environmental Protection and Research (ISPRA) The Italian Institute for Environmental Protection and Research (ISPRA) The Italian Institute for Environmental Protection and Research (ISPRA) The Italian Institute for Environmental Protection and Research (ISPRA) The Italian Institute for Environmental Protection and Research (ISPRA)
Israel	Ruth Yahel Dror Zurel Simon Nemtzov	Israel Nature and Parks Authority (INPA) Ministry of Environmental Protection Israel Nature and Parks Authority (INPA)
Lebanon	Ali Baddredine Ghazi Bitar	Lebanese University, Faculty of Science Lebanese University, Faculty of Science
Libya		
Malta	Roberta Debono Luke Tabone	ERA (Environment & Resources Authority) ERA (Environment & Resources Authority)
Monaco		
Montenegro	Vesna Macic	Institute of Marine Biology; University of Montenegro
Morocco	Hocein Bazairi Mohammed ELBOUCH	BioBio Reserach Center, BIOECOGEN Laboratory, Faculty of Sciences, Mohamed V University in Rabat; National Monitoring Programme Ministère Délégué auprès du Ministre de l'Energie, des Mines,de l'Eau et de l'Environnement
Syria		
Slovenia	Borut Mavrič	National Institute of Biology
Spain	Juan Manuel Ruiz Fernández Jaime Bernardeau Esteller Lara Arroyo Maite Vázquez Luis Salud Deudero Carme Alomar David Díaz Enric Massuti	Instituto Español de Oceanografia Instituto Español de Oceanografia Instituto Español de Oceanografia Instituto Español de Oceanografia Instituto Español de Oceanografia Instituto Español de Oceanografia Instituto Español de Oceanografia Instituto Español de Oceanografia
Tunis	Jamila Ben Souissi	Institut National Agronomique de Tunisie
Turkey	Ergün TAŞKIN Melih Ertan ÇINAR Hasan Barış ÖZALP	Manisa Celal Bayar University Ege University Çanakkale Onsekiz Mart University, Faculty of Marine Science and Technology

Annex III
CI1-Assessment habitats Database

The Excel document is available in this link: https://docs.google.com/spreadsheets/d/18C2Y-f1bwBwy9pGtwB2Y65LYd4R9LE-O/edit#gid=2113527451

Annex IV
CI2-Assessment habitats Database

The Excel document is available in this link: https://docs.google.com/spreadsheets/d/17q5-PcrWF8rdhsXqIlhJjWimWz-MeaoL/edit#gid=1114393165

Annex V
IMAP Habitat templates

Introduction

This document presents the IMAP Habitat templates. These templates summarise the key elements of the CI1 and CI2 implementation for each selected habitat. The provided information is organised in 6 main sections:

IMAP Habitat template sections
1-Short description of the habitat
2-Number and name of contracting parties (CPs) indicating IMAP monitoring activities in the habitat
3-General comment on the CI1 and CI2 IMAP implementation on the habitat
4-Implementation features CI1 (Spatial and temporal scales, metrics, Assessment criteria, Thresholds and Baselines)
5-Implementation features CI2 (Spatial and temporal scales, metrics, Assessment criteria, Thresholds and Baselines)
6-Key references

The contents of the IMAP Habitat templates were based on the information compiled for the analysis of the IMAP benthic habitats CI1 and CI2 monitoring plans and implementation. For some habitat types we decided to consider the subcategories of habitats (i.e. MA2.5 Littoral biogenic habitat) while for other habitats we combined the information in a single template (e.g. MC1.5 Circalittoral rock and MC2.51 Coralligenous platforms). Finally, for the Bathyal habitats and *Cladocora caespitosa* reefs (MB2.53 Reefs of *Cladocora caespitosa*) the scarcity of compiled information hindered us to produce the corresponding habitat template. A summary of the available Habitat templates is found in Table 1.

Table 1. List of Habitat templates developed for the Barcelona Convention updated list main habitats selected for the assessment IMAP CI1 and CI2. Available templates are indicated in bold, whereas non available ones are indicated in italics.

Broad habitat types	Habitat templates available from the Barcelona Convention updated list main habitats (and subcategories) selected for the assessment
Mediolittoral hard substrate	**MB1.51a Well illuminated infralittoral rock, exposed** **MA2.5 Littoral biogenic habitat**

	MA2.51 Platforms of encrusting Corallinales **MA2.53 Reefs of Vermetidae**
Infralittoral hard substrate	**MB1.51 Algal-dominated infralittoral rock** *MB2.53 Reefs of Cladocora caespitosa*
Infralittoral soft sediment	**MB2.54 Posidonia oceanica meadow** **MB5.521 Association with indigenous marine angiosperms** *MB3.511 Association with maerl or rhodoliths*
Circalittoral hard substrate	**MC1.5 Circalittoral rock** **MC2.51 Coralligenous platforms**
Circalittoral sediment	**MC3.52 Coastal detritic bottoms with rhodoliths**
Bathyal	*Upper bathyal* *Lower bathyal* Only Bathyal since most countries do not distinguish between upper and lower Bathyal

Mediolittoral hard substrate habitats

Platforms of encrusting Corallinales (Littoral biogenic habitat MA2.51)

1-Short description of the habitat

This habitat is formed by the biogenic, tri-dimensional, hard structures built by the red algae *Lithophyllum byssoides*. The vertical thickness of these structures can reach more than one meter. As a consequence, different assemblages may be found from the upper portion of this habitat, which is situated in the lower mediolittoral zone, to the lower, submerged one. *Lithophyllum byssoides* platforms/rims develop in specific climatic, hydrological and sedimentary conditions. They seem to develop better over calcareous rocks, on steep shores in areas with strong hydrodynamism and where the temperature of surface coastal waters does not drop below 14°C in the winter. This habitat has an important role in preventing or slowing down the rock erosive processes. Well-developed *platforms/*rims increase microhabitat complexity and the associated biodiversity on the narrow Mediterranean intertidal fringe. The habitat is vulnerable to physical impacts, such as coastal developments and trampling, and very sensitive to environmental stresses related to water quality and changes in sea level (Gubbay *et al.* 2016).

2-Number and name of contracting parties (CPs) indicating IMAP monitoring activities in the habitat

Seven contracting parties namely Algeria, Croatia, France, Malta, Morocco, Spain and Türkiye

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

Monitoring is ongoing in 4 CPs whereas the implementation status is unknown for the other 3 CPs.

4-Implementation features CI1

- Scales of Monitoring:

Scale	Range	Comments
Spatial	not indicated	Information is rarely provided, e.g. Croatia estimates 70% of total extent of the habitat to be monitored and France estimates 100% of their coastline to be monitored
Temporal	3-6 years	

- Metrics:

Habitat area/extent

- Assessment criteria and thresholds:

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

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:

Some operational baselines are available, often resulting in cartography attained by CARLIT method (carried out to fulfil WFD and/or MSFD reporting requirements in the EU countries or within dedicated research projects).

5-Implementation features CI2

- Scales of Monitoring:

Scale	Range	Comments
Spatial	1-10 sites (2 CPs), 11-50 sites (2 CPs), >50 sites (1 CP)	For majority of CPs number of sites is not clearly indicated
Temporal	each year (3 CPs) to every 2-3 years (2 CPs)	

- Metrics:

Country	Metrics
Algeria	Typical or sensitive species biomass, population structure, density, volume, growth and mortality rate, occupation rate
Croatia	CARLIT (the length of the coast occupied by each community type, for each geomorphological situation) is used but the condition of main bioconstructors/typical species is not assessed
France	CARLIT (the length of the coast occupied by each community type, for each geomorphological situation), % cover of key and opportunistic macroalgal species
Malta	% area covered by live *Lithophyllum byssoides* thalli, total cover of habitat type
Morocco	not indicated
Spain	CARLIT (the length of the coast occupied by each community type, for each geomorphological situation) but the condition assessment of main bioconstructors/typical species could not be confirmed
Türkiye	Ecological Evaluation Index (EEI; percentage cover of macroalgae), Alien Biotic Index (ALEX; percentages of abundance of 4 biogeographic groups: native, established, casual and invasive)

- Assessment criteria and thresholds

To date, percentage cover of alive algal thalli (as the main bioconstructors) in comparison to the total cover may be identified as one of the criteria to assess the status/condition of algal trottoirs/rims. However, no clear thresholds are established to assess GES based on that descriptor. For example, in Malta live coverage of *L. byssoides* above 70% was interpreted as indicative of undisturbed conditions (in terms of criterion D6C5 of MSFD i.e. the extent of adverse effects from anthropogenic pressures on habitat type). However, it was also pointed out that further research is needed to determine the causes (if any) for the differences in % live thalli across the survey stations (ERA 2020).

- Baselines:

The existence of operational baseline on the condition of algal trottoirs/rims is indicated for 3 CPs.

6-List of Key references

Environment and Resources Authority - ERA (2020) Update on Articles 8, 9, and 10 of the Marine Strategy Framework Directive (2008/56/EC) in Malta's Marine Waters". Second Assessment Report, 541 p. Available at: www.era.org.mt (last access July 30 2022)

Gubbay S, Sanders N, Haynes T, Janssen J, Rodwell, JR, et al. (2016) European Red List of Habitats. Part 1: Marine habitats. Publications Office of the European Union, Luxembourg, https://data.europa.eu/doi/10.2779/032638

Vermetid reefs (Littoral biogenic habitat MB2.51)

1-Short description of the habitat

Mediterranean vermetid reefs are biogenic formations constructed by the gregarious gastropods belonging to the genus Dendropoma often in association with *Vermetus triquetrus*, another solitary vermetid, and the coralline alga *Neogoniolithon brassica-florida* which cements their tubular shells (Gubbay *et al*. 2016, Baddredine *et al.* 2019). These intertidal or shallow subtidal bioconcretions may be thousands of years old and can form huge and diverse structures, occasionally several meters wide. Vermetid reefs host many species distributed differently across the bioconcretion, depending on wave action and the position on the reef. In the seaward part of the reef, the reef crest, the concretion is made of Dendropoma shells actively growing while Neogoniolithon cements the reef and triggers the vermetid settlement. Behind the reef crest, a shallow lagoon develops, covered by photophilic algal communities. This portion ends close to the shore, where Neogoniolithon and vermetids dominate again. Besides being biodiversity hotspots, vermetid reefs protect coasts from erosion, regulate sediment transport and serve as carbon sinks. They are most extensive in the Levantine Sea, but are also abundant in some areas of the western basin, for example in Sicily and SE Spain (Milazzo *et al*. 2017). The habitat is vulnerable to physical impacts, such as coastal developments and trampling, pollution and ocean acidification which may impair the reef-building vermetids' recruitment success, cause shell dissolution and/or alter the shell mineralogy (Gubbay *et al*. 2016).

2-Number and name of contracting parties (CPs) indicating IMAP monitoring activities in the habitat

Three contracting parties namely Lebanon, Israel and Tunisia.

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

Israel and Lebanon perform ongoing monitoring of this habitat, while the monitoring in Tunisia seems to be in the planning phase.

4-Implementation features CI1

- Scales of Monitoring:

Scale	Range	Comments
Spatial	1-10 sites	
Temporal	3-6 years in Tunisia, every year in Lebanon	Not indicated for Israel

- Metrics:

Habitat area/extent

- Assessment criteria and thresholds:

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

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:

Some operational baselines are available through national initiatives or dedicated research projects

5-Implementation features CI2

- Scales of Monitoring:

Scale	Range	Comments
Spatial	1-10 sites	
Temporal	3-6 years in Tunisia, every year in Lebanon	Not indicated for Israel

- Metrics:

Country	Metrics
Israel	Species diversity indices, Beta diversity, ratio invasive / local native (biomass and abundance) – mainly for Mollusca, biomass, net production and net calcification
Lebanon	Benthic (Macroalgae and Invertebrates) communities-Number of dead/ living vermetidae- Ecological status of the vermetid reefs-vulnerability-Impact of anthropogenic pressures-Non-indigenous species-Rarity
Tunisia	not indicated

- Assessment criteria and thresholds

Ratio of dead versus alive individuals of each vermetid species is indicated as an assessment criterion for this habitat in Lebanon, whereas other two CPs do not clearly specify it.

Although thresholds were indicated as available for Lebanon during expert consultation, no quantitative thresholds have been explicitly determined in the literature to assess GES to date; the work by Baddredine *et al.* 2019 indicates that living specimens of the endemic reef builder gastropod *Dendropoma anguliferum* were found only on non-impacted site (though in low density i.e. 1 individual/100 cm^2) whereas living individuals of *Vermetus triquetrus* were found in some non-impacted and moderately impacted sites along Lebanese coast (at average densities of 11 individuals/100 cm^2 at non-impacted site and 1-3 individuals/100 cm^2 at moderately impacted sites). Conversely, living vermetids were absent from highly impacted sites. The reef-building encrusting red alga *Neogoniolithon brassica-florida* dominated at the non- impacted to moderately impacted sites along Lebanese coast (with average percent cover ranging between 40% and 50%) whereas it was almost completely absent from the highly impacted sites.

Some additional information on Assessment criteria and Thresholds is available from studies conducted in the Italian and Israel coasts.

Baselines:

Operational baselines are available for vermetid reefs in Lebanon and Israel. In addition, some historical perspective is provided: in Israel Rilov *et al.* (2020) compared its own data to the earlier work (sporadic surveys spread over 22 years between 1973–95 at 16 sites; Lundberg 1996, Lundberg & Olsvig-

Whittaker 1998 cited in Rilov *et al*. 2020); in Lebanon, a recent study by Badreddine *et al.* (2019) compared its results on living vermetid reef builders with the data from 2002 (Morhange *et al*. 2006 cited in Badreddine *et al*. 2019).

6-List of Key references

Badreddine A, Milazzo M, Saab MAA, Bitar G, Mangialajo L (2019) Threatened biogenic formations of the Mediterranean: current status and assessment of the vermetid reefs along the Lebanese coastline (Levant basin). Ocean Coast. Manag. 169, 137–146. https://doi.org/10.1016/j.ocecoaman.2018.12.019

Gubbay S, Sanders N, Haynes T, Janssen J, Rodwell, JR, et al. (2016) European Red List of Habitats. Part 1: Marine habitats. Publications Office of the European Union, Luxembourg, https://data.europa.eu/doi/10.2779/032638

Milazzo M, Fine M, Claudia E, Marca L, Chemello R (2017) Drawing the Line at Neglected Marine Ecosystems: Ecology of Vermetid Reefs in a Changing Ocean. In Marine Animal Forests: The Ecology of Benthic Biodiversity Hotspots pp. 1–23 Springer, Cham.

Rilov G, Peleg O, Guy-Haim T, Yeruham E (2020) Community dynamics and ecological shifts on Mediterranean vermetid reefs. Mar Environ Res (160): 105045, https://doi.org/10.1016/j.marenvres.2020.105045

Infralittoral hard substrate

Algal-dominated infralittoral rock (MB1.51) & Well illuminated infralittoral rock (MB1.51a)

1-Short description of the habitat

This habitat consists of rocky bottoms usually covered by erect macroalgae in the infralittoral stage. The macroalgae cover can range from forming full cover by canopy forming algae (e.g. fucales Cystoseira spp. Like species) to rocky barrens dominated by sea-urchins without any algal cover. Among these two conditions the habitat can be characterised by different cover of canopy forming algae, bush-forming, turf forming algae, encrusting algae, sessile macroinvertebrate and epiphytes. Overall, these assemblages are very rich in species and their species composition differs greatly depending on environmental conditions found across their wide distribution across the Mediterranean. The abundance of predatory fishes, sea urchins and invasive species (fishes and sea-urchins) have a major role in determining the abundance of different algae and are strongly modifying the assemblages. These infralittoral rocky habitats are highly diverse habitats and showcase some of the highest primary production rates in the Mediterranean. Moreover, they are supporting commercial artisanal fishing and recreational tourism. The main pressures and threats are related to overfishing, habitat destruction by coastal development, pollution and invasive species (Gubbay *et al*. 2016).

2-Number of contracting parties (CPs) indicating IMAP monitoring activities in the Habitat

Sixteen contracting parties namely Albania, Algeria, Croatia, Cyprus, France, Greece, Israel, Italy, Lebanon, Malta, Montenegro, Morocco, Slovenia, Spain, Tunisia, Türkiye

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

Related to CI1, 9 CPs have a clearly ongoing monitoring programme for this habitat, 3 CPs are in the planning phase, whereas implementation status is currently unknown for 4 CPs. Related to CI2, 12 CPs have a clearly ongoing monitoring programme to assess the condition of this habitat, 1 CP is in the planning phase, whereas implementation status is currently unknown for 3 CPs. This habitat type is among the most often monitored ones at the Mediterranean level.

4-Implementation features CI1

- Scales of Monitoring:

Scale	Range	Comments
Spatial	not indicated	Information is rarely provided on the number of sites, e.g. 19% of CPs indicate monitoring at 1-10 sites. However, Italy, France and Spain estimate 100% of the total extent of the habitat to be monitored and Croatia up to 70%
Temporal	3-6 years	Not indicated for 63% of CPs with ongoing or planned monitoring

- Metrics:

Habitat area/extent

- Assessment criteria and thresholds:

The assessment criteria may be identified as the extent of loss of the habitat type, resulting from anthropogenic pressures /physical disturbance. For the CARLIT method, which maps the length of the coast occupied by each community type (for each geomorphological situation), the assessment is based on the ratio between measured ecological quality and referent state ecological quality for coast type where a particular macroalgal community is noted.

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 habitat type in the assessment area (which should take into account regional or sub-regional specificities).

- Baselines:

Some operational baselines are available, often resulting in cartography attained by the CARLIT method (carried out to fulfil WFD and/or MSFD reporting requirements in the EU countries or within dedicated research projects), focusing on the medio-littoral and the upper infralittoral. However, less information is available on the subtidal algal communities deeper than 2-3 m. Considering the EU Member states, the data on range and extent of infralittoral rocky habitats are often not readily publicly available due to their inclusion in a broad habitat type "1170 Reefs" and reported as such for the purpose of the EU Habitat Directive.

5-Implementation features CI2

- Scales of Monitoring:

Scale	Range	Comments
Spatial	From <10 sites to >101 sites	number of sites selected for monitoring of this habitat by CPs is highly variable (38% of CPs with <10 sites, 19% with 11-50 sites, 12.5% with >50 sites and the rest is not indicated)
Temporal	Every year (5 CPs) to every 2-3 years (9 CPs)	Not indicated for 12.5% of CPs with ongoing monitoring programme

- Metrics:

Country	Metrics
Albania	CARLIT (the length of the coast occupied by each community type, for each geomorphological situation)

Algeria	typical and sensitive species biomass, population structure, density, volume, growth and mortality rate, occupation rate
Croatia	CARLIT (the length of the coast occupied by each community type, for each geomorphological situation)
Cyprus	EEI-c index (percentage cover of macroalgae), Species presence (whole community or selected species only), Species abundance (numbers or cover), Population size (abundance)
France	CARLIT (the length of the coast occupied by each community type, for each geomorphological situation), % cover of key and opportunistic macroalgal species
Greece	EEI-c index (percentage cover of macroalgae), abundance of habitat types
Israel	Species diversity indices, Beta diversity, ratio invasive / local native (biomass and abundance) – mainly for Mollusca specimens, biomass, net production and net calcification; for fish, macroalgae and invertebrates
Italy	CARLIT (the length of the coast occupied by each community type, for each geomorphological situation)
Lebanon	Relative abundance (three levels of semiquantitative value are used: 1 = rare, 2 = common and 3 = abundant), dominance or frequency, species richness, diversity indices, equitability, Margalef index/nb. habitats, vulnerability, heritage value, aesthetic value, economic importance, rarity, naturalness index and environmental value
Malta	CARLIT (the length of the coast occupied by each community type, for each geomorphological situation) – results (EQR) for the coastline extrapolated to the adjacent submerged areas (under assumption the same pressures that may be linked to water quality are acting upon both habitat types)
Montenegro	CARLIT (the length of the coast occupied by each community type, for each geomorphological situation)
Morocco	not indicated

Slovenia	EEI-c index (percentage cover of macroalgae), species presence (whole community or selected species only), species abundance (numbers or cover)
Spain	Abundance (number of individuals; 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	Ecological Evaluation Index (EEI; percentage cover of macroalgae), Alien Biotic Index (ALEX; percentages of abundance of 4 biogeographic groups: native, established, casual and invasive)

- Assessment criteria and thresholds

Assessment criteria	Thresholds					Comments
	HIGH	GOOD	MODERATE	POOR	BAD	
EQR derived from CARLIT	>0.75–1	>0.60–0.75	>0.40–0.60	>0.25–0.40	0–0.25	Ballesteros *et al.* 2007
EQR derived from EEI-c	0.75–1	0.48–0.75	0.25–0.48	0.04–0.25	0–0.04	Orfanidis *et al.* 2011
EQR derived from reef-EBQI	≧7.5	≧6–7.5	≧4.5–6	≧3.5–4.5	<3.5	Thibaut *et al.* 2017
EQR derived from ALEX	≧0.8–1	≧0.6–0.8	≧0.4–0.6	≧0.2–0.4	≧0–0.2	Cinar *et al.* 2014

- Baselines:

Operational baselines on the condition of infralittoral algal communities in certain areas are available for at least 70% of the contracting parties with ongoing or planned monitoring programmes for these habitats.

6-List of Key references

Ballesteros E, Torras X, Pinedo S, García M, Mangialajo L, de Torres M (2007) A new methodology based on littoral community cartography dominated by macroalgae for the implementation of the European Water Framework Directive. Mar. Pollut. Bull. (55): 172–180.

Gubbay S, Sanders N, Haynes T, Janssen J, Rodwell, JR, et al. (2016) European Red List of Habitats. Part 1: Marine habitats. Publications Office of the European Union, Luxembourg, https://data.europa.eu/doi/10.2779/032638

Orfanidis S, Panayotidis P, Ugland KI (2011) Ecological Evaluation Index continuous formula (EEI-c) application: a step forward for functional groups, the formula and reference condition values. Mediterr. Mar. Sci. (12): 199–231.

Thibaut T, Blanfuné A, Boudouresque CF, Personnic S, Ruitton S, Ballesteros E, Bellan-Santini D, Bianchi CN, Bussotti S, Cebrian E, Cheminée A, Culioli J-M, Derrien-Courtel S, Guidetti P, Harmelin-Vivien M, Hereu B, Morri C, Poggiale J-C, Verlaque M (2017) An ecosystem-based approach to assess the status of Mediterranean algae-dominated shallow rocky reefs. Mar. Pollut. Bull. (117): 311-329.

Çinar ME, Bakir K (2014) ALien Biotic IndEX (ALEX) – A new index for assessing impacts of alien species on benthic communities. Marine Pollution Bulletin (87): 171-179.

Infralittoral soft sediment

Posidonia oceanica meadow (MB2.54)

1-Short description of the habitat

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).

2-Number and name of contracting parties (CPs) indicating IMAP monitoring activities in the habitat

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

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

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.

4-Implementation features CI1

- Scales of Monitoring:

Scale	Range	Comments
Spatial	Not indicated	
Temporal	Mainly every 3 years	

- Metrics:

Habitat area/extent

- Assessment criteria and thresholds:

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

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:

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)

5-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)
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 and EBQI - Ecosystem-based quality index; Mapping of depth limit of the *P. oceanica* meadows (Typology of depth limit and condition of shoots) Density of shoots leaf biomass number of leaves per shoot Leaf surface Epiphytic cover on leaves Morphometry (length) of leaves Quantification of 13 *P. oceanica* components; certain parameters remain to be determined
Greece	Abundance of habitat type, Habitat quality - ecological quality status, ecosystem structure
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

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	≧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

- Baselines:

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).

6-List of Key references

Bennett S, Roca G, Romero J, Alcoverro T (2011) Ecological status of seagrass ecosystems: an uncertainty analysis of the meadow classification based on the *Posidonia oceanica* multivariate index (POMI). Mar. Pollut. Bull. (62): 1616-1621.

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Lipej L, Mavrič B, Šiško M, Trkov D, Orlando-Bonaca M (2018) Terensko kartiranje morskih habitatnih tipov Natura 2000 v slovenskem morju /Field mapping of the Natura 2000 marine habitat types in the Slovenian sea/. Final Report, National Biology Institute, Piran, 77 p.

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Association with indigenous marine angiosperms (MB5.521)

1-Short description of the habitat

Seagrass habitats made by monospecific and mixed meadows of *Zostera* sp., *Cymodocea nodosa* and/or *Ruppia* sp. develop between the surface and 15 m depth in lagoons and down to 50 m depth in the open sea. These habitats are distributed along most of the Mediterranean coast showing a patchy distribution from a few meters to several kilometers wide. These seagrasses with the leaf canopy and networks of rhizomes and roots provide habitat for a diverse assemblage of species (epibenthic algae, invertebrates and fishes). Mediterranean seagrasses other than *Posidonia oceanica* form dense and highly productive meadows or beds. Besides, seagrass meadows act as spawning zones for several species of fishes and cephalopods and they serve as wintering areas for several species of birds. There is increasing anthropogenic pressure on these habitats mainly from pollution, habitat destruction by coastal development, aquaculture, fishing activities and invasive species (Gubbay *et al.* 2016).

2-Number and name of contracting parties (CPs) indicating IMAP monitoring activities in the habitat

Ten contracting parties namely Algeria, Croatia, Cyprus, Greece, Lebanon, Morocco, Slovenia, Spain, Tunisia and Türkiye

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

Related to CI1, 3 CPs have a clearly ongoing monitoring programme for this habitat, 2 CPs are in the planning phase, whereas implementation status is currently unknown for 5 CPs. Related to CI2, 7 CPs have a clearly ongoing monitoring programme to assess this habitat, 1 CP is in the planning phase, whereas implementation status is currently unknown for 2 CPs.

4-Implementation features CI1

- Scales of Monitoring:

Scale	Range	Comments
Spatial	1-10 sites (Morocco & Türkiye)	Not defined for 71% of CPs with monitoring programme
Temporal	Every 3 years (Spain & Türkiye)	Not defined for 71% of CPs with monitoring programme

- Metrics:

Habitat area/extent

- Assessment criteria and thresholds:

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

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 habitat type in the assessment area (which should take into account regional or sub regional specificities).

- Baselines:

Limited operational baselines on the distribution and extent of the Cymodocea and Zostera meadows are available, indicated only for 29% of CPs that monitor this habitat. Considering the EU Member states, the data on range and extent of seagrass habitats other than *Posidonia oceanica* meadows are often not readily available due to their inclusion in broad habitat types such as "1110 Sandbanks slightly covered with seawater all the time", "1160 Large shallow inlets and bays", "1130 Estuaries" and/or "1150 Coastal lagoons" and are reported as such for the purpose of the EU Habitat Directive.

5-Implementation features CI2

- Scales of Monitoring:

Scale	Range	Comments
Spatial	1-10 sites	
Temporal	2-3 years	

- Metrics:

Country	Metrics
Algeria	typical species (epiphytes, endofauna, vagile fauna) biomass, population structure, density, volume, growth and mortality rate, occupation rate
Croatia	CYMOX index (modified): Root Weight Ratio, total dry weight, N content in rhizomes; δ 15N and δ 34S isotopic ratio in rhizomes; Cu, Cd and Zn content in rhizomes
Cyprus	CymoSkew index: leaf morphometry, shoot density
Greece	CymoSkew index: leaf morphometry, shoot density
Lebanon	Cymodocea morphology, morphometrics, density and biomass
Morocco	abundance, biomass, biometric characteristics, recovery rates of typical species;
Slovenia	leaf length, lower depth limit
Spain	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)
Tunisia	not indicated
Türkiye	species richness, coverage, shoot density, Ecologic Evaluation Index (EEI)

- Assessment criteria and thresholds

Assessment criteria	Thresholds					Comments
	HIGH	GOOD	MODERATE	POOR	BAD	
EQR derived from CymoSkew	0,75-1	0,5-0,75	0,25-0,5	0-0,25	0	Orfanidis *et al*. 2020, there are some variants of the thresholds
EQR derived from MediSkew index	0-0,2	0,2-0,4	0,4-0,6	0,6-0,8	0,8-1	Orlando Bonaca *et al*. 2015
EQR derived from CYMOX	0,8-1	0,2-0,4	0,4-0,6	0,6-0,8	0,8-1	Oliva *et al*. 2012
Ecologic Evaluation Index (EEI) results						Not indicated
Environmental status according to MSFD (Spain)						To be confirmed
EQR derived from ZonoMI	0,775-1	0.550-0,774	0,325-0,549	0,1-0,324	0-0,1	Official Gazette of the Republic of Croatia No. 96/ 2019

- Baselines:

Out of 10 Contracting Parties monitoring this habitat, the existence of an operational baseline is indicated for 50% of them.

6-List of Key references

Gubbay S, Sanders N, Haynes T, Janssen J, Rodwell, JR, et al. (2016) European Red List of Habitats. Part 1: Marine habitats. Publications Office of the European Union, Luxembourg, https://data.europa.eu/doi/10.2779/032638

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Orlando-Bonaca M, Francé J, Mavrič B, Grego M, Lipej L, Flander-Putrle V, Šiško M, Falace A (2015) A new index (MediSkew) for the assessment of the Cymodocea nodosa (Ucria) Ascherson meadow's status. Mar Environ Res (110): 132-141

Circalittoral hard substrate

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

1-Short description of the habitat

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).

2-Number and name of contracting parties (CPs) indicating IMAP monitoring activities in the habitat

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

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

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.

4-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	Not defined for 58 % of CPs monitoring this habitat

- Metrics:

Habitat area/extent

- Assessment criteria and thresholds:

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

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);

- Baselines:

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.

5-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)	
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
Italy	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 *Asteroides calycularis*), bleaching events, biometry of *Corallium rubrum*
Spain	Abundance (number of individuals; 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

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

- Baselines:

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

6-List of Key references

Ballesteros E (2006) Mediterranean coralligenous assemblages: a synthesis of present knowledge. Oceanography and Marine Biology 44: 123-195.

Cánovas-Molina A, Bavestrello G, Cau A, Montefalcone M, Bianchi CN, Morri C, Canese S, Bo M (2016). A new ecological index for the status of deep circalittoral Mediterranean megabenthic assemblages based on ROV photography and video footage. Continental Shelf Research (121): 13-20.

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.

Enrichetti F, Bo M, Morri C, Montefalcone M, Toma M, Bavestrello G, Tunesi L, Canese S, Giusti M, Salvati E, Bianchi CN (2019) Criteria to assess the environmental status of temperate mesophotic reefs. Ecological Indicators (102): 218-229.

Ferrigno F, Russo GF, Sandulli R (2017) Coralligenous Bioconstructions Quality Index (CBQI): a synthetic indicator to assess the status of different types of coralligenous habitats. Ecological Indicators (82): 271-279.

Gatti G, Bianchi CN, Morri C, Montefalcone M, Sartoretto S (2015) Coralligenous reefs state along anthropized coasts: application and validation of the COARSE index, based on a Rapid Visual Assessment (RVA) approach. Ecological Indicators (52): 567-576.

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Montefalcone M, Morri C, Bianchi CN, Bavestrello G, Piazzi L (2017) The two facets of species sensitivity: stress and disturbance on coralligenous assemblages in space and time. Marine Pollution Bulletin (117): 229-238.

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Sartoretto S, Schohn T, Bianchi CN, Morri C, Garrabou J, Ballesteros E, … Gatti G (2017) An integrated method to evaluate and monitor the conservation state of coralligenous habitats: the INDEX-COR approach. Marine Pollution Bulletin (120): 222-231.

UNEP/MAP (2020) Agenda item 5: Parallel CORMON Sessions (Pollution and Marine Litter, and Biodiversity and Fisheries) Update of Monitoring Protocols on Benthic Habitats. Technical report, Athens, 100 p.

Circalittoral sediment

Coastal detritic bottoms with rhodoliths (MC3.52)

1-Short description of the habitat

'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 "maerl" 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).

2-Number of contracting parties (CPs) indicating IMAP monitoring activities in the Habitat

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.

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

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.

4-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:

Habitat area/extent

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:

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

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:

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.

5-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	not indicated
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	Abundance (number of individuals; 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 defined
Türkiye	Species richness, abundance, diversity index, TUBI, ALEX

- Assessment criteria and thresholds

At the moment, there are no ecological indices developed specifically to assess the status of the rhodolith beds. 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:

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

6-List of Key references

Basso D, Babbini L, Kaleb S, Bracchi VA, Falace A (2016) Monitoring deep Mediterranean rhodolith beds. Aquatic Conservation: Marine and Freshwater Ecosystems 26 (3), 549-561.

Gubbay S, Sanders N, Haynes T, Janssen J, Rodwell, JR, et al. (2016) European Red List of Habitats. Part 1: Marine habitats. Publications Office of the European Union, Luxembourg, https://data.europa.eu/doi/10.2779/032638

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